# CHAPTER III
# RESEARCH METHODOLOGY

## 3.1 Research Design

This study uses a mixed methods approach with a Explanatory Sequential design. According to (Creswell 2014). The Explanatory Sequential design, which was used in this study, begins with the collection and analysis of quantitative data, followed by qualitative data to further explain the quantitative findings.

This study adopted an Explanatory Sequential design, in which quantitative data from quasi-experimental measurements were analyzed first to determine the effectiveness of the Problem-Based Learning (PBL) strategy supported by Wordwall. Next, the qualitative stage was conducted through interviews to clarify and interpret the factors behind the numerical results (Ozdemir et al., 2021; Anshu et al., 2022).

The selection of quasi-experimental designs was based on the conditions of the research in the classroom, where random assignments was difficult perform. According to Ary et al. (2010), quasi-experimental designs are appropriate to use when random assignment is not feasible, yet researchers still aim to evaluate the effectiveness of a treatment. The *pre-test* and *post-test* control group models was provide an opportunity to compare students' reading skills before and after treatment, as well as to test the effectiveness of implementing Wordwall-based PBL (Kasi et al., 2020; Librea, 2023).

The use of mixed methods with this design also provides advantages in the form of data triangulation. Quantitative results from *the pre-test* and *post-test* showed changes in learning outcomes, while qualitative data served to provide contextual explanations related to students' experiences, motivations, and perceptions of the implementation of PBL assisted by Wordwall. This is in line with (Creswell, 2014), emphasizing that the integration of quantitative and qualitative data can improve the validity, reliability, and depth of research analysis. Thus, this approach allows researchers to obtain a more complete and comprehensive picture of the effectiveness of the interventions applied (Badeo, 2021; Celik, 2024).

The research design can be described as follows:

Table 3. 1 Table of Research Design

| Group | Pre-test | Treatment | Post-test |
|---|---|---|---|
| Experiment | $O_1$ | PBL + Wordwall | $O_2$ |
| Control | $O_3$ | Conventional Methods | $O_4$ |

Information:

- $O_1$ & $O_3$ : Pre-test to measure students' reading ability.
- Treatment : The treatment in the experimental group used PBL + Wordwall.
- $O_2$ & $O_4$ : Post-test to measure improved reading comprehension.

After the quantitative stage is completed, a qualitative method is used through in-depth interviews to explore students' experiences and perceptions of the implementation of PBL with Wordwall.

## 3.2 Population and Sample

Participants in this study are grade VIII students of SMP Negeri 15 Gresik in the 2024/2025 school year. The study population consisted of 210 students of grade VIII who are divided into several classes.

This study uses purposive sampling to determine the research sample. According to Creswell (2014), purposive sampling, also known as subjective sampling or judgmental sampling, is a sampling technique in which researchers select research participants based on certain considerations. Based on the recommendations of the English teacher and the researchers' considerations, two classes was selected as the research sample, namely one class as an experimental class and one class as a control class. The selection of samples was carried out by taking into account the equivalent abilities of students, which can be seen from their report card scores. The number of research samples was 60 students, with 30 students in the experimental class and 30 students in the control class. This sampling technique is in line with Ary et al. (2010), who explain that in educational research, the selection of intact classes with relatively equivalent abilities is a common practice when random assignment is not feasible.

In addition, five students from the experimental class were deliberately selected as interview participants to gain deeper insights into their perceptions and experiences during the implementation of the PBL strategy using Wordwall. This selection took into account the students' level of participation and achievement (high, medium, and low) to ensure a diversity of perspectives. According to Creswell (2014) and Ary et al. (2010), deliberately selecting participants based on varying levels of performance allows researchers to collect richer qualitative data and effectively triangulate quantitative results.

## 3.3 Research Instrument

Based on the research questions, this study aims to examine both the effectiveness of using the Problem-Based Learning (PBL) strategy through Wordwall in improving students' reading comprehension and students' perceptions regarding its implementation. To collect the required data, the following research instruments was used:

### 3.3.1 Reading Comprehension Test

The test instrument was designed to objectively measure students' reading comprehension ability before and after the implementation of the PBL strategy using Wordwall. The tests was consisted of a pre-test and a post-test, which were developed based on the reading comprehension framework. To ensure the quality of the items, the test was adopted from the *Oxford University Press English Language Teaching standardized materials*, which are widely recognized for their validity and reliability in assessing English reading comprehension.

3.3.1.1 Pre-Test

The pre-test aims to measure students' initial ability to understand English reading before being given treatment using Wordwall-assisted Problem-Based Learning (PBL) strategies. Through this pre-test, researchers

can find out the level of students' reading comprehension before being given an intervention, identify the difficulties experienced by students, and use it as a reference to compare the effectiveness of the strategies applied. In addition, the pre-test also provides an overview of students' ability to recognize vocabulary, process written texts, find main ideas, understand the organization of the text, and interpret the meaning of information accurately.

According to Ary et al. (2010), research instruments are essential tools for collecting data, and they must be developed carefully to ensure validity and reliability so that the results accurately reflect the variables being studied. In this study, the pre-test was designed in the form of 25 multiple-choice questions containing several English reading texts that were selected based on the level of suitability and relevance to students' language skills. The preparation of questions refers to Linguistic Comprehension aspect in theory Simple View of Reading (SVR) by Gough and Tunmer (1986) which includes: Discovering the main idea of the reading text, recognizing detailed information presented explicitly, interpreting the meaning of vocabulary in the context of the text, making inferences to draw conclusions, understanding the organization and flow of the text as a whole.

3.3.1.2 Treatment

The treatment stage was carried out after the pre-test, where the experimental class was taught using *the Problem-Based Learning* (PBL) strategy assisted by Wordwall, while the control class was taught using conventional textbook-based learning methods. This treatment was conducted in three meetings, with the duration of each meeting being two lesson hours.

The learning process in the experimental class is designed in accordance with the principles of PBL which emphasizes the active involvement of students in solving authentic problems (Barrows & Tamblyn , 1980; Hmelo-Silver, 2004). Students are directed to identify problems based on the reading text given, then conduct group discussions to find solutions, and continue by doing quizzes and interactive exercises through Wordwall. After the discussion is over, each group presents their findings and receives feedback from the teacher.

The entire series of activities is in line with the views of Ary et al. (2010), who state that in experimental research, a treatment is a specific condition or intervention applied to the experimental group in order to examine its effect on the dependent variable. Thus, the application of Wordwall-assisted PBL not only aims to improve students' critical thinking skills and reading comprehension, but also to significantly differentiate learning outcomes between the experimental and control groups. The design of this treatment is expected to create an interactive, fun learning atmosphere and provide a more meaningful learning experience for students.

3.3.1.3 Post-Test

Post-tests are given after the treatment stage is completed to measure the extent to which the application of Problem-Based Learning (PBL) strategies assisted by Wordwall has an effect on improving students' reading comprehension skills. Post-test serves as an evaluation tool to compare learning outcomes before and after treatment, so that the effectiveness of the learning strategies used can be determined.

The post-test instrument consists of 25 multiple-choice questions with a level of difficulty, format, and text length equivalent to the pre-test to ensure a more objective comparison result. The preparation of post-test questions uses the same framework and indicators as the pre-test, referring to the Linguistic Comprehension aspect in theory Simple View of Reading (SVR), with the following indicators: Finding the main idea of the reading text, recognizing the detailed information presented explicitly, interpreting the meaning of vocabulary in the context of the text, making inferences to draw conclusions, understanding the organization and flow of the text as a whole.

3.3.1.4 Validity and Reliability of the Test

In this study, test items were adopted from *Oxford University Press English Language Teaching standard materials* that have been internationally recognized for their validity and reliability. However, to ensure the suitability of the instrument with the context of this study, validity and reliability tests are still carried out using data from pre-test and post-test students.

a. Statistical Test

The instruments adopted from *the standard materials of Oxford University Press English Language Teaching* were then be analyzed using the results of the students' pre-test and post-test. The goal is to measure the empirical validity of each question item and ensure the overall reliability of the test in the actual research context.

a) Question Item Validity Test

The validity test of question items is carried out by calculating the correlation between the score of each question item and the total test score. The results of the calculation were then be compared with the critical value at a significance level of 5% (0.05). If the correlation value is greater than the critical value, then the question item is declared valid; On the other hand, if the correlation value is smaller, then the question item is considered invalid. According to Ary et al. (2010), validity refers to the extent to which an instrument measures what it is intended to measure, and one of the approaches to establish validity is through item analysis and correlating individual item scores with the total score, assisted by statistical software such as SPSS. In this study, the validity test was carried out using pre-test and post-test results data from instruments adopted from *Oxford University Press English Language Teaching*.

b) Reliability Test

The instrument adopted from *Oxford University Press English Language Teaching standardized materials* was then analyzed using the results of the students' pre-test and post-test to test their empirical validity. The results of the validity and reliability analysis were processed with the help of the SPSS program, with reliability calculated through Cronbach's Alpha coefficient. This coefficient value indicates the level of internal consistency of the instrument, with the interpretation of the results being ≥ 0.80 very reliable, 0.70–0.80 reliable, 0.60–0.70 fairly reliable, and < 0.60 less reliable. The instrument is declared reliable if the coefficient is more than 0.70, making it suitable for use in social science research (Leifler, 2020; Ota et al., 2023). Thus, a statistical testing based on pre-test and post-test data ensures that the instrument not only meets theoretical standards but is also empirically consistent. (Roemintoyo et al., 2023).

### 3.3.2 Interview

Interviews were conducted after the treatment has been completed with several students from the experimental group using a semi-structured format, so that participants can express their opinions flexibly, while maintaining the consistency of the questions to remain relevant to the research focus (Hashim dkk., 2022). Interviews were conducted after the treatment has been completed with several students from the experimental group using a semi-structured format, so that participants could express their opinions flexibly, while maintaining the consistency of the questions to remain relevant to the research focus (Hashim dkk., 2022). In developing the interview, the researcher refers to aspects of the student's interpretation and experience, according to the Ali et al. (2024), which emphasizes the importance of understanding how participants interpret the learning process as well as their experiences of the methods and tools used. A total of 12 questions were developed, consisting of 6 questions representing students' experiences and 6 questions representing their interpretations.

The independent formulation of questions is in line with the characteristics of qualitative research, which places the researcher as the main instrument, allowing the researcher the freedom to design questions that are most relevant to the research context (Haswani, 2014; Lingao, 2023). In addition, the use of semi-structured interviews provides flexibility for researchers to arrange the flow of questions themselves, explore answers further, and adjust questions to developments during the interview (Maristy & Margana, 2020; Pathomchaiwat & Thongrin, 2024). Thus, the development of interview questions in this study is fully aligned with the principles and requirements of qualitative research.

The qualitative data obtained from these interviews complement the results of the quantitative test by providing deeper insights into the effectiveness of Wordwall-assisted PBL strategies. In addition, interviews help researchers comprehensively understand students' perspectives, particularly regarding learning experiences,

challenges faced, and the impact of technology use on student engagement and learning outcomes (Boakye, 2021).

### 3.4 Research Variables

The variables in this study consist of two types:

1. Independent Variable : Problem-Based Learning (PBL) *strategy* integrated with Wordwall media.
2. Dependent Variable : Reading comprehension ability of grade VIII students of UPT SMP Negeri 15 Gresik.

Variables are freely chosen because PBL with Wordwall is believed to increase student interaction and engagement (Song et al., 2024). Bound variables were measured through a reading comprehension test consisting of a pre-test and post-test according to *the reading comprehension indicator*(Gough & Tunmer, 1986; Seleem et al., 2023).

### 3.5 Data Collection Procedure

In this study, data was collected through tests (pre-test and post-test) and interviews. The test instrument was used to obtain quantitative data on students' reading comprehension skills, while interviews were conducted to obtain more in-depth qualitative data related to student involvement and learning experience.

The questions were adopted from *Oxford University Press English Language Teaching standardized materials* , which are widely recognized for their validity and reliability in measuring English reading skills. The implementation stage of data collection begins with giving a pre-test at the first meeting to find out the students' initial ability to understand reading. The pre-test consists of 25 multiple-choice questions with four answer options (a, b, c, and d). After the pre-test, the experimental class was taught using the Wordwall-assisted Problem-Based Learning (PBL) strategy, while the control class was taught using conventional methods with textbooks and worksheets. The learning process proceeded according to the recommendations of previous research to ensure that changes in learning outcomes truly reflected the effects of treatment, not external factors or measurement errors (Leifler, 2020). After the treatment is completed, both classes are given a post-test with the same number and difficulty level of questions as the pre-test. Post-tests are used to determine the extent to which students' reading ability improves after the treatment is given, as well as to compare the results between the experimental class and the control class.

Furthermore, interviews were conducted after treatment with several students from the experimental class. Interviews are conducted in a semi-structured manner, so that students can express their experiences freely but still in a directed manner. Interview questions include students' opinions on the use of Wordwall, how PBL strategies help them understand reading texts, challenges faced during the learning process, and comparisons of learning using Wordwall with conventional methods. The interview data complements the quantitative findings by providing in-depth insights into student perceptions (Boakye, 2021; Hashim et al., 2022). This data collection process is carried out in a structured and integrated manner, covering three main stages: pre-test, treatment, and post-test combined with interviews.

### 3.6 Data Triangulation

In this study, a mixed methods approach was used by combining quantitative and qualitative methods to obtain a more comprehensive understanding of the phenomenon under study (Desoyo, 2021; Wahyuni et al., 2020). This study applied a one-stage triangulation design, in which quantitative and qualitative approaches were carried out simultaneously with equal levels of importance (Getenet, 2021). Quantitative data were obtained through pre-tests and post-tests to measure learning outcomes objectively, while qualitative data were collected through interviews to explore the participants' experiences, views, and responses in depth (Wahyuni et al., 2020). Both types of data were analyzed separately according to the characteristics of the method, then the results of the analysis were combined at the interpretation stage to examine the similarities and differences in the findings (Koşan et al., 2022; Zhang et al., 2024).

In this study, data validation was carried out continuously through triangulation by comparing test results and interview data to maintain the quality and consistency of the research data (Ota et al., 2023). The results of the pre-test and post-test analyses were used to represent student learning outcomes, while the interview data provided contextual explanations that deepened the understanding of quantitative findings based on students' experiences in PBL-based learning with the help of Wordwall (Wahyuni et al., 2020; Ota et al., 2023). The integration of these two types of data allows for a more comprehensive picture of both student learning outcomes and their learning experiences, as well as strengthening the validity and reliability of research findings through a process of cross-validation between data (Rahman et al., 2023; Supriyadi et al., 2022).

### 3.7 Data Analysis Techniques

According to Ary et al. (2010), data analysis is the process of systematically applying statistical and logical techniques to organize, summarize, and interpret data in order to draw valid conclusions. In this study, pre-test and post-test scores were analyzed to determine the difference in learning outcomes and test the effectiveness of *Wordwall-assisted Problem-Based Learning (PBL)* on students' reading comprehension. Descriptive statistics such as the mean, standard deviation, minimum, and maximum scores was calculated to observe the overall performance of each group before and after the treatment. The analysis was carried out using SPSS 27 through normality and homogeneity tests as a prerequisite.

In addition, qualitative data was analyzed using interactive model based on Miles and Huberman's (2014) model, which consists of data collection, data condensation, data display, and drawing and verifying conclusions to interpret students' interpretation and experiences during the implementation of Wordwall-assisted PBL.

#### 3.7.1 Quantitative Analysis

3.7.1.1 Normality Test

The normality test was used to ascertain whether the data in the experimental and control classes came from a normally distributed population, with significance value criteria greater than 0.05. The data is said to be normally distributed if the significance value (*p-value*) is greater than 0.05 (Sari et al., 2020).

3.7.1.2 Homogeneity Test

The homogeneity test is a statistical procedure used to prove the similarity of variance between groups. In this study, a homogeneity test was carried out to find out whether there was a similarity of variance between the experimental class and the control class. The test was carried out with the help of SPSS version 27, with the data criteria being said to be homogeneous if the significance value is greater than 0.05 (Williams et al., 2024). If the data meets the homogeneity requirements, then the analysis can be continued using parametric tests.

3.7.1.3 Paired Sample T-Test

This test is used to analyze data in the same group (intra-group), to compare pre-test and post-test scores. The Paired Sample T-Test was used to find out if there was a significant difference between students' learning outcomes before and after treatment, so that an improvement in reading ability could be seen after being given treatment (Namaziandost et al., 2020; Suciati et al., 2023).

3.6.1.4 Independent Sample T-Test

This test is used to analyze differences in learning outcomes between groups (inter-groups), especially between the experimental class and the control class. The Independent Sample T-Test was used to find out if there was a significant difference between the learning outcomes of students taught using the Wordwall-assisted PBL strategy and those taught by conventional methods. In addition, *effect size* calculations such as Cohen's d can be used to determine how much of a practical effect the treatment is given (Almawadeh, 2023; Yao et al., 2025).

**3.7.2 Qualitative Analysis**

3.7.2.1 Data Collection

This stage aims to gather information relevant to the research focus. Qualitative data was obtained through semi-structured interviews with five students from the experimental class who were deliberately selected to explore their perceptions and experiences during the implementation of the Problem-Based Learning (PBL) strategy using Wordwall. The selection of participants took into account their level of participation and learning achievement (high, medium, and low) in order to obtain a diversity of views. This is in line with Creswell (2014) and Ary et al. (2010), who state that selecting participants based on variations in ability produces richer data and strengthens the triangulation of quantitative results.

The use of five interview participants is considered adequate in qualitative research because the main focus is not on large numbers, but on the depth of information that each informant can provide. Qualitative research focuses on selecting participants who are able to provide rich and in-depth explanations of the phenomenon being studied (Bokiev et al., 2021; Zhang et al., 2023). As long as participants are able to explain their experiences in detail, a small number is not an obstacle (Akmal et al., 2020). Several recent studies also show that five participants are sufficient to achieve data saturation (Omari et al., 2023), and a number of methodological experts mention that the number of qualitative interview informants generally

does not need to exceed seven people (Yuzhen et al., 2023). Previous studies have also used the same number, for example, five students in a study of game-based English language learning (Sofian Hadi et al., 2022) and five participants in a study of English Education students (Maharani et al., 2024). With this number, researchers can explore each participant's answers in greater depth so that the interviews can provide a fairly complete picture of the learning process (Zhou et al., 2025).

3.7.2.2 Data Condensation

Data condensation is a basic process in qualitative analysis that involves selecting, simplifying, and condensing raw data from observations, interviews, and documentation in order to focus on information that is relevant to the research objectives (Miles, 2014). According to Ary (2010), data condensation helps researchers manage abundant data and eliminate irrelevant information, thereby facilitating the identification of main themes. This process includes coding, grouping, and transforming data into themes and sub-themes that represent important research concepts (Fahrudin et al., 2021). Thus, data condensation serves to sharpen, classify, and organize information so that meaningful conclusions can be drawn systematically throughout the research process (Basri et al., 2023).

3.7.2.3 Data Display

The reduced data is then presented in an organized and systematic manner to make it easier for researchers to read patterns, relationships, and trends between variables (Miles and Huberman's, 2014). This stage serves as a bridge between data condensation and drawing conclusions, where simplified information is arranged in a format that is easily accessible and interpretable (Fahrudin et al., 2021). Commonly used forms of data presentation include tables, matrices, graphs, flowcharts, networks, and narrative texts that help researchers organize information visually and descriptively (Basri et al., 2023). Through structured and clear data display, researchers can easily identify themes, trends, and important relationships in the data, making the analysis process more effective and supporting the validity of the conclusions produced (Sakti et al., 2024).

3.7.2.4 Drawing And Verifying Conclusions

In the final stage, researchers draw preliminary conclusions based on the data presented, then critically test the validity of these conclusions during the research process (Miles and Huberman's, 2014). This stage is the culmination of the qualitative analysis process, in which researchers synthesize insights from the reduced and presented data to form a coherent interpretation and answer the research questions (Wan Mohd Yunus, 2020). This process involves identifying patterns, relationships, and main themes that emerge from the data, as well as verification to ensure that the conclusions are truly supported by credible evidence (Rahmawati et al., 2021). Verification is carried out continuously through cross-checking between data sources, triangulation, or confirmation with participants to maintain the consistency

and validity of the research results (Basri et al., 2023). Thus, drawing conclusions and verification serve as a quality control mechanism that ensures that the research results accurately, validly, and reliably reflect the phenomenon being investigated (Sakti et al., 2024).

Thus, the data analysis in this study integrates quantitative and qualitative methods in a mixed methods framework. The quantitative approach provides empirical evidence through statistical testing, while the qualitative approach enriches the results by explaining student interpretation and experiences in depth. The integration of these two approaches is expected to be able to provide a comprehensive understanding of the effectiveness of the Wordwall-assisted PBL strategy on improving students' reading comprehension skills.

### 3.8 The Effect Size Formulation

Effect size *analysis* is an important complement to the statistical significance test because it provides information about the magnitude of the practical impact of a learning intervention, not just showing whether the differences found are statistically significant (Irwanto, 2023). Thus, *effect size* helps researchers and education practitioners understand the extent to which the application of learning strategies really has a meaningful influence on improving student learning outcomes.

In the context of this study, *effect size* was used to determine the extent to which Wordwall-assisted Problem-Based Learning (PBL) strategies had an effect on students' reading comprehension skills. The results *of effect size* analysis are important because statistically significant results do not always mean practical significance. Therefore, the combination of significance tests, *effect size analysis*, and *percentage change* provides a more comprehensive picture of the effectiveness of interventions both from a statistical and practical perspective (Insorio & Insorio, 2023).

To determine the magnitude of the difference between the experimental group and the control group, researchers calculated the effect size based on the results of the Independent Samples T-test. According to Cohen (1988), the effect size can be calculated using the following formula:

$$d = t \times \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$$

Information:

- $d$ = *effect size* (Cohen's *d*)
- $t$ = The value of *t* obtained from the *Independent Sample T-Test*
- $n1$ = The number of participants in the experimental group
- $n2$ = The number of participants in the control group

Figure 3. 1 Interpretation of Cohen's Kappa Values

Interpretation of Cohen's kappa.

| Value of Kappa | Level of Agreement | % of Data that are Reliable |
|---|---|---|
| 0–.20 | None | 0–4% |
| .21–.39 | Minimal | 4–15% |
| .40–.59 | Weak | 15–35% |
| .60–.79 | Moderate | 35–63% |
| .80–.90 | Strong | 64–81% |
| Above.90 | Almost Perfect | 82–100% |

Meanwhile, if the data meets parametric assumptions, effect size can be calculated using Cohen's d, which is the most common *effect size* measure in educational research. The categorization is: 0.20 = small, 0.50 = medium, and 0.80 = large (Irwanto, 2023; Jantasode & Ruangjaroon, 2025).

Thus, the *effect size* analysis in this study not only complements the results of the significance test, but also confirms how much the practical influence of the application of Wordwall-assisted PBL strategies on improving students' reading comprehension skills. This allows research results to make a more relevant and applicable contribution to the world of education.

### 3.9 Statistical Hypothesis

The purpose of this study was to find out if there was a significant difference between the use of Wordwall-assisted Problem-Based Learning (PBL) strategies and conventional methods on students' reading comprehension skills. Based on these objectives, the statistical hypothesis in this study can be formulated as follows:

1. Null Hypothesis ($H_0$):

   There is no significant effect of applying the Problem-Based Learning strategy integrated with Wordwall on students' reading comprehension or a value > sig $\alpha$ = 0.05. This means that the null hypothesis ($H_0$) is accepted, and the alternative hypothesis ($H_a$) is rejected.

   Mathematical forms:

   $$H_0 : \mu_1 = \mu_2$$

   with $\mu_1$ = the average reading comprehension score of students in the experimental class, and $\mu_2$ = the average reading comprehension score of students in the control class.

2. Alternatif Hypothesis ($H_a$):

   There is a significant effect of applying the Problem-Based Learning strategy integrated with Wordwall on students' reading comprehension or a value < sig $\alpha$ = 0.05. This means that the alternative hypothesis ($H_a$) is accepted, and the null hypothesis ($H_0$) is rejected.

   Mathematical forms:

   $$H_a: \mu_1 \neq \mu_2$$

   The testing criteria are as follows:

- If the significance value (Sig.) < α = 0.05, then $H_a$ is accepted and $H_0$ is rejected.
- If the significance value (Sig.) > α = 0.05, then $H_0$ is accepted and $H_a$ is rejected