Improving Students' Learning Independence and Critical Thinking Ability by Applying Project Based Learning Model: A Case Study in Jembrana

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ABSTRACT

Soft skills of independent learning and critical thinking are necessary in the 21st century. Independent learning trains students to have a responsible attitude when performing assigned tasks by using ideas, the innovation and creativity that students have to complete assigned tasks and hopefully it will continue to be integrated into adulthood. At the same time, critical thinking skills are needed to analyze existing knowledge and resources to solve problems that students encounter in daily life. The project-based learning (PBL) model supports students to actively participate in learning activities and project creation processes, so that learning materials become easier to understand and skills can be developed. skills such as independent learning and critical thinking. Analyze the impact of the PBL model on independent learning skills. Quantitative method with MANOVA (Multivariate Analysis of Variance) analysis was used in this study. This study uses a control class of 19 students and an experimental class of 10 students. The results show that applying the PBL model has a significant impact on critical thinking skills and learning independence, as evidenced by the significance level of 0.000 < 0.05 and 0.011 < 0.05. The learning process by giving projects to fifth grade elementary students provides an opportunity to develop basic concepts of the material available to them. During the project implementation process, many problems will certainly arise that encourage students to think critically when solving problems. Independent learning occurs before analysis, where students must gather multiple references to find and support their hypotheses to come up with more effective and efficient solutions.

Keywords : Project Based Learning, Independent Learning, Critical Thinking Ability.

INTRODUCTION

Education plays an important role in creating a productive and globally competitive young generation. Education in Indonesia must develop and strengthen the skills needed to survive in the 21st century. In this regard, the school curriculum should focus more on developing skills and abilities than not only focusing on study materials (Halimatusyadiyah, et al., 2022). Education is very useful in guiding students to develop mentally and physically to form a basic personality (Umasugi, 2020). Education is also considered the process of changing the behavior and attitudes of a person or a group of

people to become an adult through training, education and action (Hidayat & Abdullah, 2019). Primary school plays an important role in forming a person's personality and educational level. Elementary school provides the time and place for students to develop basic attitudes and behaviors that will last a lifetime. Therefore, basic education is very important so that students can build a solid foundation to become a good human being. Basic education helps create a generation where every individual is moral and ethical and in the future will be an individual who will have a positive impact on society and the country (Tuhuteru, et al., 2023). Positive values that students can develop include: sense of responsibility, honesty, tolerance and empathy (Pattiasina et al., 2022). Equally important skills and abilities that need to be trained and developed in students are independent learning and critical thinking skills.

Independent learning is important. It must be developed in elementary students as learners. The concept of independence in learning is demonstrated when students apply an independent learning base, students try to complete tasks as much as possible without seeking help from others. In this case, students will try to complete the task according to their own abilities in order to create positive intellectual changes (Fitriasari & Fauzi, 2021). The concept of independent learning helps students to have a greater sense of responsibility for the learning material. Students are expected to be able to contribute to the learning process in the form of ideas, innovation, and creativity, both in and out of the classroom, once the classroom learning is completed in the real world. The teacher plays only the role of guide and motivator. Learning is not limited to the classroom, but also outside the classroom or in real life. Students spend more time outside the classroom than inside the classroom. Students who learn the theory in class and then apply it outside the class will see their abilities and skills increase rapidly (Fajar and Agustina, 2019).

Many cases are observed in adolescents, schoolchildren, and students who lack the ability to study independently. The cause of this phenomenon is due to habits: truancy, cheating, studying only before the exam, leaking exam questions. The main problem in these cases is the presence of a mental disorder that will persist until the study continues. Independent learning is an integral part of learning methods in higher education that helps students develop an active role (Pratiwi & Laksmiwati, 2016). The decisive factor of independent learning is the motivation of the student's interest and desire to learn to acquire new knowledge. Students will feel more energized when content-based learning is more meaningful. Independent learning plays an important role in responsible decision making because individuals must analyze problems, think about

their work, make decisions, and take responsibility for the actions they take. presently. Currently. Responsible decision making is necessary for students to deal with problems in their own lives as they find themselves in the midst of rapid social change; therefore, students must study independently throughout their lives (Kopzhassarova et al., 2016).

Critical thinking is defined as the ability to continuously react to the surrounding world, in the process of identifying to predict ways of receiving objective information, comparing and analyzing from different perspectives to find understand the complexity and contradictions in human beliefs. A critical thinker should solve every problem independently, especially when making decisions supported by various strong arguments. Rational and critical thinking is emphasized in making decisions that are considered correct and must be implemented (Kopzhassarova, et al., 2016). Educational goals prioritize critical thinking skills, where the process is carried out at higher stages such as analysis, synthesis, evaluation, inference and reflection, giving individuals the opportunity to evaluate the decisions made, whether reasonable or not (Utami, et al., 2017).

Critical thinking is important in the field of education as seen in the gap between students who have been taught critical thinking skills from an early age and those who have not been taught these skills (Gelerstein, et al., 2016). Critical thinking is divided into several indicators, including: providing basic clarification, essential support, conclusions, further clarification, strategies, and tactics (Ennis, 1985). Basic problem clarification is shown by defining the core of the problem and essential support involves identifying and evaluating the skills needed to accept a decision (Kumala & Samudera, 2022). Critical thinking skills are needed in the 21st century, which supports the 5.0 era, making it a core task in the learning process. Critical thinking ability is not considered as the ability to find and possess information, but rather an individual's ability to analyze and use information to solve problems (Gerber and Scott, 2011). The Indonesian government has required critical thinking as an important skill for students that is emphasized from basic education to higher education (Pravita & Kuswandono, 2021).

Teachers are irreplaceable for students, Indonesian society is multicultural and multidimensional, where the role of teachers is rarely replaced by technology. Teachers play an important role in the success of education. The teacher is the main subject in the classroom and the learning process is guided by the curriculum. Curriculum improvement must be supported by teacher professionalism (Wachidi et al., 2020). Project-based learning (PBL) helps students gain a deeper understanding of the knowledge they acquire,

develop themselves to a higher level, and create motivation to learn. PBL provides the freedom to question, plan, and investigate so that students can become independent thinkers and learners who respond to their learning needs by finding solutions to real-world problems. The multi-functionality of projects is discussed and implemented by students and teachers in interesting ways. Projects are designed in a cultural, developmental, cognitive and motivational way. Students can design their projects with their own standards such as preparation for starting the project, motivation for designing the project, and content of the project implementation process (Al-Busaidi & Al-Seyabi, 2021).

The project-based learning (PBL) model is useful for increasing students' contribution to the problem-solving process and developing children's creativity and skills (S. Bell., 2010). The application of PBL aims to improve student communication, collaboration, problem-solving skills, and preparation for real-world problems (Jollands, et al., 2012). The steps of implementing PBL start from various basic questions until finally a project is created (Ismuwardani et al., 2019). PBL is considered a technique for prospective teachers to interact, discuss and develop knowledge by applying existing theories to solve problems. Students' attitudes, skills, and knowledge do not only come from the transfer of knowledge from teachers to students but also from outside (Yulhendri, et al., 2021). PBL has been used to improve various skills such as self-confidence and creativity (Fitria, et al., 2020), speaking skills (Abdul, et al., 2021), performance and comprehension (Rofieq, et al., 2019), creative thinking skills (Biazus & Mahtari, 2022), problem-solving skills and abilities (Jalinus & Nabawi, 2017), etc. Novelty in this research is that it highlights recent advances in education with a focus on the application of Project Based Learning (PBL) Model to improve students' learning independence and critical thinking skills in Jembrana, By highlighting a case study in Jembrana, this research enriches the understanding of how PBL can be adapted successfully in the local context, demonstrating its relevance in improving the quality of education in the area through an emphasis on collaboration, exploration, and reflection. This approach offers an innovative and effective way to shape students into independent learners and resilient critical thinkers, ready to face the challenges of the future. Based on this, it is known that many skills can be developed from the PBL learning model. Therefore, researchers want to see the impact of project-based learning models in improving the ability to learn independently and think critically of grade V students in Jembrana.

METHOD

This research was conducted from May to August 2023 in Jembrana. This study used a quasi-experimental research design and control class. The experimental sample consisted of 19 students and the control sample consisted of 10 students, making a total of 29 students. The sampling technique used was purposive sampling. Data collection was done using a Likert scale questionnaire and a pretest. The pretest was administered before the students received the treatment, while the posttest was administered after the students received the treatment. The pretest and posttest were designed to measure students' thinking skills. Likert scale questionnaires were distributed to assess students' ability to learn independently.

The collected data were analyzed using quantitative descriptive data analysis and multivariate analysis of variance (MANOVA) test. The control class applied the general learning model. While the experimental class applied the project-based learning (PBL) model. The application of PBL in the classroom was used to compare the effectiveness of the learning model with the conventional learning model. Figure 1 below shows the conceptual framework of the study.

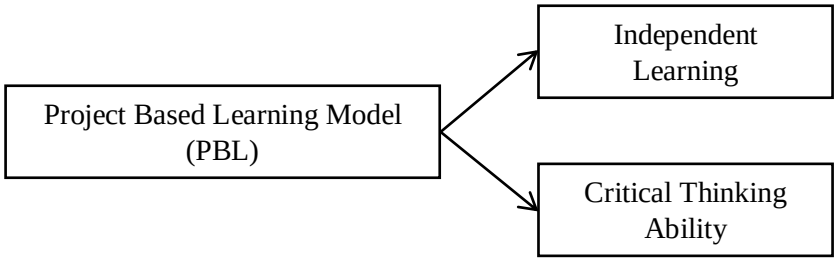

Figure 1. Conceptual Framework

RESULTS AND DISCUSSION

Descriptive Quantitative Data Analysis

The value of critical thinking skills is obtained through pre- and post-tests to see the level of students' mastery of critical thinking skills. Comparisons were made between students who studied in the conventional model in the control class and the project-based learning (PBL) model. Table 1 presents the results of the descriptive analysis of critical thinking skills and academic independence.

Table 1. Results of Descriptive Statistical Analysis of Critical Thinking Skills and Learning Independence

	Description	N	Minimum	Maximum	Mean
Critical Thinking	Pre Test Eksperiment	10	40	68	54,50
	Post Test Eksperiment	10	60	80	70,60
	Pre Test Kontrol	19	27	67	50,89
	Post Test Kontrol	19	67	98	87,47
Learning Independence	Pre Test Eksperiment	10	34	84	57,40
	Post Test Eksperiment	10	76	100	86,40
	Pre Test Kontrol	19	32	86	56,21
	Post Test Kontrol	19	56	100	77,89

Source: Processed Data, 2023

There were 10 students in the experimental class and 19 students in the control class, as shown in Table 1. The ability to master critical thinking in the experimental class that applied project-based learning (PBL) was improved. good improvement, shown by the average value increasing from 54.50. at 70.60. Independent learning in the experimental classroom increased rapidly. The average score increased from 57.40 to 86.40 with a difference of 29. The control class applying the conventional learning model achieved learning independence values from 56.21 to 77.89, a difference of 21.68. Based on this value, it can be seen that the project-based learning model is more effective in increasing students' learning autonomy than the conventional model.

The number of 5th grade students participating in the study was 29 students. The pre- and post-test results of each test were collected and summarized in a score distribution. The frequency distribution of scores to measure students' critical thinking skills is shown in Table 2

Table 2. Distribution of Critical Thinking Skills and Learning Independence Score Acquisition in Jembrana Grade V Students

Skill	Score range	Description	Control Class		Experiment Class	
			Pre-test	*Post-test*	*Pre-test*	*Post-test*
Critical Thinking	0 – 20	Very Bad	0	0	0	0
	21 – 40	Bad	3	0	1	0
	41 – 60	Medium	9	0	6	1
	61 – 80	Good	7	3	3	9
	81 – 100	Very Good	0	16	0	0
	0 – 20	Very Bad	0	0	0	0
	21 – 40	Bad	1	0	2	0

Learning Independence	41 – 60	Medium	11	1	3	0
	61 – 80	Good	6	12	4	4
	81 – 100	Very Good	1	6	1	6

Source: Processed Data, 2023

The critical thinking ability of the students in the experimental class in Table 2 achieved an average pre-test score of 6 students and a good score of 3 students. The post-test score of the experimental class had 9 students achieving good grades and 1 student achieving average grades. The independent learning ability of Jembarana 5th grade students in the experimental class has grades of poor, average, good and very good, 2 students, 3 students, 4 students and 1 student respectively. The post-test scores in the experimental class had a good score of 4 students and a very good score of 6 students. This figure shows that applying project-based learning (PBL) can improve students' mastery of critical thinking skills and independence in learning.

Validity

The validity of the tool must be demonstrated from its content, structure, and indicators (Yusup, 2018). The purpose of validation is to verify the accuracy of the measurement. The validity check can be checked by checking the value of account r and the value of table r. If the value of number r is greater than the table r then the construction is declared valid (Purpasari & Pupita, 2022). Table 3 below lists the validity test result

Table 3. Validity Test Results

Variable	Item	r_{count}	r_{table}	Description
Pretest Control Learning Independence	1	,586	,456	Valid
	2	,640	,456	
	3	,502	,456	
	4	,603	,456	
	5	,697	,456	
	6	,561	,456	
	7	,789	,456	
	8	,559	,456	
	9	,566	,456	
	10	,513	,456	
Post-Test Control Learning Independence	1	,588	,456	Valid
	2	,519	,456	
	3	,504	,456	
	4	,873	,456	
	5	,889	,456	

	6	,684	,456	
	7	,795	,456	
	8	,880	,456	
	9	,467	,456	
	10	,846	,456	
Pretest Experiment Learning Independence	1	,679	,632	Valid
	2	,677	,632	
	3	,676	,632	
	4	,856	,632	
	5	,704	,632	
	6	,805	,632	
	7	,762	,632	
	8	,783	,632	
	9	,759	,632	
	10	,645	,632	
Post-test Experiment Learning Independence	1	,723	,632	Valid
	2	,723	,632	
	3	,689	,632	
	4	,772	,632	
	5	,654	,632	
	6	,764	,632	
	7	,687	,632	
	8	,723	,632	
	9	,810	,632	
	10	,662	,632	

Source: Data Processing, 2023

The validity of the instrument will be declared valid if it has an $r_{count} > r_{table}$. The r_{table} value with the total10 respondents in the experimental class is 0.632. Respondents as many as 19 people for the control class r_{table} valuer of 0,456. Table 3 shows that the $r_{count} > r_{table}$, sehingga dapat diketahui bahwa data instrument telah dinyatakan valid. Nilai r_{count} terbesar so it can be seen that the instrument data has been declared valid. The largest rcount value known in Table 3 is 0.889> 0.632, and the smallest r_{count} valuei is 0,467 > 0,456. Based on Table 3, it is found that the learning independence variable uses a questionnaire instrument in data collection.

Reliability

The reliability test is useful in proving the accuracy and consistency of an instrument to measure a construct. The construct is declared reliable if it has a cornbach's alpha value> 0.6. When the construct value is <0.6, it is stated that the construct is not reliable and cannot be relied upon to describe the existing conditions in the field (Ghozali

& Latan, 2015). Cornbach alpha reliability is seen from the value> 0.6, Table 4 lists the processed reliability test results.

Table 4. Reliability Test Results

Variable	Nilai Croncbach's Alpha	Description
Pretest Control Learning Independence	,803	Reliable
Post-test Kontrol Kemandirian Belajar	,888	
Pretest Experiment Learning Independence	,898	
Post-test Experiment Learning Independence	,871	

Source: Data Processing, 2023

Data from collection using a questionnaire is declared reliable if it has a Cronbach's alpha value> 0.6. The control class pretest - post test data and the pre test - post test experiment learning independence variables have a Cornbach's Alpha value above 0.8 which is more than 0.6. The values listed in Table 4 show that the questionnaire data variables that have been collected are declared reliable or reliable.

Normality

Data normality testing is carried out on each sample separately with consideration of the grouping of independent variables and dependent variables (Orcan, 2020). Normality checks can be done in various ways, the most commonly used techniques are Kolmogorov-Smirnov and Shapiro-Wilk (Park, 2008; Razali & Wah, 2011). Research using Kolmogrov-Sminorv test analysis, the data is declared to have a normal distribution if it has an Asym.Sig value> 0.5. Table 5 shows the results of normality testing using Kolmogorov-Smirnov.

Table 5. Normality Test Results of PBL and Conventional Learning Model Application

Variables	Learning Model	Kolmogorov-Smirnov[a]		
		Statistic	df	Sig.
Critical Thinking	Conventional	,161	19	,200*
	Project Based Learning	,145	10	,200*
Learning Independence	Conventional	,115	19	,200*
	Project Based Learning	,246	10	,087

Source: Data Processing, 2023

The data collected using the questionnaire instrument was tested based on Kolmogorov-Sminorv. Testing with Kolmogorov Smirnov is declared normally distributed if it has a sig value> 0.05. Table 5 lists the significance values of the Kolmogorov-Sminorv test results. The significance values listed in Table 5 are known to

have a significance value> 0.05, all learning models for both skills except learning independence on project-based learning have a significance value of 0.2> 0.05. Learning independence skills with project-based learning model has a significance value of 0.087 > 0.05. Based on the test results, it is concluded that the data is normally distributed.

Homogeneity

Homogeneity test is a hypothesis test that aims to show that the data analyzed comes from a population whose variance is not significantly different (Kasmadi, 2013). Homogeneity testing can use Box's Test and Levene test. Data is declared homogeneously distributed if it has test results with significance> 0.05. Further testing with Manova can be carried out if homogeneity is met. Table 6 shows the results of Box's Test.

Table 6. Box's Test of Equality of Covariance Matrices

Box's M	F	df1	df2	Sig
1,713	,517	3	8215,513	,670

Source: Data Processing, 2023

The Box's M value listed in Table 6 was found to be 1.713 with a significance of 0.670 > 0.01. The significance value of 0.670 indicates that the covariance matrix between groups is assumed to be the same. This value indicates that the data is homogeneous. In addition to using Box's Test, homogeneity can be tested using the levene test. Table 7 lists the results of the levene test for both skills, namely critical thinking and learning independence.

Table 7. Levene Test

Variable	Levene Statistic	df1	df2	Sig
Critical Thinking	,000	1	27	,997
Learning Independence	,115	1	27	,737

Source: Data Processing, 2023

Levene test tests the data whether it has a homogeneous distribution or not. Homogeneous data is characterized by a significance value > 0.05. The critical thinking skills variable through the levene test has a significance value of 0.997> 0.05. The learning independence variable has a significance value of 0.737 after going through the levene test. Based on Table 7, it is known that the data is homogeneous.

Hypothesis Test

Testing using MANOVA (Multivariate Analysis of Variance) is seen through significance. A significance value <0.05 means that there is a difference in the level of

skill mastery, and vice versa. The significance value is seen through the Wilks' Lambda effect. Table 8 lists the multivariate test values.

Table 8. Multivariate Tests

Variables	Effect	Value	F	Hipotesis df	Error df	Sig.	Partial Eta Squared
Learning Model	Wilks' Lambda	,442	16,439 [b]	2,000	26,000	,000	,558

MANOVA testing using Wilks' Lambda. The multivariate test results inform that there is a significant difference in the level of mastery of critical thinking skills and learning independence in grade V students in Jembrana as evidenced by the value of F (2, 26) = 16.439, p < 0.001; Wilks' Lambda = 0.442, ηρ = 0.558. F value = 16.439 with a significance value of 0.000 < 0.05. This means that there is a difference in the ability of critical thinking skills and learning independence between students who use conventional learning models and project-based learning. Other tests are shown using Tests of Between in Table 9.

Table 9. Tests of Between – Subjects Effects

Variables	Effect	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Learning Model	Critical Thinking	1865,415	1	1865,415	31,614	,000	,539
	Learning Independence	928,611	1	928,611	7,535	,011	,218
Error	Critical Thinking	1593,137	27	59,005			
	Learning Independence	3327,389	27	123,237			

Source: Processed Data, 2023

The relationship between learning models and critical thinking skills has a significance of 0.000 <0.05. The difference in critical thinking skills obtained by students occurs with the application of different learning models, namely conventional and project-based learning. The relationship between the two learning models with learning independence skills has a significance of 0.011 <0.05. This means that there is a significant difference in the level of learning independence between students who learn using conventional and project-based learning models. The test results in Table 8 show that differences in learning models cause significant differences in critical thinking skills

[F(1, 27) = 31.614, p = 0.000, ηρ2 = 0.539], but cause significant differences in learning independence [F(1, 27) = 7.535, p = 0.011, ηρ2 = 0.218].

Application of Project Based Learning to Critical Thinking Skills

Research shows that applying a project-based learning model has a significant effect in improving the mastery of critical thinking skills among fifth-grade students in Jembrana. Project-based learning is a complex learning model that includes critical thinking, understanding the context of real-world problems, teamwork, and communication. Student learning in PBL focuses on completing a project. Teachers identify projects with problems that are relevant to real-life situations surrounding students. The teacher acts as a guide for students to complete assigned projects. Implementing tasks that include multiple stages and have different difficulties for students will promote the sharpening and development of students' critical thinking (Artama et al., 2023). PBL requires students to actively learn to develop critical thinking skills. Critical thinking skills include several ideas such as understanding material, finding problems, asking questions, communicating ideas, analyzing, and drawing conclusions (Eldiva and Azizah, 2018).

The project-based learning (PBL) model helps to develop critical thinking starting from the project selection stage that matches students' subjects and real-life problems. The planning stage starts from students' knowledge, identifying and asking questions that provide opportunities for students to expand their awareness and think about the activities integrated into the learning strategy with the PBL drawing model. Textbooks used in lectures should also support PBL teaching strategies. The implementation of this process requires qualified teachers who are able to prepare project-based learning activities. Teachers are required to conduct additional research on other topics to determine the impact on the effectiveness of learning levels to create changes in teaching styles (Issa and Khataibeh, 2021). The advantage of applying the PBL model is that students become more proactive in acquiring knowledge through experimental project activities compared to conventional models. The application of the PBL model requires attention to several important factors such as the ability to successfully achieve project learning objectives (Biazus & Mahtari, 2022).

The weakness of the PBL model lies in time constraints and student characteristics. The PBL model takes time to complete during meetings. Considering the characteristics of students, the PBL model is difficult to apply to students with a low level

of willingness to actively participate in project implementation. Teachers play an important role in increasing student motivation so that students are enthusiastic about completing projects and achieving learning goals (Kusumawati, 2019). Another weakness of the PBL model is that students with a low level of understanding of concepts cannot participate in implementing projects. This leads to students tending to make mistakes during project stages (Noviansyah & Sudira, 2020). The cost required to implement the PBL model is huge and the end result is obtained in the form of a product in the form of a tool or learning. materials. The preparation of the students is to prepare the raw materials and other needs in such a way that the production of the product will cost money (Nawangsari et al., 2022).

Application of Project Based Learning to Learning Independence

The results show that applying the project-based learning model has a clear effect in improving the learning independence of Jembrana 5th grade students as shown in Table 8. The significance level is 0.011 <0, 05. Strategies are used to maximize students' understanding and mastery of the material as well as academic skills such as problem solving, independent learning, teamwork, responsibility, honesty, communication Communicating and conveying ideas can be done through project-based learning (PBL). This project focuses on education to open up opportunities in a student-centered learning system. Student-led projects are carried out collaboratively by integrating real-world problems with practical teaching and are effective in developing knowledge and creativity (Indrawan et al., 2019). The opportunities provided to students during their studies will challenge them to extend the concepts of the learning material they already understand to successfully complete the assigned project. Students who understand the study material well and are equipped with soft skills will be able to solve real-life problems. Learning independence is important for students who are developing concepts that require more theory and examples.

The Project Based Learning (PBL) independent learning model has the ability to develop soft skills such as creative thinking, collaboration and problem solving. Soft skills are essential when implementing project-based learning. The party that has a major influence on the success of PBL in achieving learning goals is the teacher. The teacher plays the role of instructor in the PBL model. Each learning model has its weaknesses and advantages in application, so teachers must have strategies to overcome these weaknesses. PBL has advantages in applications such as:1) train students to use logic to solve problems; 2) help students recognize the use of subjunctives; 3) proficient in critical

thinking and strategic design skills; 4) conduct experiments as a form of hypothesis testing; 5) Students' independent learning is carried out to solve problems encountered during project implementation. Steps taken to resolve the issue include:a) encourage students to participate in class discussions; b) encourage the development of students' higher-order thinking skills; c) motivate students to analyze, synthesize, evaluate and summarize; d) help students find reference sources to develop solutions to problems encountered (Halimatusyadiyah et al., 2022).Project-based learning can create an independent attitude in learning. Project-based learning encourages students to be more independent in completing tasks and automatically expand their knowledge (Ismuwardani et al., 2019).

The process of working on projects provides students with new knowledge so that they can test their ideas and increase their creativity. Learning in schools should apply the PBL model during the learning process because it can bring many benefits when applied (Guo et al., 2020). Students' active participation provides experience of the learning material as it is directly applied in practice. Direct participation in the project will facilitate better student understanding (Saputri, et al., 2022).

CONCLUSION

The application of project-based learning (PBL) model to grade V elementary school students in Jembrana has a significant effect on the level of mastery of critical thinking skills and learning independence. The results proved with the acquisition of a significance value of $0.000 < 0.05$ and $0.011 < 0.05$. The learning process that assigns projects to fifth grade students provides an opportunity to develop the basic concepts of the material they have. The project process certainly has many problems that encourage students to think critically so that problems can be solved. Learning independence is carried out before analyzing where students are required to collect many references to find and support their hypotheses in order to provide effective and efficient solutions.

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