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Investigating the Effectiveness of Ecoliteracy-Integrated Project-Based Learning in Fostering Creative Thinking Skills Among Elementary School Students

(Investigasi Efektivitas Ecoliteracy-Integrated Project-Based Learning dalam Menumbuhkan Keterampilan Berpikir Kreatif di Kalangan Siswa Sekolah Dasar)

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Abstract: This research was grounded in the issues identified at Tlahap Public Elementary School, Temanggung Regency, namely, students' suboptimal understanding of explanatory text writing, suboptimal mastery of creative thinking skills, and low environmental awareness. This research aimed to explain the effectiveness of the ecoliteracy based project-based learning on creative thinking skills compared to the conventional learning model in elementary school students. The investigation applied a quantitative approach involving an experimental method. Hence, it consisted of experimental and control groups. Employing a random sampling method, Class VA was selected as the experimental group, and class VB was chosen as the control group at Tlahap Public Elementary School, Temanggung Regency. Data collection was conducted via observation, questionnaires, and tests. Instruments were previously tested using the content validity method. Data analysis utilized analysis of variance with a significance level of 5%. Prerequisite tests were conducted before treatment, including a normality distribution test and a homogeneity of variance test. The results indicated normal and homogeneous distribution. Analysis of variance t-test on posttest data of the experimental and control groups showed a probability value of 0.000 ($p < 0.05$). The average posttest score of the experimental class was 85.57, while the control was 77.14. The conclusion is that the project-based learning model based on ecoliteracy and creative thinking skills in explanatory test writing instructions was more effective than the conventional model for elementary school students.

Keywords **ecoliteracy, effectiveness, creative thinking skills, project-based learning**

Abstrak: Landasan penelitian ini berdasarkan pada permasalahan yang terdapat di SD Negeri Tlahap, Temanggung, yakni pemahaman siswa pada materi menulis teks eksplanasi kurang optimal, penguasaaan aspek kemampuan berpikir kreatif oleh siswa kurang optimal, dan rendahnya sikap penuli lingkungan oleh siswa. Tujuan penelitian ini mendeskripsikan efektivitas model *project-based learning* berbasis ekoliterasi terhadap kemampuan berpikir kreatif dibandingkan dengan konvensional pada siswa Sekolah Dasar. Pendekatan kuantitatif metode eksperimen diterapkan dalam penelitian ini. Desain penelitian terdiri atas kelompok eksperimen dan kontrol. Kelas VA dipilih sebagai kelompok eksperimen dan kelas VB kontrol di SD Negeri Tlahap Temanggung dengan menggunakan metode pengambilan sampel acak. Pengumpulan data dilakukan melalui observasi, angket, dan tes. Instrumen diuji dengan metode validitas konten. Analisis data menggunakan analisis varian dengan tingkat signifikasi sebesar 5%. Uji prasyarat dilakukan sebelum perlakuan uji normalitas distribusi dan uji homogenitas varians. Hasil menunjukkan berdistribusi normal dan homogen. Analisis varian uji-t pada data postes kelompok eksperimen dan kontrol menunjukkan bahwa nilai probabilitas sebesar 0,000 ($p<0,05$). Perbandingan rata-rata postes kelas eksperimen berpikir kreatif dalam pembelajaran menulis teks eksplanasi lebih efektif dibandingkan model konvensional pada siswa Sekolah Dasar. Nilai rata-rata posttest kelas eksperimen adalah 85,57, sedangkan kontrol adalah 77,14. Kesimpulannya adalah bahwa model pembelajaran berbasis proyek berbasis ekoliterasi dan keterampilan berpikir kreatif dalam instruksi penulisan tes eksplanasi lebih efektif daripada model konvensional untuk siswa sekolah dasar.

Kata Kunci **ekoliterasi, keefektifan, kemampuan berpikir kreatif, *project-based learning***

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INTRODUCTION

Learning is the process between teachers and students in processing knowledge, skills, and attitudes (Dimyanti & Mudjiono, 2009). 21st-century learning emphasizes creative thinking, critical thinking, independence, productivity, collaboration, and communication (Permendikbud, 2016). It also comes with demands emphasizing four competencies that must be developed: teamwork, communication skills, critical thinking, and creativity (Supena et al., 2021). Among these four competencies, creative thinking skills are essential for learners to face everyday challenges and phenomena.

Creative and critical thinking are essential competencies that form the basis of education (Safi'i et al., 2021). The implementation of learning models and approaches for students is important in developing profound thinking. Correspondingly, project-based learning model aligns with 21st-century competencies and the implementation of an Independent Curriculum (*Kurikulum Merdeka*) (Rochmawati et al., 2022). It can encourage students to develop products independently or in groups. In this regard, the distinctive form of project-based learning can be presented by administering cooperative learning techniques and research-based approaches involving students actively, creatively, and comprehensively (Almulla, 2020). Through this model, students usually collaborate to solve problem, develop products for specific audiences, and evaluate developments projects (Kakotsaki et al., 2016). Thus, implementing project-based learning is considered a breakthrough in encountering challenges, according to the Independent Curriculum, which focuses on developing students' soft skills.

The environment plays a crucial role in creating quality learning processes and outcomes. According to Ardoin & Heimlich (2021); Özdas & Batdi (2017), the environment as a learning resource is a basic component in developing students' knowledge and skills autonomously and optimally. Thus, the actual environment around learners shapes their knowledge and attitudes in learning implementation. Similarly, in ecoliteracy-based learning, teachers facilitate and raise awareness among students about the significance of environmental conservation in daily life (Karlina et al, 2017). In line with these ideas, Idrus (2017) states that educators must be able to manage the learning environment well through learning conditioning, learning methods, and learning outcomes to make it more meaningful and directed.

Based on observations and interviews with teachers at Tlahap Public Elementary School, Temanggung Regency, several obstacles were found, especially in Indonesian language learning, namely: (1) Indonesian language materials containing abstract concepts, principles, and theories were considered complex for students to understand, (2) students had not optimally mastered the five aspects of creative thinking skills, (3) learning resources in the form of the environment were not optimally utilized, (4) students' ecoliteracy attitudes were still low, as indicated by their indifference to the environment such as littering and neglecting plants resulting in drying and wilting, (5) students' lack of knowledge about the connection of language concepts such as writing texts with everyday life events, and (6) teachers were not optimal in determining and implementing innovative learning models in the element of text writing. Based on these root problems, there was a gap between expectations and realities that were not in harmony. Therefore, it was necessary to determine a model to be used as a guideline for achieving learning objectives.

The first relevant research by Khafah et al., (2023) revealed that substantial project-based learning affected learners' critical and creative thinking in ecosystem concepts. This research is relevant because it employed a similar model and influenced creative thinking skills. However, the difference was spotted in the object; the previous study referred to high school students, whereas the present research focused on elementary school students. The second relevant study by McKinney (2023) demonstrated that project-based learning could guide students in active thinking and help develop

creative knowledge and skills through direct involvement in real problems and situations. The similarity in this study was found in the learning model being used. Meanwhile, the difference existed in the determined research object.

The third relevant research by Isa & Azid (2021) indicate that learners in the experimental achieved higher scores than the control group in project-based learning. In addition, based on the results, all respondents agreed that project-based learning needed to be applied because it could create an amusing learning environment. The similarity with this research was situated in the applied model. In contrast, the difference could be noticed in the focused research object. The fourth relevant research conducted by Nugroho et al., (2018) showed that problem-based learning improved students' ecological knowledge more effectively. The relevance of the research was related to ecological literacy in learning. Meanwhile, the difference was the learning model and research object applied.

Based on the above elaboration, research on the effectiveness of project-based learning models based on ecoliteracy on creative thinking skills for elementary school students had never been conducted before. Hence, the present research is essential to overcome the learning obstacles encountered by teachers and students. In addition, the application of this model is expected to improve students' attitudes to think creatively when solving everyday problems and to value the environment more.

Good teaching and learning activities require methods/models according to the learning environment conditions (Darmuki et al., 2023). Project-based learning facilitates learners with autonomy, exploration, and investigation in the class by engaging them in proper projects (Chiu, 2020). It focuses on problem-solving and learning activities through stimuli (David & Felleti, 1997:206). It also provides opportunities for teachers to foster learning interest, manage learning, stimulate problem-solving abilities, facilitate decision-making, conduct investigations, and facilitate collaboration among students. Furthermore, this model enables learners to have knowledge and skills by completing assignments as well as possible according to the needs and materials obtained to be implemented in society (Sani, 2015:175).

According to Wudinger & Qureshi (2015), the project-based learning model guides students to problem-solving through problem identification and plan development processes. The optimal creativity and skills possessed by students will support problem-solving solutions through question posing, idea discussion, observation, prediction, experimentation, data analysis, and conclusion drawing. Furthermore, this learning model is considered effective in assisting students build metacognitive skills and knowledge through planning, solution, and problem-evaluation actions (Hugerat, 2016). Referring to the elaboration of these experts, learning with this model is consideres to be able to facilitate students actively in problem-solving processes, conducting investigations, making decisions, and independently or collaboratively completing projects.

The characteristics of project-based learning differ from other types of learning models (Thomas, 2000; Ravitz & Blazevski, 2014:2). These characteristics consist of (1) centeredness, (2) controlled statement, (3) constructive investigation, (4) autonomy, and (5) realism. Centeredness characteristics direct teachers to creatively and skillfully act as facilitators, focus on statements or problems, and solve problems through appropriate principles, concepts, and sciences. Constructive investigation is designed to equip students with new skills and knowledge. Student activities through project-based learning provide opportunities for decision-making and acting as solution-seekers (autonomy). In addition, student activities in the learning process are based on realistic environments integrated into assignments.

According to Doppelt (2005), through project-based learning, students can easily understand materials with the aim of problem-solving. Based on Wena (2013:147), the advantages of this model include: (1) increasing motivation encourages students to understand learning material deeply with problem-solving goals and project completion; (2) the learning environment conditions can support students more actively in solving complex problems; (3) applying group learning processes in project completion supports students in developing communication skills; (4) project-based learning facilitates students to identify information as support in problem-solving; (5) acquisition of experiences for

students such as project organization, time allocation, and resource management in task completion; (6) implication in actual learning processes according to natural and social environment conditions; (7) increasing thinking skills; and (8) creating a more conducive learning atmosphere. Despite these advantages, the application of project-based learning has some shortcomings, including the learning process that requires costs and time (Railsback, 2002:2013).

Caring attitudes towards the environment contribute to shaping students' character. This needs to be developed so that students are sensitive and caring towards the surrounding environment (Sholihat, 2023). Instilling awareness about the importance of environmental conservation (ecoliteracy) is one alternative to preventing environmental problems. Keraf (2014) states that ecoliteracy is described as a high level of human awareness of the significance of the environment. Environmental literacy is a conception of the interaction among human and natural social structures. In the scope of education, students can use critical thinking, problem-solving, and practical decision-making skills based on considerations from all sides based on environmental issue (Barret et al., 1997; Karimzadegan & Meiboudi, 2012). Success in the learning process with ecoliteracy requires a connection between knowledge, skills, influence, and behavior. Based on these explanations, environmental literacy (ecoliteracy) is a conscious attitude toward preserving and conserving both natural and social human environments.

Today's education era demands creative professionals, namely those demonstrating flexibility and originality in resolving complex projects. Fisher (1995); Wurdinger & Qureshi (2015) defines an individual's ability to generate new ideas through combination, change, or application of different ideas as creativity. Accordingly, creative thinking ability is a process that leads to solution-oriented, innovative, and insightful thinking. It emphasizes the importance of knowledge and motivation in theoretically and practically developing ideas (Runco & Chand, 1995; Hosseini, 2014). Additionally, Potur & Barkul (2009) explain that creative thinking is the ability to think cognitively, authentically, and problematically. Creative thinking, problem-solving, communication skills, and teamwork are critical elements in defining professionals (Le, 2023). Therefore, it can be synthesized that creative thinking ability is thinking flexibly and originally for problem-solving processes.

According to Guilford (Naim, 2017:217), creativity is a person's way of thinking divergently to generate various alternative solutions to problems that need to be solved. Sund's argument in Slameto (2010:147) and Guilford (Naim, 2017:217) describes the criteria of individuals with creative potential as follows: (1) Fluent thinking ability (fluency), including discovering various responses, questions, and problem-solving, having alternatives in doing various things, and being able to solve problems with multi-perspective considerations; (2) Flexible thinking ability (flexibility), comprising having varied ideas, questions, and answers, being able to observe problems from different perspectives, and being able to change strategies and ways of thinking; (3) Original thinking ability (originality), incorporating being able to express unique and new expressions and being able to find unusual combinations of elements; (4) Elaboration thinking ability (elaboration), including being able to develop, add ideas, and specify objects to make them engaging.

In the present study of the effectiveness of ecoliteracy-based project-based learning, researchers focused on the learning process of explanatory text writing. Fundamental material to describe one or more events by including cause-and-effect relationships is called explanatory text (Knapp & Watkins, 2005:125). According to Nurhayati et al., (2018), explanatory texts contain explanations of why and how events occur in technical and scientific fields, such as natural, social, and cultural events.In understanding and implementing explanatory texts, learners must think critical and creatively to discover understand the language, structure, and content (Hakim & Subyantoro, 2019; Zulaikhah et al., 2020). Based on these ideas, it can be synthesized that explanatory text contains detailed explanations of cause-and-effect events, including the formation of natural, social, and cultural occurrences.

Based on the outlined issues, previous relevant studies, and literature reviews, this paper strived to describe the effectiveness of project-based learning based on ecoliteracy in teaching creative thinking skills to students when writing explanatory texts. The researchers investigated fifth-grade

students at Tlahap Public Elementary School, Temanggung Regency, specifically on explanatory text writing materials. In the research completion process, students in the treatment group to apply project-based learning stages based on ecoliteracy, including preparing important questions on the concepts learned, designing project plans, creating activity schedules, monitoring project-based learning performance, and assessing the projects created (Mulyasa, 2014:145-146). Students creatively wrote explanatory texts on natural event themes using recycled materials like cardboard. The final form of the learning project was that students could write explanatory texts, one of which was about the water cycle, and then create a pop-up book related to the topic. The use of recycled materials was a form of implementation of ecoliteracy-based project learning. Ultimately, this research is anticipated to optimize explanatory text writing instructions, increase student creativity, and foster awareness of protecting, preserving, and caring for the environment.

METHOD

The quantitative approach employed in the present study investigated the effectiveness of project-based leaning based on ecoliteracy in enhancing the creative thinking potential of fifth-grade learners at Tlahap Public Elementary School, Temanggung Regency. The research design utilized was quasi-experimental. According to Creswell (2015:575), it strives to examine the presence and extent of the cause-effect relationship obtained.

Referring to Arikunto (2010:161), variables are the objects of attention in research. Correspondingly, the present study consisted of independent and dependent variables. Each group of variables was given a pretest and posttest. The project-based learning model was applied in the experimental group. The research followed these stages are outlined as follows: (1) pre-survey process and obtaining school permission, (2) development and pilot testing of instruments, (3) coordination with subject teachers, (4) pretest implementation, (5) experiment implementation, (6) posttest implementation, and (7) data analysis.

The research data focused on evaluations of the learning process on the topic of explanatory text writing. The pretest, administered to both groups before the experiment, served as a baseline measurement. Following the confirmation of homogeneity, the next stage was to treat the experimental group. After the experiment processes were completed, the pretest scores were compared with the posttest scores to determine whether there was a decrease, no difference, or an increase in students' scores. The target population included fifth-grade students at public elementary schools in Temanggung Regency. Random drawing was applied as a sampling technique (Sugiyono, 2017:81), resulting in two fifth-grade classes at Tlahap Public Elementary School, each with 21 students, namely Class A for the experimental and Class B for the control groups. Data collection occurred in May, during the second semester of the 2022/2023, at Tlahap Public Elementary School, Temanggung Regency.

The data collection process involved three techniques: (1) Observation sheets were utilized to determine the learning process directly; (2) Questionnaire sheets were utilized to assess students' responses to creative thinking abilities; (3) Essay-type test questions for pretests and posttests consisted of eight questions based on test indicators, including fluency, flexibility, originality, and elaboration. Table 1 below contains the indicators of the questions.

Table 1
Pretest and Posttest Indicators of Creative Thinking Ability

Assessment Aspects	Indicators of Creative Thinking Ability	Indicators of Questions
Fluency	Generating multiple answers, ideas, problem-solving approaches, and questions	Identifying natural phenomena based on various research findings
	Providing various ways or suggestions for doing various things	Analyzing natural phenomena such as the causes of landslides and stages of the water cycle through interrogative sentences
	Solving problems with more than one solution	
Flexibility	Generating diverse thoughts, answers, and questions	Categorizing patterns of the explanatory text about natural occurrences

Assessment Aspects	Indicators of Creative Thinking Ability	Indicators of Questions
	Evaluating a problem using different perspectives	Applying language features of the explanatory text
Originality	Being able to generate new and unique expressions	Enforcing efforts from one's ideas to presented problems
	Being able to make specific combinations of existing parts	Providing comments or responses to discussed natural phenomena
Elaboration	Being able to add, enrich, and develop an idea	Organizing answers on the causes or stages of natural phenomena occurring in everyday life
	Describing object details	Projecting detailed solutions to complex problems

To ensure the validity and reliability of the data collection instruments, the researchers employed several techniques. Content validity, as explained by Nurgiyantoro (2011:156), assesses the relevance of the test instrument to its intended purpose. The researchers used expert judgment to evaluate the tests. For the questionnaire, construct validity was tested using Pearson's product-moment correlation with a significance level of 5% in SPSS 23 software (Nurgiyantoro, 2009:136). Instrument reliability was assessed through inter-rater testing to determine the strength of agreement between Researcher 1 (the teacher) and Researcher 2 (the observer). Given the open-ended nature of the instrument, Cronbach's alpha formula was used for the reliability test. The reliability coefficient correlation score interpretations were based on Guilford in Jihad & Haris (2012:181): 0.081 to 1.00 (high), 0.061 to 0.80 (moderate), 0.41 to 0.60 (somewhat low), 0.21 to 0.40 (low), and 0.00 to 0.20 (very low).

Data analysis techniques included scores from observation sheets, questionnaires, and explanatory text learning items. Data from observation and questionnaires employed a four-point Likert scale and were subsequently converted into numerical values. The Shapiro-Wilk test was used to assess normality. A significance value greater than 0.05 (sig>0.05) indicated normal data distribution. A homogeneity test (Nurgiyantoro, 2009:136) was conducted to assess the population variance description of each group for significant differences or homogeneity. Finally, an independent sample t-test was used to determine if there was a statistically significant difference between students who received the treatment learning model and those who used the conventional model.

RESULTS AND DISCUSSION

The explanatory text writing scores were obtained using a writing assessment instrument. The assessment was conducted both before and after the explanatory text writing instruction. Two types of data were generated based on the instrument: pre-treatment and post-treatments scores for both the experimental and control groups.

Initial Ability Description

Pretest Data of the Experimental Group

Students of Class VA at Tlahap Public Elementary School, Temanggung Regency, were designated as the experimental group. The instructional intervention was carried out over three sessions. The description of the pretest results for the experimental group is illustrated in Table 2.

Table 2
Description of Pretest Results

N	Valid	21
21	Missing	0
	Mean	74.42
	Median	73.00
	Std. Deviation	4.29
	Variance	18.45
	Minimum	68.00
	Maximum	85.00

The description in the table above indicates a mean of 74.42, a median of 73.00, a standard deviation of 4.29, a variance of 18.45, a minimum score of 68.00, and a maximum score of 85.00. Likewise, the frequency distribution results are depicted in Figure 1.

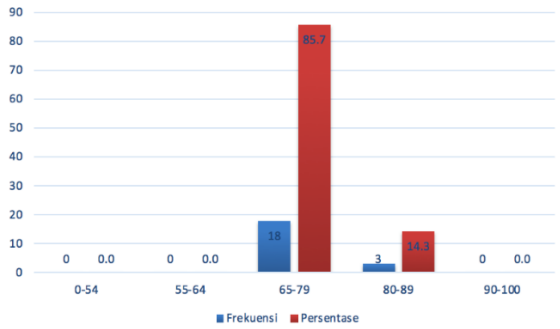

Figure 1
Frequency Distribution of Pretest Scores of The Experimental Group

Analysis of raw score data for the 21 students in Class VA revealed that in the experimental group's pretest, 3 students achieved the highest score of 85, while 2 students obtained the lowest score of 68. Additionally, no student scored 100.

Pretest Data of the Control Group

Students of Class VB at Tlahap Public Elementary School, Temanggung Regency, representing the control group, followed a conventional learning model over three sessions. The description of pretest results is provided in Table 3.

Table 3
Description of Pretest Results

N	Valid	21
21	Missing	0
	Mean	71.95
	Median	73.00
	Std. Deviation	6.35
	Variance	40.34
	Minimum	60.00
	Maximum	81.00

The description of pretest results for the control group students in Class VB yielded a mean of 71.95, a median of 73.00, a standard deviation of 6.35, a variance of 40.34, a minimum score of 60.00, and a maximum score of 81.00. Meanwhile, the frequency distribution of learning outcomes is presented in Figure 2 below.

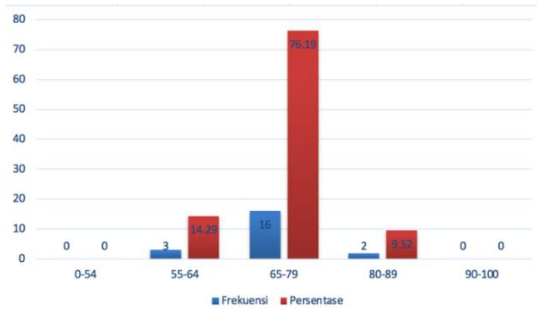

Figure 2
Frequency Distribution of Pretest Scores of The Control Group

Analysis of the raw score data for the 21 students in Class VB, serving as the control group, revealed that in the control group's pretest, 1 student achieved the highest score of 81, 2 students obtained the lowest score of 60, and no student scored 100.

Final Ability Description

Posttest Data of the Experimental Group

Table 4 presents the posttest outcomes following instructions on explanatory text writing utilizing an ecoliteracy-based project-based learning model in the experimental class.

Table 4
Description of Posttest Results

N	Valid	21
21	Missing	0
	Mean	85.57
	Median	86.00
	Std. Deviation	3.85
	Variance	14.85
	Minimum	80.00
	Maximum	92.00

The description of posttest results shows a mean of 85,57, a median of 86,00, a standard deviation of 3.85, a variance of 14.85, a minimum score of 80.00, and a maximum score of 92.00. Furthermore, the frequency distribution results are represented in Figure 3 below.

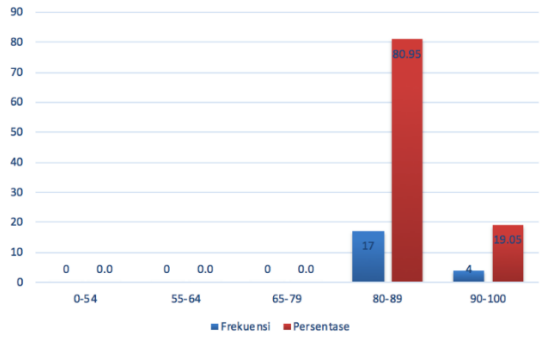

Figure 3
Frequency Distribution of Posttest Scores of the Experimental Group

The analysis of raw score data for the treatment group consisting of 21 students revealed that nobody achieved full marks which is a 100. On the other hand, two students attained the highest score of 92, while three others scored the lowest at 80. The utilization of recycled materials in this study's project could enhance students' attentiveness and environmental consciousness. Examples of the project undertaken by students in the experimental class are depicted in Figure 4, while Figure 5 illustrates sample project outcomes.


Figure 4
Example of Project-Based Learning Process

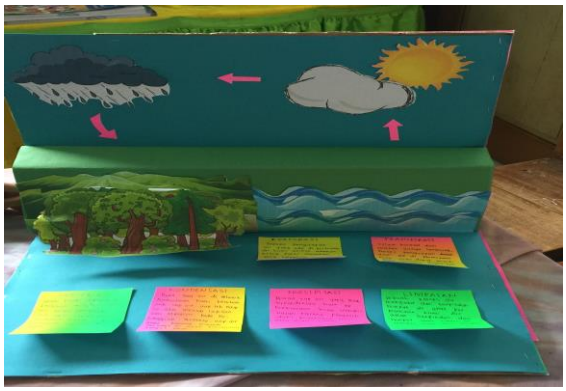

Figure 5
Example of Explanatory Text Project

Posttest Data of the Control Group

Table 5 presents the description of posttest outcomes for the control class following instructions on explanatory text writing.

Table 5
Description of Posttest Results

N	Valid	21
21	Missing	0
	Mean	77.14
	Median	78.00
	Std. Deviation	3.35
	Variance	11.22
	Minimum	72.00
	Maximum	82.00

The posttest results indicate a mean of 77.14, with a median of 78.00, the standard deviation of 3.35, and the variance of 11.22. The lowest score obtained was 72.00, while the highest was 82.00. The frequency distribution of these outcomes is represented in Figure 6.

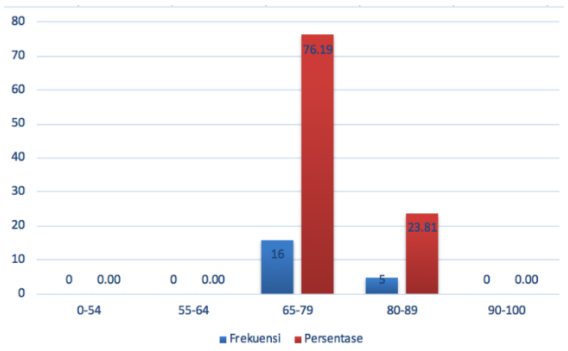

Figure 6
Frequency Distribution of Posttest Scores of the Control Group

None of the 21 students achieved a score of 100. Specifically, two people attained the highest score of 82, while three others scored 72. These results demonstrated an improvement in the experimental and control groups between pre- and post-treatment. The observed improvement indicated differences in the effectiveness of the instructional models.

Project-based learning model can facilitate learners in collaborating to find solutions to environmental problems (Sholihat, 2023). In addition, it also has been asserted Gary (2015); Tafakur et al., (2023) that project-based learning can promote learners' communication skills, enable them to acquire new information, solve problems within contexts, and practice in the form of design projects, thus producing professionally-ready students. Furthermore, project-based learning and creative thinking abilities have been proven to be correlated. Muhaimin (2015) states that creative and critical thinking processes can instill environmental ethics in students, fostering social responsibility and environmental awareness. Overall, the differences in student activities are shown as follows.

Table 6
Comparison of Learning Stages

Learning Stages in Experimental Class	Learning Stages in Control Class
Questions Preparation	***Stimulation***
Students are introduced to issues by showing videos and observing deeper into questions arising from natural phenomena.	Students are stimulated through videos about natural phenomena such as landslides and floods.
Project Planning Design	***Problem Identification***
Students are taken through concrete actions to answer existing questions with a project plan, such as designing a pop-up media about natural phenomena as a project design stimulation.	Students identify problems based on videos shown by the teacher.
Schedule Arrangement	***Data Collection***
Students arrange schedules according to available time and agreed-upon targets.	Students seek for information associated with worksheets provided by the teacher.
Learning Implementation Monitoring	***Data Processing***
Students create previously designed products and monitor them.	Students discuss and analyze the data obtained in groups.
Assessment	***Presentation***
Students present project results, and other groups provide assessments. Subsequently, students and teachers conduct learning evaluations as a follow-up to the learning process.	Students communicate the results of discussions.
	Evaluation
	Students and teachers draw conclusions based on the discussed materials.

Analysis of Prerequisite Tests

Normality Test

The Shapiro-Wilk normality test was conducted to evaluate the distribution of research data. Table 7 below presents the normality test results for the learning model.

Table 7
Normality Test Results of Pretest and Posttest Data Distribution

No	Data	Class	Shapiro Wilk Statistic	Df	Sig	Conclusion
1	Pretest	Experimental	0.934	21	0.164	Normal
2		Control	0.928	21	0.123	Normal
3	Posttest	Experimental	0.943	21	0.247	Normal
4		Control	0.929	21	0.129	Normal

The normality test results for the pretest of the experimental group displayed that p=0.164, indicating p>0.05. Similarly, the pretest results for the control group displayed that p=0.123, also indicating p>0.05. The normality test for the posttest of the experimental group yielded p=0.247, indicating p>0.05. Meanwhile, the posttest for the control group yielded p=0.129, also indicating p>0.05. Based on these results, (H_a) was accepted, while (H_0) was rejected, indicating that the data were normally distributed.

Homogeneity Test

The homogeneity test was performed utilizing Levene's test statistic utilizing *SPSS version 23* software to determine whether the populations were homogeneous. If the *p-value* was greater than the alpha, the null hypothesis was rejected, indicating homogeneity. Conversely, if the p-value was less than the alpha value, the null hypothesis (H0) was accepted, indicating heterogeneity. Referring to Table 8 below, the significance value (p) for the pretest was 0.052, while for the posttest group was 0.575. With a significance level of 5% applied in data analysis, both groups were considered homogeneous.

Table 8
Summary of Homogeneity Test Results

Variables	Sig.	Description
Pretest Assessment of Explanatory Text Writing Instructions	0.052	Sig. > 0.05 = homogenous
Posttest Assessment of Explanatory Text Writing Instructions	0.575	

Hypothesis Testing

Independent t-test for Pretest Data of Experimental and Control Groups

Table 9 displays the summary of the data before treatment in the experimental and control classes of explanatory text writing instructions.

Table 9
Summary of Pretest Data t-test Results

Data	Sig. (2-tailed)	Description
Pretest assessment	0.148	Sig. > 0.05

From the results above, a significance value of 0.148 was obtained with p 0.000 (p>0.05), indicating no significant distinction between the pretest results of the experimental and control groups. Meanwhile, Table 10 contains the summary of the posttest data t-test after treatment in the experimental and control classes.

Table 10
Summary of Posttest Data t-test Results

Data	Sig. (2-tailed)	Description
Posttest assessment	0.000	Sig.> 0.05

Based on the *SPSS* software calculations, the significance value was 0.000, less than 0.05 (0.000< 0.05). The independent samples t-test results for posttest data showed a mean difference of 8.42 and significance with p<0.05. Furthermore, the comparison of the average (mean) posttest scores was 85.57 for the experimental and 77.14 for the control, with a difference of 8.43. Thus, the null hypothesis was rejected, and the alternative hypothesis was accepted. Consequently, there was a difference in explanatory text writing instruction using an ecoliteracy-based project-based leaning model compared to the conventional teaching model. The positive impact could be observed through significant research results. Over the four weeks of the study, students demonstrated higher enthusiasm and focus during the learning process. Following these results, according to Nawangsari, Pujiastuti, and Gularso (2022), there is a correlation between project creation and creative thinking skills.

Referring to Kizkapan's argument (2017) that project-based learning focuses on developing critical and scientific thinking values for students. The application of this model can guide students to explore issues in daily life, understand knowledge effectively, and collaborate within groups. According to Genc (2015), project-based learning can empower learners to connect their learning to the actual condition. Through this approach, they are oriented towards transforming challenges into solutions to encountered problems. Relevant research conducted by Khafah et al., (2023) shows that project-based leaning is significant in the concepts of ecosystems and can be an alternative to empowering 21st-century skills. The relevance of the study to Pramesti et al., (2022) indicates that activities using this model can support creative thinking skills and sustainability notions associated with environmental matters.

Results of Creative Thinking Questionnaires for Experimental and Control Groups

The questionnaires distributed to the experimental and control groups successfully elicited aspects of fluency, flexibility, originality, and elaboration. The indicators were adapted from Sund, as cited in Slameto (2010:147) and Guilford, as mentioned in Naim (2017:217). The breakdown of fluency aspects included (1) students expressing their opinions during the learning process, (2) students being able to work on learning tasks, (3) students capable of answering questions by providing detailed explanations and more than one response, (4) students making an effort to respond argumentatively to questions posed by the teacher, (5) students capable of assisting peers in dissecting problems, (6) students able to generate ideas for writing explanatory texts from multiple sources, and (7) students collaborating in constructing projects initiated by the teacher. Regarding flexibility aspects, these encompassed (1) students responding to problems in various ways, (2) students providing diverse answers, (3) students solving problems using different methods and alternative solutions to make them more concise and practical, (4) students proposing new ideas and solutions effectively, (5) students providing different examples, (6) students presenting different arguments from their peers, and (7) students reiterating explanations for better comprehension within discussion groups.

Next, originality aspects included (1) students completing tasks not solely assigned by the teacher as additional assignments, (2) students summarizing learning materials, and (3) students enjoying incorporating ideas proposed by peers during discussions. Lastly, elaboration aspects entailed (1) students daring to ask questions about unfamiliar and incomprehensible topics, (2) students offering opinions on answers provided by others, and (3) students providing real-life examples related to the material being studied.

Figure 7 illustrates the questionnaire results reflecting students' creative thinking abilities when writing explanatory texts in the experimental and control groups.

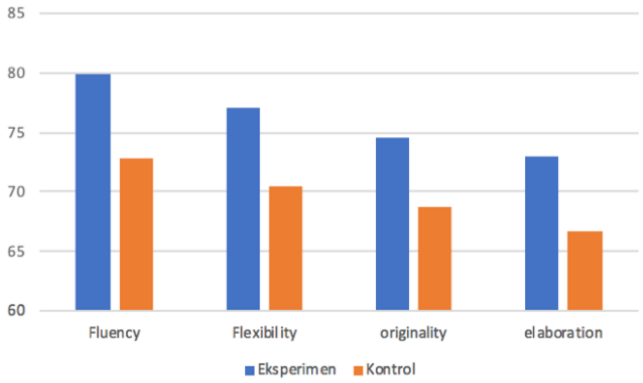

Figure 7
Summary of Creative Thinking Questionnaires

The percentages above indicate that fluency was 79.82%, flexibility was 77.09%, originality was 74.60%, and elaboration was 73.01% for the experimental. Meanwhile, for the control group, the percentages were 72.79% for fluency, 70.52% for flexibility, 68.78% for originality, and 66.67% for elaboration. Accordingly, there were more optimal outcomes in the group receiving treatment. This aligns with De Porter's (2000) assertion that individuals with creativity can apply their potential to view everything from a fresh and innovative perspective. Therefore, creative thinking involves stimulating imagination, engaging intuition, uncovering new opportunities, opening different perspectives, and arousing unexpected ideas.

Results of Observational Assessment of Student Creativity in Experimental and Control Groups

Observational assessment results, based on adaptations of Sund's theories as cited in Slameto (2010), included (1) proposing ideas or suggestions for a problem, (2) providing ways to solve problems freely in terms of presentation, (3) mastering ideas and problem-solving steps variably, (4) being original in presenting ideas in problem-solving, (5) being able to see problems from different perspectives, (6) having a high level of imagination in changing thought patterns, (7) mapping and analyzing data for problem-solving, (8) having the courage to take risks, (9) creating detailed reports, and (10) interpreting abstract concepts. The data from these observational assessments are shown in the following Figure 8.

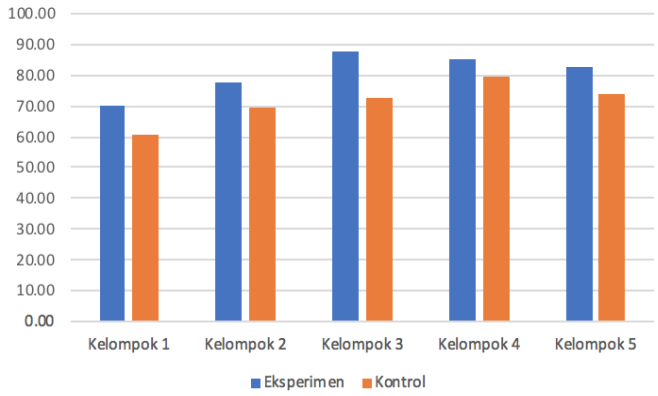

Figure 8
Summary of Observational Assessment Results of Student Creativity in Experimental and Control Groups

Based on the graph, the observational assessment results of student creativity in the experimental group indicated scores of 70.00 for group 1, 77.50 for group 2, 87.50 for group 3, 85.00 for group 4, and 82.50 for group 5. In comparison, for the control group, the results showed scores

of 60.62 for group 1, 69.37 for group 2, 72.50 for group 3, 79.37 for group 4, and 74.00 for group 5. Therefore, it can be synthesized that the creativity results of students in the experimental group were more optimal than the control group.

CONCLUSION

The findings revealed that the project-based learning model emphasizing ecoliteracy exhibited higher effectiveness. Specifically, it was evident that the creative thinking abilities of elementary school students, as assessed by indicators such as fluency, flexibility, originality, and elaboration, experienced significant development compared to classes using conventional models. The t-test results indicated a significant mean difference of 8.42*, with a p-value of 0.000 (p>0.05). Hence, the explanatory text writing instructions employing the ecoliteracy-based project-based learning model yielded better progress among fifth-grade students at Tlahap Public Elementary School, Temanggung Regency. A series of learning activities from the initial to the final stage could enhance effectiveness and influence students' attitudes towards creative thinking.

The results discovered in this study are recommended for implementation in schools. Likewise, information related to this model's theory, concepts, and benefits should be disseminated to learners to serve as a learning reference. Nevertheless, future analysis is necessary to delve into the strengths and weaknesses of this model in other subjects or learning contexts.

DECLARATIONS

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