



The Impact of Project-Based Blended Learning on User Interface Wireframe Learning Outcomes

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Abstract:

The 2022 PISA (Programme for International Student Assessment) scores show that Indonesia's achievements in reading literacy, mathematics (numeracy), and science have declined compared to PISA 2018. In general, mathematics scores fell from 379 (2018) to 366 (2022), reading scores fell from 371 (2018) to 359 (2022), and science scores fell from 396 (2018) to 383 (2022). These scores are below the OECD average (around 480 for each subject), meaning that Indonesian students' abilities are still far behind global standards. This study aims to determine the effect of implementing Project Based Blended Learning (PjB2L) on learning outcomes for wireframe material in the User Interface (UI) subject for 11th grade students at SMK IPIEMS Surabaya. A quantitative method with a posttest-only control design was applied. The sample was divided into control and experimental groups. SPSS was used to test the validity and reliability of the instruments, where all items were proven to be valid and reliable (Cronbach's Alpha > 0.60). The Shapiro-Wilk test showed that the data were normally distributed (Sig. 0.200 > 0.05), while homogeneity was indicated by a significance value of 0.237 > 0.05. A t-value of -6.914, df 54, and Sig. (two tails) 0.000 < 0.05 were obtained from the independent sample t-test, confirming a significant difference between the control group and the experimental group. The effectiveness of PjB2L in improving wireframe learning outcomes was higher than that of conventional methods. It is recommended that educators implement Project Based Blended Learning (PjB2L) as a learning strategy because it has been proven to be more effective than conventional methods. Schools need to provide support in the form of technological facilities and teacher training, while students are expected to be more active, independent, and collaborative. Further research can expand the subjects and sample size to strengthen these findings.

Keywords:

Project-based blended learning, learning outcomes, wireframe, vocational education.

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INTRODUCTION

According to Irmawati et al. (2022), the Covid-19 pandemic that lasted from 2020 to 2022 has had a significant impact on almost all sectors of life, including Indonesia. Education, which should enlighten the nation, has also experienced a serious decline. After the pandemic, the quality of a number of basic skills such as literacy, numeracy, and science has declined. Science 383 out of 396, literacy 359 out of 371, numeracy 366 out of 379, scores declined based on the 2022 PISA report results. This aligns with international findings that reported global learning loss across literacy, mathematics, and science competencies (Engzell et al., 2021).



Although the assessment was conducted in 2025, the complete results of PISA 2022 will only be released in 2026.

A number of previous studies have shown the effectiveness of blended PjBL. Putri and Dwikoranto (2022) found that blended PjBL-based learning significantly influenced students' creative thinking skills. Suana (2023), through a systematic review, confirmed that blended PjBL provides benefits in terms of concept mastery while presenting challenges related to time constraints, teacher readiness, and technological support. Fitria et al. (2024) also proved that this model has a positive effect on 21st-century skills, especially in the aspects of collaboration and problem solving. In addition, research on Digital Project-Based Blended Learning (DPBBL) by Kurniawan et al. (2024) showed a significant increase in students' problem-solving skills when the project approach was combined with digital media. These findings reinforce the argument that blended PjBL can be a solution to bridge the learning gap, consistent with global studies showing that blended PjBL enhances critical thinking, collaboration, and digital problem solving (Hashem & Rayhan, 2022).

A more specific study was then conducted on students in grades XI DKV 1 and 2 at SMK IPIEMS Surabaya, based on the phenomenon of declining PISA scores. The selection of subjects was based on the researcher's involvement in the Field School Introduction (PLP) activity. The focus of this study was on wireframe material (low fidelity and high fidelity) in the User Interface (UI) subject. Initial data showed differences in learning outcomes between classes: the average wireframe product score for grade XI DKV 1 students was below the minimum passing grade (75), at 70.82, while grade XI DKV 2 students obtained an average of 77, which exceeded the minimum passing grade. The UI subject teacher emphasized that the low achievement of class XI DKV 1 was influenced by weak learning motivation, both at home and in class. Weak motivation also contributes to low performance, consistent with research showing that learning motivation significantly predicts student achievement in blended learning environments (Yen et al., 2018). Time constraints also influence learning success, aligning with studies indicating that instructional time affects project-based digital learning outcomes (Zhang et al., 2022).

The school's internal policy also had an impact, as the principal set the learning composition at 70% practice and 30% theory. Based on these conditions, the researcher attempted to propose an alternative learning method through Project Based Blended Learning (PjB2L), which is a project-based learning model that can be implemented flexibly, both offline and online. The choice of the blended learning model is supported by the results of a survey on electronic device ownership among students in class XI DKV 1: 28 students have smartphones, 4 students have tablets, 8 students have computers, and 7 students have laptops. In addition, the school also provides a computer lab with 24 devices. With this support, it is hoped that the implementation of PjB2L can improve student learning outcomes, particularly in the development of wireframe products. This approach aligns with international practices where device accessibility supports the integration of blended PjBL (Fauzi & Saeed, 2021).

The title of the research was determined based on the following background: "The Impact of Project-Based Blended Learning on User Interface Wireframe Learning Outcomes." This study aims to analyze the effect of implementing a

project-based blended learning model, or PjB2L for short, on the learning outcomes of 11th grade DKV students on wireframe material in the User Interface (UI) subject. It is hoped that the results of this study can be used as a reference for vocational education, benefit students in improving their learning outcomes in wireframe material, benefit teachers in applying the PjB2L model in teaching wireframe material, and benefit schools as material for consideration in implementing offline and online learning activities from the PjB2L model in wireframe material.

METHOD

This research was conducted in the odd semester of the 2025/2026 academic year, namely from August to October 2025. The research location was at SMK IPIEMS Surabaya, specifically on students in grades XI DKV 1 and XI DKV 2 who were the subjects of the research. This research used a quantitative experimental design as an approach to observe the effect of independent variables on dependent variables under certain conditions. According to Fraenkel and Wallen, experimental studies are conducted to test and confirm the results that emerge from the research object. Through conditions that have been designed in advance in experimental studies, the cause-and-effect relationship between independent and dependent variables can be determined (Sugiyono, 2019). This study applied a posttest-only control pre-experimental design, in which two groups were selected randomly. The posttest-only design was chosen to avoid the practice effect of the pretest and because the sample had been proven to be homogeneous, so that the initial abilities of the two groups were considered equivalent. Improvements in learning outcomes were measured by comparing the posttest averages between the experimental and control groups, which was reinforced by calculating the effect size to show the magnitude of the influence of implementing Project Based Blended Learning (PjB2L). The first group received special treatment in accordance with the research design, while the second group did not receive such treatment (Adnan, 2020). After data were collected from both groups, a difference test was conducted to see the extent of the difference in results and whether the difference was significant.

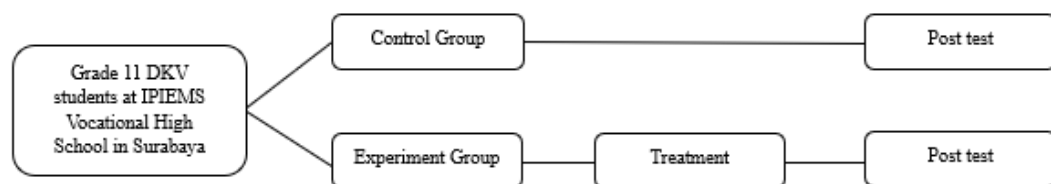


Figure 1. Research Design Diagram

The steps in data analysis are as follows:

1. Validity and Reliability Tests

Validity testing is used to ensure that each question in the instrument corresponds to the indicator being measured, while reliability is tested using Cronbach's Alpha. The instrument is considered reliable if the Cronbach's

Alpha value is greater than 0.60, making it trustworthy for use in research (Nur & Suratimah, 2023).

2. Prerequisite Tests for Analysis

The normality test uses Shapiro-Wilk to determine whether the data is normally distributed. Next, a homogeneity test is conducted to ensure that the variance between research groups is the same or homogeneous. These two tests are important so that the data meets the assumptions for using parametric tests (Razali & Wah, 2011).

3. Hypothesis Testing

After the data met the prerequisites, hypothesis testing was conducted using the independent samples t-test. This test aimed to determine the difference in learning outcomes between the experimental group that received project-based blended learning (PjB2L) and the control group that did not receive the treatment. The analysis was performed using SPSS software with a significance level of 5% ($\alpha = 0.05$) (Kareem et al., 2022).

4. Interpretation of Results

The t-test results were interpreted based on the Sig. (2-tailed) value and a comparison between the t-count and t-table values. If the Sig. value was < 0.05 and $|t\text{-count}| > t\text{-table}$, it was concluded that there was a significant difference between the experimental group and the control group.

RESULTS & DISCUSSION

1. Validity Test

Through the validity test, the measuring instrument was confirmed to be in accordance with its intended use, and reliability was used to assess the consistency of the measuring instrument so that it could be trusted (Ohsaki et al., 2019). SPSS was used in the validity and reliability tests, with the following results:

Table 1. Results of the Control Group Validity Test

Variable	r-count	r-table	Decision
K1	0.770		Valid
K2	0.712		Valid
K3	0.754	0.3739	Valid
K4	0.820		Valid
K5	0.616		Valid

From the data in Table 1, the calculated r value for each variable is greater than the table r value. The measurement tool for the control group variable is considered valid because it meets the validity requirements.

Table 2. Validity Results for the Experimental Group

Variable	r-count	r-table	Decision
E1	0.490	0.3739	Valid

E2	0.807	Valid
E3	0.610	Valid
E4	0.666	Valid
E5	0.795	Valid

The validity requirements for the experimental group variables are considered to have been met, because the r-count values for each variable exceed the r-table values listed in Table 2.

2. Reliability Test

The reliability of the questionnaire as a measuring instrument was determined through a reliability test, which was used to assess the consistency of the variable indicators. If Cronbach's Alpha exceeded 0.60, reliability was considered to have been met. Table 3 shows the results of this test.

Table 3. Reliability Test Results for the Control and Experimental Groups

Group	Cronbach's Alpha	Critical Value	Decision
Control	0.787	0.6	Reliable
Experiment	0.708	0.6	Reliable

Cronbach's Alpha values in the control and experimental groups are higher than the critical value, as shown in the table above. Therefore, the data on the control and experimental group variables are considered reliable.

3. Normality Test and Homogeneity Test

The normality test was applied to analyze the distribution of residuals or confounding variables in the regression model. Meanwhile, the homogeneity test aimed to ensure that the data in each experimental factor had the same variance or was homogeneous (Amruddin et al., 2022). In this study, both tests were conducted using SPSS software. The results are as follows:

Table 4. Normality Test Results

Group	Sig. Value	Significance Level	Decision
Control	0.200	0.05	Data is normally distributed
Experiment	0.200	0.05	Normally distributed data

A significance value of 0.200 was recorded in both the control and experimental groups in Table 4. According to Salasi (2017), the Shapiro-Wilk test is used when the sample size is less than 50. Since the significance value exceeds 0.05, the data in this study can be said to be normally distributed.

Table 5. Homogeneity Test Results

		Sig.
Data Results	Based on the Mean	0.237

The significance value of 0.237 based on the mean is listed in Table 5. According to Ismail (2018), the research data is declared homogeneous because

homogeneity is determined when the mean significance value is greater than 0.05.

4. Independent Sample t-Test

The independent sample t-test is used to test the difference in means between two independent groups. This test was chosen because there are two groups being compared, namely the treated group and the untreated group. Before the test is conducted, prerequisites such as validity, reliability, normality, and data homogeneity (Kadir, 2021) must be met. To obtain the t-count value, a specific formula is used to determine whether the difference between the two groups is significant (Navarro, 2025). The formula for calculating the t-count is as follows:

$$t = \frac{M_1 - M_2}{\sqrt{\frac{SS_1 + SS_2}{n_1 + n_2 - 2} \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

Description:

- M₁ : average score of group 1
- M₂ : average score of group 2
- SS₁ : sum of squares for group 1
- SS₂ : sum of squares for group 2
- n₁ : number of subjects/samples in group 1
- n₂ : number of subjects/samples in group 2

Additional information:

$$M_1 = \frac{\sum X_1}{n_1} \qquad SS_1 = \sum X_1^2 - \frac{(\sum X_1)^2}{n_1}$$

$$M_2 = \frac{\sum X_2}{n_2} \qquad SS_2 = \sum X_2^2 - \frac{(\sum X_2)^2}{n_2}$$

In addition to using the formula described above, the t-value can also be determined using SPSS software. The following are the results of calculations using SPSS:

Table 6. Results of the Independent Sample t-Test

t-count	df	Sig. (two-tailed)
-6.914	54	0.000

From Table 6, the Sig. (2-tailed) value is 0.000, df is 54, and the t value is -6.914. The hypothesis is determined through significance and t-value; Sig.< 0.05 is accepted, and t-value > t-table is also accepted. Because Sig. 0.000 < 0.05 and |t-count| 6.914 > t-table 2.00488, the hypothesis is confirmed accepted. The findings indicate that PjB2L significantly improves learning outcomes, consistent with studies showing positive effects of blended and

project-based learning on digital design and problem-solving abilities (Holmes et al., 2019).

5. Interpretation

From the instrument test, the validity criteria were met by all items in the control and experimental groups, as indicated by the calculated r value for each item being greater than the r table (0.3739). Therefore, the instrument was declared valid and capable of accurately measuring the research variables. The suitability of the questionnaire with the indicators to be measured was also proven through its distribution to respondents. From the reliability test, Cronbach's Alpha was 0.787 in the control group and 0.708 in the experimental group. Since both exceeded the minimum limit of 0.60, the instrument was declared reliable. Therefore, this questionnaire is reliable and consistent in measuring the same variables in different respondents.

The normality requirement was tested, resulting in Sig. 0.200 in both groups (>0.05), indicating that the data were normally distributed. Homogeneity was proven (Sig. 0.237 > 0.05), the variance of the control and experimental groups was the same, and the requirements for the independent sample t-test were also met. The t -value was -6.914, df 54, Sig. 0.000 < 0.05 , confirming that the hypothesis was accepted, and therefore a significant difference was declared to exist.

The application of project-based blended learning on wireframe material in class XI DKV 2 proved to have a positive impact in the form of an increase in learning outcomes. More effective than conventional methods, this model confirms findings consistent with Kadir (2021) regarding the use of independent sample t-tests on two different treatment groups and supports Knapp (2017), who states that the hypothesis is accepted if the significance is < 0.05 and the t -value is $>$ the t -table value.

CONCLUSION

The results of the study indicate that there is a significant difference between the group that used the project-based blended learning model and the group that did not use it. Thus, the application of PjB2L has been proven to have a positive effect on improving student learning outcomes in wireframe material in UI subjects. These results are in line with research conducted by Pohan and Maulina (2022), which states that there is an increase in learning outcomes, positive student perceptions, and an increase in *self-regulation*. In addition, these results are also in line with the results of research conducted by Anggraini, et al. (2022), which states that the application of Blended-PjBL increases problem-solving skills by 25 points and learning outcomes become very good. It is recommended that educators implement Project Based Blended Learning (PjB2L) as a learning strategy because it has been proven to be more effective than conventional methods. Schools need to provide support in the form of technological

facilities and teacher training, while students are expected to be more active, independent, and collaborative. Further research can expand the subjects and sample size to strengthen these findings.

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