CHAPTER III
RESEARCH METHODOLOGY

A. Research Method and Research Design

1. Research Method

The research method that was used in this research was mixed method. Mixed methods involves combining or integration of qualitative and quantitative research and data in a research study. Qualitative data tends to be open-ended without predetermined responses while quantitative data usually includes closed-ended responses such as found on questionnaires or psychological instruments (Creswell, 2014). This method is appropriate with the purpose of the research which investigated that interactive animations constructions could measure student's collaborative problem solving skills and improve students' understanding in learning earthquake topic.

2. Research Design

The design that was conducted in this research was pre-test and post-test design (Creswell, 2012). The researcher assigns intact groups the experimental, administers a pre-test to the group, conducts experimental treatment activities with the experimental group only.

Table 3.1 Pre-test and Post-test Design

Select experimental group	Pre-test	Experimental treatment	Post-test

(Source: Creswell, 2012)

3. Population and Sample

The location of this research was in one of Public Junior High School in Bandung. The population in this research was all 8^{th} grade students at one of Public Junior High School in Bandung. The samples were 8^{th} grade students from one class of the school. The sampling technique used was

Simple Random Sampling with one class. Fraenkel and Wallen (2007) stated that Simple Random Sampling is one obtained by using groups as the sampling unit rather than individuals.

4. Operational Definition

a. Interactive animation

By the huge progress of technologies, nowadays multimedia technology has cooperated well with education field to support educational activity such as teaching and learning to be more attractive, informative and interactive. Interactive animation could be made through several application and software, such as Adobe Flash. Interactive animation engages students to give feedback also to receive feedback on the animation itself, through functions and content on the interactive animation designed by the researcher. In this research, interactive animation was created using Flash™ with save mode software, means that the feedback given by students can be saved directly and will be converted into pdf, so that the analysis of students' works will be easier.

b. Students' Collaborative Problem Solving Skills.

As the innovative domain for PISA 2015, Collaborative Problem Solving (CPS) is defined in the draft framework as "the capacity of an individual to effectively engage in a process whereby two or more agents attempt to solve a problem by sharing the understanding. The framework identifies three core collaborative competences includes, 1) Establishing and maintaining a shared understanding, 2) Taking appropriate action to solve the problem, 3) Establishing and maintaining team organization.

Students' Collaborative Solving Problem Skills was measured via valid rubric by PISA contained the framework of whole collaborative problem solving skills. The researcher investigate and evaluate students' collaborative problem solving skills by observing the behavior of each

group during the process of playing interactive animation. Observation sheet was also constructed based on the lesson plan and collaborative problem solving syntax.

c. Students' Understanding.

Anderson and Krathwohl, (2001) stated that understanding is defined as Construct meaning from instructional messages, including oral, written, and graphic communication.

Students' understanding is indicated in the cognitive domain of knowledge, there are six cognitive domain based on Revised Bloom's Taxonomy such as C1 (Recalling), C2 (Understanding), C3 (Applying), C4 (Analyzing), C5 (Evaluating), and C6 (Creating). In this research there are four cognitive domain that will be assessed in the test instrument, they are C1 (Recalling), C2 (Understanding), C3 (Applying), and C4 (Analyzing).

C1. Remembering	: Retrieving relevant knowledge from long-term memory.
C2. Understanding	: Determining the meaning of instructional messages, including oral, written, and graphic communication.
C3. Applying	: Carrying out or using a procedure in a given situation.
C4. Analyzing	: Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose.

The improvement of students' understanding was identified by T-test instruments. There are 24 questions in the form of multiple choice with the number of four options constructed related to earthquake topics were given to the samples. Comparing the mean of Post-test scores with national academic standard achievement (KKM) was done to investigate the students' understanding improvements.

5. Assumption

a. Constructed interactive animation can measure students' collaborative problem solving by facilitating a room to share students' understanding within a group.
b. Employing constructed interactive animation can improve students' understanding since it increases students' enthusiasm in learning earthquake topic.

6. Hypothesis

H_0: Constructed interactive animation cannot improve students' understanding compared to academic standard achievement (KKM) in learning earthquake.

H_1: Constructed interactive animation can improve students' understanding compared to academic standard achievement (KKM) in learning earthquake.

7. Research Instrument

In this research, instrument is necessary to be used for gaining data. There are five types' instruments that are used in this research which are constructed interactive animations, objective test (Pre-test and Post-test Instrument), observation sheet, questionnaire, and Collaborative Problem Solving Skills rubric form.

a. Objective Test

The objective test instrument is purposed to measure cognitive process dimension based on Revised Bloom's Taxonomy. Objective test instrument consisted of 24 questions in the form of multiple choice related to the earthquake phenomenon topic that contained 4 options of answers.

b. Objective Test Item Analysis

1) Validity

According to Fraenkel (2011) Validity refers to the appropriateness, meaningful-ness, correctness, and usefulness of the inferences a researcher makes. Validity is the most important idea to consider when preparing or selecting an instrument for use. Researchers want the information they obtain through the use of an instrument to serve their purposes. Validation is the process of collecting and analyzing evidence to support such inference.

To determine the validity of the instrument in this study is by using software ANATES

The validity of each test item can be measured by using formula of correlation which was stated by Pearson, which is usually called as correlation formula, as follows:

$$r = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{[N\sum X^2 - (\sum X)^2][N\sum Y^2 - (XY)^2]}}$$

Note:

r : correlation coefficient between x and y variable

n : amount of student

x : total score in test item

y : total score of student

(Fraenkel, 2011)

2) Reliability

The degree to which individuals' deviation scores, or z-scores, remain relatively consistent over repeated administration of the same test or alternate test forms.

The formula for calculating the reliability of a test. The formula is:

$$KR_{20} = r = \frac{N}{N-1}\left(\frac{S^2 \sum pq}{S^2}\right)$$

3) Difficulty level

According to Jandaghi (2010), when an item is dichotomously scored, the mean item score corresponds to the proportion of examinees who answer the item correctly. This proportion for item *I* is usually denoted as P*i* and is called the item difficulty.

The following formula for calculating the difficulty coefficient (DifCo).

$$\text{DifCoef question } (i) = \frac{Ms(i)+Mw(i)}{NB\ Xmi}$$

(Jandaghi, 2010)

4) Discriminating Power

An index of how effectively the item discriminates between examinees who are relatively high on the criterion of interest and those who are relatively low. The index of discrimination (D) could be calculated by:

$$D = p_u - p_i$$

D : Discriminating power

p_u : The proportion in the upper group who answered the item correctly

p_i : the proportion in the lower group who answered the item correctly.

Values of D may range from – 1 .00 to 1 .00. Positive values indicate that the item discriminates in favor of the upper group; negative values indicate that the item is a reverse discriminator, favoring the lower-scoring group.

(Crocker and Algina, 2006)

5) Distractor

Distractor are incorrect alternative on a multiple choice item. A distractor analysis allows to examine how many students in the top and bottom groups selected each option on a multiple choice item. Based on Sabri (2013), a distractor analysis assist in distinguishing plausible distractors from implausible ones. A high percentage of 70% from the total distractors were regarded as implausible due to the fact that those distractors were selected neither by the top scorer nor the low score. One item clearly indicates a confusing items seeing that one distractor is selected by more students than the correct answer.

(Sabri, 2013)

In this study, the objective test instrument validity was measured using Anates version 4.0 that was developed by Drs. Karnoto ,M.Pd and Yudhi Wibisono, S.T. On Anatest version 4.0 all the formula or coefficient required in the instrument validity and has been automatically applied, so the user does not need to enter the formula on Anates anymore.

After obtaining the result of pre-test and post-test, the improvement of students' understanding is analyzed by calculating the value of N-Gain. The way to calculate the value of N-Gain is using Normalized Gain Equation. Based on Hake (1999) stated that score of Pre-test and Post-test could be computed in the equation below:

$$\langle g \rangle = \frac{(average\ of\ post-test\ \%\ score)-(average\ of\ pre-test\ 5\ score)}{100\%-average\ of\ pre-test\ \%\ score)}$$

The value of N-Gain itself has a scale to be interpreted into criteria started from Low to High, as table 3.2 below:

Table 3.2. Criteria of Normalized Gain

<g>	Criteria
$\langle g \rangle \geq 0.7$	High
$0.3 \leq \langle g \rangle < 0.7$	Moderate
$\langle g \rangle < 0.3$	Low

c. Observation Sheet

There were two forms of observation sheet, there are for students' activities and teacher's activities, this instrument is arranged based on research lesson plan and the syntax of Collaborative problem solving.

1) Students Observation Sheet

The observation sheet which is shown in the table 3.2 contained the sequence of students' activities based on research lesson plan which has been validated through judgment by experts in relevant field. Students' activities were planned in accordance with collaborative problem solving syntax, presented as follows:

Table 3.3 Students' Observation Sheet Instrument based on Research Lesson Plan and Collaborative Problem Solving Syntax

No.	CPS Stages	Applied activities
1.	1st stage: understanding the problem situation by interpreting initial information about the problem and any information that is uncovered during exploration and interactions with the problem	a. Expressing the opinion regarding earthquake phenomenon to the teacher. b. Doing simple earthquake simulation by shaking peer's chairs and peer's table with stuffs on it.
2.	2nd stage: Selecting, organizing and integrating information with prior knowledge	a. This stage of CPS contained in the process of doing constructed interactive animation, that they give a feedback of missions related to earthquake phenomenon based on their prior knowledge repeatedly with different sub-topic of

No.	CPS Stages	Applied activities
		missions.
3.	3rd stage: Planning, which consists of clarifying the goal of the problem, setting any sub-goals, and developing a plan to reach the goal state.	a. This stage of CPS contained in the process of doing constructed interactive animation, that the students discuss about the plan to build resistant building during solving the last mission
4.	4th stage: Monitoring steps in the plan to reach the goal state and reflecting on possible solutions and critical assumptions	a. Giving attention to the teacher's feedback regarding their work on constructed interactive animation.

2) Teacher Observation Sheet

The researcher who acted as the facilitator should give a systematical instruction and guidance toward the students which was observed and evaluated using the observation sheet shown in Table 3.4 as follow:

Table 3.4 Teacher's Observation Sheet based on Research Lesson Plan

No.	Activity	Done	Undone	Notes
1	Providing Pre-test instrument			

No.	Activity	Done	Undone	Notes
	for students.			
2	Gaining students' attention by asking about their opinion and experience of earthquake phenomena.			
3	Guiding the students to open-ended questions about the frequent problems found in earthquake phenomena.			
5	Controlling and guiding the students to finish the constructed interactive animation.			
6	Evaluating students' collaborative problem solving skills using valid CPS skills indicator.			
	Providing			

No.	Activity	Done	Undone	Notes
	clarification of students' work on constructed interactive animation.			
	Reflecting students' feedback on constructed interactive animation.			

3) Collaborative Problem Solving Skills Indicators

This research aimed to carry out students' collaborative problem solving skills through constructed interactive animation in learning earthquake. Therefore, a valid collaborative problem solving skills indicators are important to be involved in measuring students' collaborative problem solving skills which is shown in the Table 3.5 below:

Table 3.5. Collaborative problem solving skills Indicators according to Program for International Student Assessment (2015)

	(1) Establishing and maintaining shared understanding	**(2) Taking appropriate action to solve the problem**	**(3) Establishing and maintaining team organization**
(A) Exploring and Understanding	(A1) Discovering perspectives and abilities of team members	(A2) Discovering the type of collaborative interaction required and establishing goals	(A3) Understanding roles to solve problem

	(1) Establishing and maintaining shared understanding	(2) Taking appropriate action to solve the problem	(3) Establishing and maintaining team organization
(B) Representing and Formulating	(B1) Building a shared representation and negotiating the meaning of the problem (common ground)	(B2) Identifying and describing tasks to be completed	(B3) Describing roles and team organization (communication protocol/rules of engagement)
(C) Planning and Executing	(C1) Communicating with team members about the actions performed	(C2) Enacting plans	(C3) Following rules of engagement
(D) Monitoring and Reflecting	(D1) Monitoring and repairing the shared understanding	(D2) Monitoring results of actions and evaluating success in solving the problem	(D3) Monitoring, providing feedback and adapting the team organization and roles

(PISA, 2015)

8. Research Procedure

a. Preparation Stage

1) Finding students learning problem in certain topic;
2) Investigating students learning problem;
3) Determine the specific topics to do the experiment;
4) Conducting literature review regarding independent and dependent variable of experiment;
5) Determining possible school and classes for choosing population and sample;
6) Formulating hypothesis of experiment;
7) Designing research instrument for pre-test, post-test, Implementation and assessment;
8) Conducting proposal research revision after receiving recommendation, critics and suggestions;

9) Constructing Research Instrument tools such as flash animation, lesson plan, observation sheet, collaborative problem solving skills indicator, and objective test;
10) Revising research instruments after receiving suggestions from supervisors.
11) Validity, reliability, difficulty level, discriminating power, distractor test of objective test Instrument using Ana test version 4.0 and expert judgment.
12) Validity test of flash animation, lesson plan, observation sheet, collaborative problem solving skills indicator through expert judgment.
13) Revising research instruments after receiving suggestions from the experts.

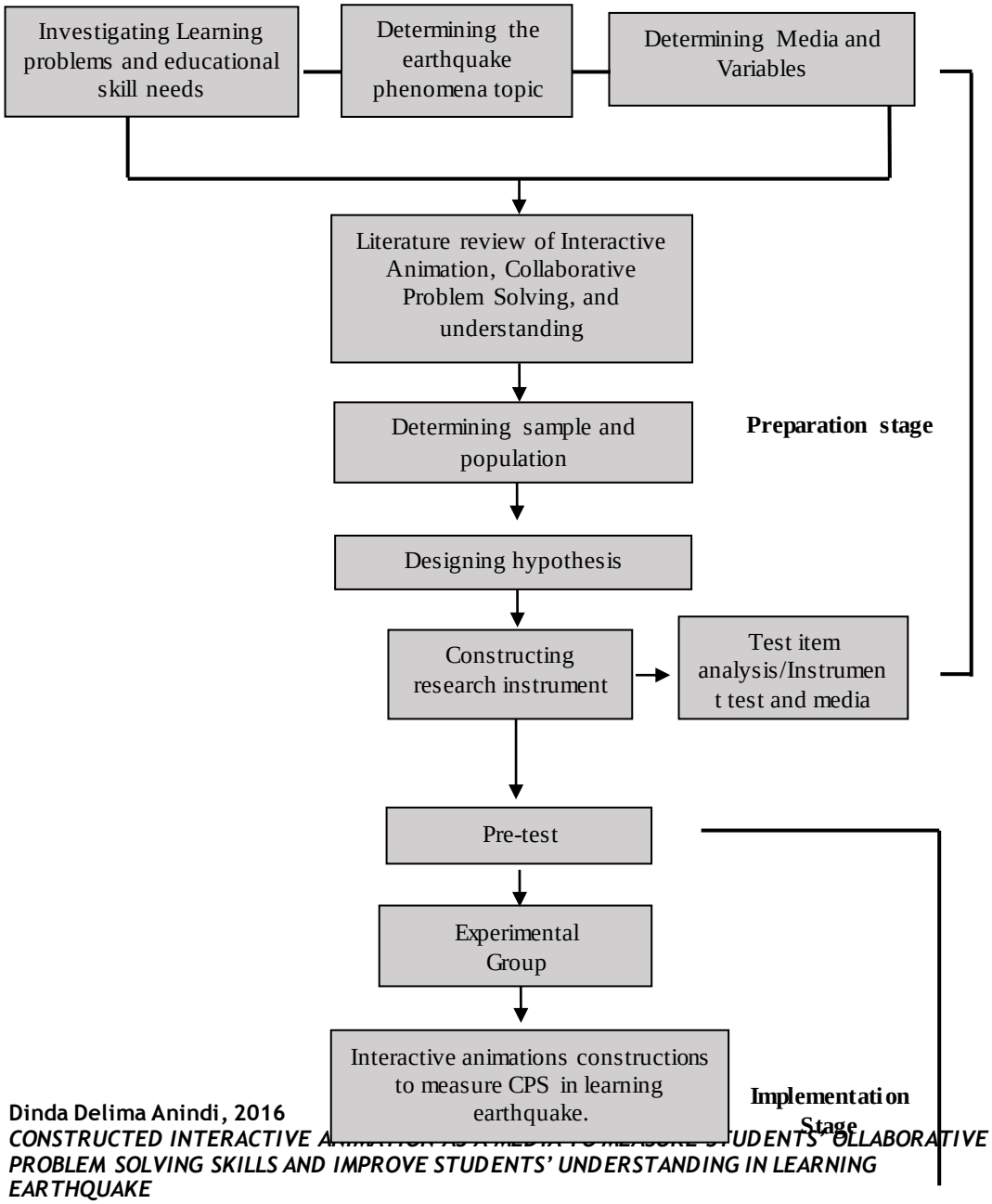
b. Implementation Stage

1) Conducting Pre-test of earth topic both in control and experimental group/ class
2) Giving an introduction to earthquake phenomena in experimental class by giving the students experience of earth quake simulation in class.
3) Experiment treatment (Implementing animations constructions through scientific problem in learning earthquake).
4) Recording the data of experiment
5) Conducting Post-test of earth topic in experimental group/ class.

c. Completion Stage

1) Analyzing the data of experiment statistically
2) Constructing table of result
3) Conducting test of hypothesis
4) Interpreting data

5) Constructing conclusion of experiment.



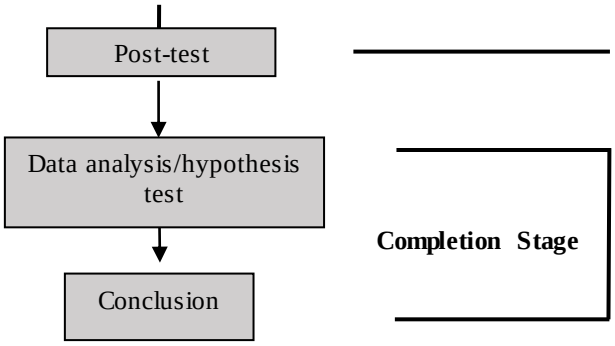


Figure 3.1 Research Flowchart.