CHAPTER III
RESEARCH METHODOLOGY

3.1 Research Method

Based on the purpose of this research. Pre-experimental research or usually known as weak experiment method was used. In this type of research, the procedure involves a within-group or within-individual, and a single group or single individuals are studied (Creswell, 2017).

3.2 Research Design

The design used in this research was one group posttest and a pretest (Creswell, 2017). In this research design, there were two experimental classes that are not significantly different for each other. Those of two classes taught by the same treatment. The pretest conducted to investigate the student's initial computational thinking skills. Then, the experimental class was given treatment by learning using the gamification classroom in the respiratory system topic. The last, it ended with a posttest to measure the enhancement of students' computational thinking. The posttest was the same test with the pretest. There is no control group in this design to be compared due to only one group involved in the research (Mertler & Charles, 2008). Table 3.1 is the design used in this research.

Table 3.1

Research Design

Group	Pretest	Treatment	Posttest
Experiment	O_1	X	O_2

(Mertler & Charles, 2008)

O_1 : Pretest of student's achievement

X : Implementation of Gamification Classroom on Respiratory System

O_2 : Posttest of student's achievement

3.3 Population and Sample

This research was conducted in a high secondary school in Bandung. According to the curriculum, the respiratory system topic is being taught to the students in 8th -grade. The population in this research is 8th-grade students with two classes as samples. The researcher took the sample using a convenience sampling

technique. It is the technique to select the subject who conveniently are available for the study. (Fraenkel, Wallen, & Hyun, 2012).

3.4 Operational Definition

In order to avoid misconceptions about this research, operational definitions are explained in this research. Those terminologies are explained as follow:

1) Gamification classroom was applied by using Classcraft web application as a tool to create learning media and as a tool on a game-based approach in the leaning activity. The computer used in this research as a tool for students to learn about biology material given, and the implementation of gamification in this research was investigated by using researcher's field note. The gamification content created based on the respiratory system concept of respiratory system organs, mechanism of breathing, and respiratory system diseases.

2) Computational thinking is a method of solving problems and also exercising metacognitive, problem-solving, and reasoning skills. Student's computational thinking skills was measured based on the student's answer in the essay questions related to respiratory system topic.

3) Respiratory System is the teaching and learning materials proposed to students of 8th grade based on curriculum 2013. These materials were dominantly explaining about Respiratory System Organ, Breathing Mechanism, and Respiratory System Diseases. The material were taught by using gamification classroom as teaching strategy.

3.5 Assumption

Based on the study literacy and some expert, the assumption in this research stated as follow:

1) Gamification classroom by using Classcraft as the game-based approach will develop critical thinking and teamwork capabilities in an environment dominated by learning soft skills in the 21st-century.

2) Computational thinking (CT) is a mindset and a process for the problem-solving. As a goal of science education by gamification is increasingly acknowledged.

3.6 Hypothesis

The following hypothesis in this research are mentioned as follows:

Hi: There is a significant enhancement on students' computational thinking in learning respiratory system by using gamification classroom by using Classcraft application

Ho: There is no significant enhancement on students' computational thinking in learning respiratory system by using gamification classroom by using Classcraft application

3.7 Research Instrument

The instrument used in this study is used to determine the students' computational thinking in learning respiratory system material and student's impressions. The research observed through the computational thinking test and questionnaire. The computational thinking test instrument is pretest and posttest question, and a questionnaire was given after the teaching-learning process. The instruments were used in this research is stated in Table 3.2.

Table 3.2

Research Instrument

No.	Instrument	Data Obtained
1.	Computational Thinking Test	Student's Computational Thinking
2.	Impression Questionnaire	Student's impression

Further description of the instruments described as follows:

3.7.1 Computational thinking test

The computational thinking test in this research was a set of essays about the respiratory system concept. The purpose is to measure a student's computational thinking skills. The CT strands contained in the objective test are decomposition, pattern recognition, abstraction, and algorithms. For the research instruments to be appropriate for this research, the test item was checked for its principal analysis. It includes Reliability, Validity, Distinguish Power, Difficulty Level, and Distractor Effectiveness.

1) Reliability

Reliability means can be trusted. A test has a high level of reliability if the test can provide permanent results if tested repeatedly.

$$r11 = \left(\frac{n}{n-1}\right)\left(1 - \frac{\Sigma\sigma_i^2}{\sigma_i^2}\right)$$

<div align="right">(Ali, Carr, & Ruit, 2016)</div>

The reliability of the essay instrument measured using formula as following:

Description

r11   : reliability test

n   : the number of items

$\Sigma\sigma_i^2$: the number of score variance of items

σ_i^2 : total variance

The reliability of the instrument classified in the following table below:

Table 3.3

Reliability classification

Correlation coefficient	Reliability category
0,80-1,00	Very high
0,60-0,79	High
0,40-0,59	Average
0,20-0,39	low
0,00-0,19	Very low

<div align="right">(Ali et al., 2016)</div>

2) Validity

Validity is the ability of a measuring instrument to measure what should be measured. The validity used in this study is the validity of the item or item. Essay validity instrument calculated by the coefficient formula product-moment by Karl Pearson as follows:

$$Rxy= \frac{N\Sigma xy-(\Sigma x)(\Sigma y)}{\sqrt{\{N\Sigma x^2-(\Sigma x)^2\}\{N\Sigma y^2-(\Sigma y\}^2}}$$

(Kaplan & Saccuzo, 2013)

To interpret the correlation coefficient score gai ned from the calculation above, the validity criteria used in the following table:

Table 3.4

Validity Classification

Correlation coefficient	Reliability category
0,80-1,00	Very high
0,60-0,79	High
0,40-0,59	Average
0,20-0,39	low
0,00-0,19	Very low

(Kaplan & Saccuzo, 2013)

3) Discrimination power

The power of discriminating questions is the ability of a problem to distinguish between intelligent students and those who have less ability. Problems that have high discriminating power means that the problem can distinguish between smart students and less clever students. The formula used to determine the discriminating power of multiple-choice instruments is:

$$D = \frac{B_A}{J_A} - \frac{B_B}{J_B} = P_A - P_B$$

(Brown, 2004)

Description:

J	: Total of participant
J_A	: Total of a top group participant
J_B	: Total of a bottom group participant
Y	: total score
B_A	: Total of bottom group participant answer correctly
B_B	: Total of a bottom group participant

B_A/J_A : Proportion of top group participant answer correctly

B_B/J_B : Proportion of bottom group participant answer correctly

The formula used to determine the distinguishing power of multiple-choice instruments is:

$$D=\frac{\text{Top group average-bottom group average}}{\text{total maximum score}}$$

(Zulaiha, 2008)

Table 3.5

Discrimination power classification

Discrimination power classification	Discrimination power criteria
0,00-0,20	Bad
0,21-0,40	Fair
0,41-0,70	Good
0,71-1,00	Excellent

4) Difficulty level

The level of difficulty test for the instrument in this study was conducted by searching for the essay instrument difficulty index value by using the formula:

$$P=\frac{\text{Mean}}{\text{Maximum score}}$$

(Zulaiha, 2008)

Difficulty index level categorizes in the following table below:

Table 3.6

Difficulty classification

Difficulty level	Test item category
0,00-0,30	Difficult
0,31-0,70	Average
0,71-1,00	Easy

(Zulaiha, 2008)

5) Distractor effectiveness

After all the principal analysis of the test is done, the data from the calculation are then categorized according to the item qualification table according to (Zainul, 2002), to determine whether the questions tested are worthy to be accepted or rejected. The qualification table is shown in Table 10.

Table 3.7

Distractor score

Category	Score
Accepted	1) Validity $\geq 0,40$
	2) Distinguishing power $\geq 0,40$
	3) Difficulty level $0,25 \leq p \leq 0,80$
Revision	1) Distinguishing power $\geq 0,40$; Difficulty level $p < 0,25$ or $p > 0,80$; but validity $\geq 0,40$
	2) Distinguishing power $< 0,40$; Difficulty level $0,25 \leq p \leq 0,80$; but Validity $\geq 0,40$
	3) Distinguishing power $\geq 0,40$; Difficulty level $0,25 \leq p \leq 0,80$; but validity between $0,20 - 0,40$
Rejected	1) Distinguishing power $0,40$. Difficulty level $p < 0,25$ or $p > 0,80$
	2) Validity $< 0,20$
	3) Distinguishing power $< 0,40$ and validity $< 0,40$

3.7.2 Impression Questionnaire

Student Impression questionnaire was used to measure the level of the impression of each student as a response after experiencing learning the respiratory system through the gamification classroom by using Classcraft application. The questiommaire consist of positive statements. For the scoring is 4 for agree and 1 for disagree (Siregar, 2013). In this research, the Student impression questionnaire was distributed after the implementation of the gamification classroom using the Classcraft application. The analysis of the questionnaire was obtained using the

following formula:

$$\text{Students' impression value} = \frac{\text{Total score value}}{\text{Total number of respondent}}$$

<div align="right">(Mahfira, 2018)</div>

The result of the percentage above categorized into the impression level based on the impression level rubric in Table 3.8

<div align="center">Table 3.8</div>

<div align="center">Impression Level Rubric</div>

Value	Impression Level
<3.00	Negative impression
>3.00	Positive impression

<div align="right">(Mahfira, 2018)</div>

3.8 Instrument Analysis Result

3.8.1 Recapitulation of Computational Thinking Test Instrument

The instrument of this research was tested in class before uses to assess students. The computational thinking test was conducted in 9-grade students of the same school, who had learned the respiratory system concept when they were in grade 8. The computational thinking test were tested using ANATEST 4.0.9 (the result attached on appendix C1. Recapitulation of empirical validation) in the form of validation, reliability, distraction level, and discriminating power. Table 3.9 is the recapitulation result of the computational thinking test. For the reliability test, the result is 0,67, which means high.

<div align="center">Table 3.9</div>

<div align="center">Recapitulation Result of the Computational Thinking Test</div>

Computational thinking element	Question Number	Discriminating Power		Level of Difficulty		Validity		Note
		Value	*Category*	*Value*	*Category*	*Value*	*Category*	
Decomposition	1	0.47	Good	0.60	Medium	0.75	High	Accepted
	2	0.45	Good	0.51	Med	0.61	High	Acce

Computational thinking element	Question Number	Discriminating Power		Level of Difficulty		Validity		Note
		Value	*Category*	*Value*	*Category*	*Value*	*Category*	
					ium			pted
	3	0.45	Good	0.59	Medium	0.70	High	Accepted
Pattern Recognition	4	0.38	Good	0.58	Medium	0.63	High	Accepted
Abstraction	5	0.27	Fair	0.51	Medium	0.52	Medium	Revised
Algorithm	6	0.37	Good	0.57	Medium	0.65	High	Accepted

3.9 Data Analysis

The result of this research is gathered by a quantitative approach. The data gathered in the research were gained from students' pretest and posttest that measures students' computational thinking skills and questionnaires to measure students' impressions toward gamification classroom using Classcraft application in the learning processes. The result will describe whether there is an enhancement in students' computational thinking. The further explanation will explain below.

3.9.1 Data Analysis for Student's Computational Thinking Aspect

Students' computational thinking Skill in this study is analyzed based on the student's answers. Each component present was scored one point, given the maximum point for each question is 100. Each student needs to answer 6 test items that make the maximum point for the test is 600, and the average point of the whole test is 100. The scores obtained by each student in the pretest and posttest were calculated to get the index gain (N-gain) that represents the enhancement from pretest to posttest. The N-gain was calculated using the following formula.

$$\text{N-gain} = \frac{\text{Posttest score-pretest score}}{\text{maximal score-pretest score}}$$

(Hake, 1999)

The index of the gain obtained was interpreted to determine the effectiveness of this study from the pretest to the posttest. The interpretation of the gain index is stated in Table 3.10

Table 3.10

Interpretation of Gain Index

Gain Index	Interpretation
0.7 < N-gain	High
0.3 < N-gain ≤ 0.7	Medium
N-gain ≤ 0.3	Low

(Hake, 1999)

To determine the scale of effectiveness of the learning model, the scores obtained by each student in the pretest and posttest were calculated to gain effect size,

$$\text{Eta squared} = \frac{t2}{t2+(N-1)}$$

(Pallant, 2016)

The index of effect size gain was interpreted to determine the scale of effectiveness on this study. The interpretation of the gain index is stated in Table 3.11

Table 3.11

Interpretation of Effect Size

Effect size index	Interpretation
0.01 - 0.05	Small effect
0.06 - 0.013	Moderate effect
>0.014	Large effect

(Pallant, 2016)

3.9.2 Data Analysis for Student's Impression

The questionnaire is used for students' impressions on the gamification classroom by using Classcraft application. The analysis of the questionnaire was used Microsoft Excel 2010. The data was taken from 40 students of 8th grade in

one of Junior High School in Bandung. The questionnaire consists of twelve statements about the students' impression of the gamification classroom using the Classcraft application. Twelve numbers in the questionnaire, state about the positive statement and divided into two option of agree and disagree.

3.10 Research Procedure

There are three main stages of procedure in this research which divided into preparation stage, implementation stage, and completion stage that elaborated as follows:

1) Preparation Stage

   a) Investigating the research problem

   b) Identifying research variables

   c) Deciding the research variable

   d) Reviewing the literature of the research

   e) Designing a research instrument

   f) Validating the research instrument to the expert

   g) Revising the research instrument

2) Implementation Stage

   a) Determination of experimental class

   b) Give pretest to class purposed to obtain information from the initial students' computational thinking skills. The computational thinking test attached in appendix B.1.

   c) Analyze the result of the pretest

   d) Conduct research activity by implementing gamification classroom by using Classcraft in the experimental class

   e) Give posttest to the class to gain information about students' enhancement in computational thinking skill. The computational thinking test attached in appendix B.1.

   f) Assessing students' computational thinking.

3) Completion Stage

   a) Analyzing the data

   b) Discussing the data gained

   c) Drawing the conclusion based on the discussion and analysis

d) Reporting the result of the research

4) The scheme of research procedure stages is shown in figure 3.1 below:

```
┌─────────────────────────────────────────────────────────────────────┐
│  ┌──────────────┐  ┌──────────────┐  ┌──────────────┐  ┌──────────────┐ │
│  │Investigating │  │ Identifying  │  │ Deciding the │  │Investigating │ │
│  │the research  │──│  research    │──│  research    │──│the research  │ │
│  │  problem     │  │  variables   │  │  variable    │  │  problem     │ │
│  └──────────────┘  └──────────────┘  └──────────────┘  └──────────────┘ │
│  ┌──────────────┐                          │                            │
│  │ Preparation  │         ┌────────────────────────────────┐           │
│  │    Stage     │         │ Deciding the research instrument │          │
│  └──────────────┘         └────────────────────────────────┘           │
│                           ┌────────────────────────────────────┐       │
│                           │Validating research instrument to the│      │
│                           │              expert                  │      │
│                           └────────────────────────────────────┘       │
│                                      ┌──────────┐                        │
│                                      │ Revision │                        │
│                                      └──────────┘                        │
└─────────────────────────────────────────────────────────────────────┘
```

Preparation Stage

Deciding the research instrument

Validating research instrument to the expert

Revision

Conduct Pretest

Implementation Stage

Conducting learning with Classcraft application

Conduct Post-test

Analyzing the data

Discussing the data gained

Completion Stage
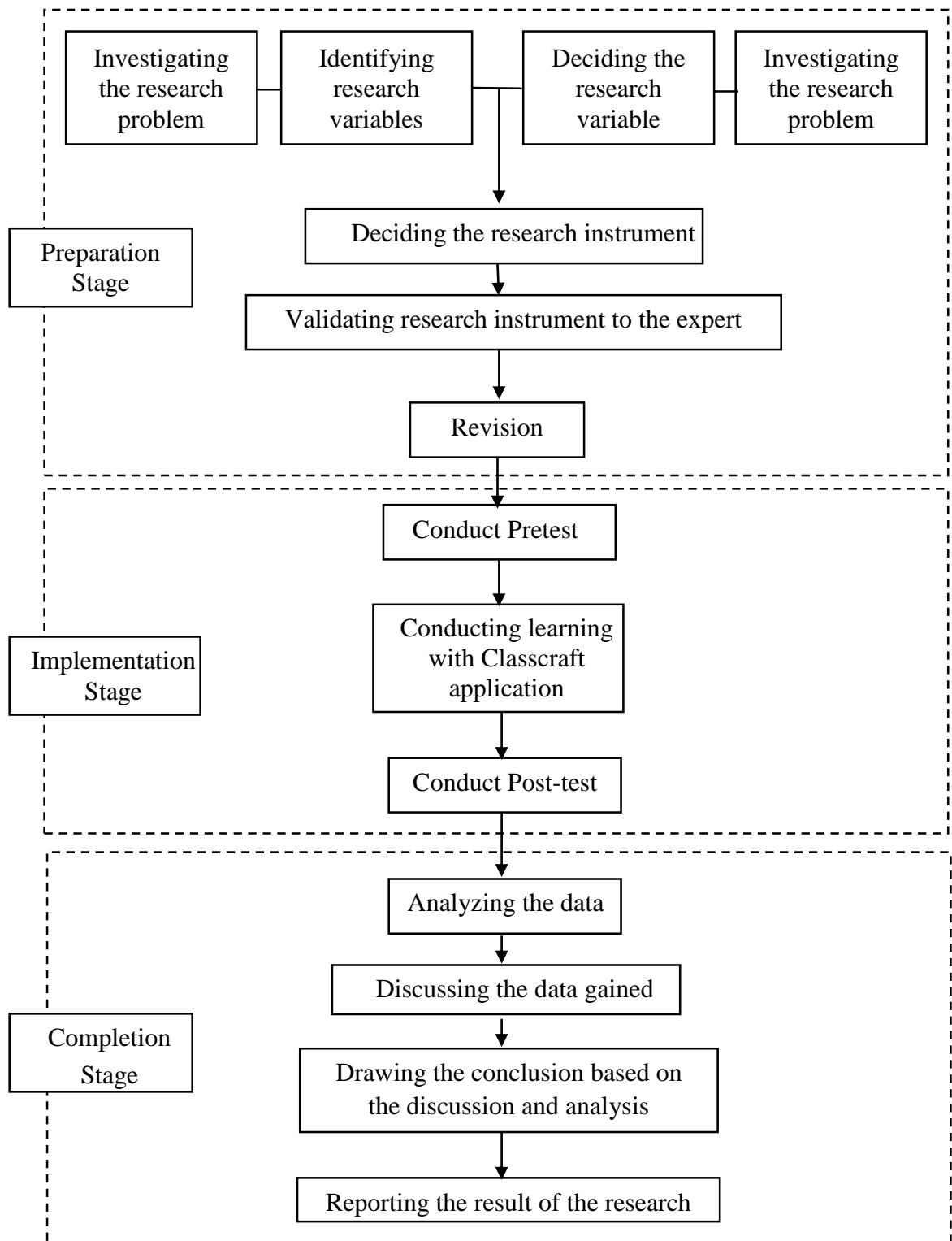
Drawing the conclusion based on the discussion and analysis

Reporting the result of the research

Figure 3.1 Research Procedure Scheme