CHAPTER III
RESEARCH METHODOLOGY

A. Research Method

The research method that is used in this research was descriptive research. According to best, descriptive research is concerned with how what is or what exists is related to some preceding event that has influenced or affected a presents condition or event (Cohen et al., 2007). Furthermore, Fraenkel and Wallen (2011) stated that descriptive studies describe a given state of affairs as fully and carefully as possible. In this method the research focus to develop inch critical thinking multiple chioce question from 8th grade on living nthings and environmental sustainability.

B. Population and Sample

The population in this research were 8th grade students at International Junior High School in Bandung. The sample was drawn from 125 respondents of the 8th grade students from three schools of International Junior High School in Bandung, which are School "X", School "Y", and School "Z". The sampling technique that is used for this research was a purposive sampling according to Fraenkel and Wallen (2011). Purposive sampling is different from convenience sampling in that researchers do not simply study whoever is available but rather use their judgment to select a sample that they believe, based on prior information, will provide the data they need (Fraenkel and Wallen, 2011).

According to Cohen et al., (2007) stated that for purposive sampling the sample has been chosen for a specific purpose. The consideration is because the researcher choose sample based on the requirement such as the school implemented the curriculum 2013 or student has been learned about the concept that will be tested, have a good multimedia facilities e.g. personal computer, and located in Bandung, due to limited time and resources. The sample chosen from three International School with 8th grade students as representative.

C. Operational Definition

a. Science Virtual Test

Science virtual test is the test that used a computer based testing concept. It is the form of test in which the computer is an integral part of question papers' delivery, response storage, and reporting of results from a test. The instrument of test is in multiple choice that made by Adobe Flash 9.0 software. There were some media that used in the test such as video, picture, diagram, and poster.

b. Critical Thinking.

Critical thinking in this research is plan to measure using instrument test in multiple choice type based on Inch. Critical thinking which is used in this research was an according to eight elements of critical thinking which as a related function. The elements are: purpose, question at issue, assumptions, point of view, information, concepts, interpretation and inference, and implication and consequences. Based on the elements, critical thinking will lead the student to the level of critical thinking.

D. Research Instrument

The instrument that used in this research was multiple choice test item with four option based on the eight elements of Inch's critical thinking to measure students' critical thinking on living things and environmental sustainability. The science virtual test made by Adobe Flash 9.0.

Science virtual test was adapted from Rusyati and Firman (2015). It was designed to measure students' critical thinking on living things and environmental sustainability consist of three steps: (1) content analysis; (2) constructing the instrument (multiple choice test); (3) validity judgment of the instrument by expert.

1. Content Analysis

Before constructing the test item, content analysis was needed to determine the content that used to measure students' critical thinking on Junior High School. The theme of this research about the living things and environmental sustainability in 8th grade that limited by Core Competency (KI) and Basic Competence (KD) that are attached in 2013 Curriculum shown in the Table 2.2.

Then, there were five major topic that appropriate with the theme used such as structure and function of plant, reproduction system, developing of citizen and the impact, sun radiation, and climate change.

2. Constructing the Instrument

The instrument that has been constructed are in multiple choice form. It is consist of 26 items with 4 options each number. The question was related to the theme that has been determined in the previous step (content analysis). It was constructed to measure the students' critical thinking based on the elements of critical thinking by Inch. Inch et al. (2006) detailing the eight elements of critical thinking is a function that is interconnected, as follows: purpose, question at issue, assumptions, point of view, information, concepts, interpretation and inference, implication and consequences. Which had been elaborated by Paul and Elder (2008), in the following table 2.1. The table contain of 8 elements with 26 sub elements, which Paul and Elder used as a guide for student in the critical thinking. Then, author adjust it for constructing the instrument of science virtual test based on that criteria.

3. Validity of the Instrument by Expert

In order to test the validity of the instrument the questions that have been constructed then judged by the 3 expert of education, 3 expert of content, and 3 expert. There were three aspects to judge by expert based on the background of the expert. The aspects are:

a. Content

There are several criteria that have been judged by expert related the content of the instrument: (1) information on "living things and environmental sustainability" has been clearly presented, (2) using the correct term in accordance with the rules of biology, (3) articles / pictures / video / table in accordance with the rules of biology, (4) description / explanation of the article / image / comic / video / table in accordance with the rules of biology.

b. Critical Thinking Aspect

On this aspect, the item test were assessed by the experts about the appropriateness of each item with eight elements of critical thinking that consist

of 26 sub elements of critical thinking by Inch et al (2006). These elements can be seen on the Table 2.1.

c. Media

For the aspects of media there were some criteria that have been judged by the expert, such as: the composition of the text (size, color, and type) clear so easy to read, there was harmony between text and background colors, the quality of illustrations (pictures, video, or animation) both in terms of placement, size, and color, submission of information in the form of interactive multimedia audio with clear intonation and tempo was not too fast or too slow, audio effects in interactive multimedia can attract attention and did not distract the user, audio effects that appear in the interactive multimedia for multimedia operation does not distract the user and does not cover the narrative voice, the position, shape navigation, buttons and has a consistent color and the same functions at each screen.

The result of instrument validity by the expert was used a majority formulation. The result of data from expert judgments based on the aspect (above) can be seen on the Appendix B. After validating of the instrument by the expert, the analysis was conducted. Based on the result of analysis there were several items that should be revised. Then, the test field of the instrument was conducted in three International Junior High School after revising the instrument. The result of revision of instrument based on the expert judgment can be seen on Appendix A. Then, the story board of the science virtual test can be seen on Appendix E.

E. Instrument Analysis

The instruments which are used to measure students' critical thinking is in multiple choice test with four option. This instrument includes to the problem of eight elements that consist of 26 sub elements by Inch. The analysis of instrument will be covers validity, reliability, discriminating power, and reliability.

1. Validity

Validity refers to the appropriateness, meaningfulness, correctness, and usefulness of the inferences a researcher makes (Fraenkel and Wallen, 2011). The validity test was judged by the expert to check the test instrument valid or not to

measure students' critical thinking on living things and environmental sustainability theme.

$$r_{xy} = \frac{n \sum xy - [(\sum x)(\sum y)]}{\sqrt{[n \sum x^2 - (\sum x)^2][n \sum y^2 - (\sum y)^2]}}$$

Where,

r$_{xy}$ = items correlation coefficient.
X = items scores
N = amount of subject

(Minium *et al.*, 1993)

The following formula (above) can be used to determine test item validity. The item test was checked using ANATES version 4.1.0 and content validity by expert based on majority. To interpret the validity, the researcher used reference as shown table 3.1.

Table 3.1 Interpretation r value (Correlation)

The amount of r value	Interpretation
0.80 – 1.00	Very high
0.60 – 0.79	High
0.40 – 0.59	Prosperous
0.20 – 0.39	Low
0.00 – 0.19	Very low

(Jacobs and Chase, 1992)

2. Reliability

Reliability refers to the stability, dependability, or consistency of test results (Kaplan and Saccuzo, 2012). Reliability test is used to show whether an instrument can be used and reliable to measure the students' critical thinking or not. The analysis of reliability has been done by statistical using SPSS version 16. The interpretation of the reliability value was refer as table 3.2. A reliability measure designed by Lee Cronbach in 1951, factors in scale size in reliability estimation, calculated using the following formula:

$$\alpha = \frac{K}{K-1}\left(1 - \frac{\sum_{i=1}^{K} \sigma_{Yi}^2}{\sigma_x^2}\right)$$

Where, K is the number of items in the measure, σ_x^2 is the variance (square of standard deviation) of the observed total scores, and $\sigma_{Y_i}^2$ is the observed variance for item i.

(Cronbach, 1951)

Table 3.2 Interpretation Reliability Coefficient

Reliability Coefficient	Interpretation
0.80 – 1.00	Very high
0.60 – 0.79	High
0.40 – 0.59	Prosperous
0.20 – 0.39	Low
0.00 – 0.19	Very low

(Jacobs and Chase, 1992)

3. Difficulty Level

For a test that measures achievement or ability, item difficulty is defined by the number of people who get a particular item correct (Kaplan and Saccuzzo, 2012). According to Arikunto (2012), a good test is the test which has not very difficult or very easy. The analysis of diffultiy level by using an ANATES software version 4.1.0. The value of the difficulty level can be determined by the formula:

$$P = \frac{B}{JS}$$

Where,
P = difficulty index
B = the number of students answering right
JS = total number of students

(Kaplan and Saccuzzo, 2012)

The category of the difficulty level in the following Table 3.3.

Table 3.3 Category of Difficulty Level

Value of Difficulty Index (P)	Category
0.00 – 0.30	Difficult
0.31 – 0.70	Moderate
0.71 – 1.00	Easy

(Arikunto, 2012)

4. Discriminating Power

Discrimination power analysis is used to determine the question wether it is good or bad quality. Discriminating power is the ability of the test or question to differentiate between high achiever and low achiever (Arikunto, 2012). The analysis of the discrimination power has been done by statistically using ANATES version 4.1.0.

The formula which use to analyze discriminating power as follows:

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

D = Discriminating power
JA = Amount of high achiever
JB = Amount of low achiever
BA = Amount of high achiever who answers question with the right answer
BB = Amount of low achiever who answers question with the right answer
PA = Proportion of high achiever who answers question with the right answer PB = Proportion of low achiever who answers question with the right answer

(Arikunto, 2012)

Table 3.4 Category of Discriminating Power

Discriminating Power (Value)	Interpretation
0.00 – 0.20	Poor
0.21 – 0.40	Satisfactory
0.41 – 0.70	Good
0.71 – 1.00	Excellent

If the value of the disciminating power is negative, the item test should be rejected.

(Arikunto, 2012)

5. Distractor

When taking a multiple-choice examination, the author must determine which of several alternatives is "correct." Incorrect choices are called distractors. In the section on item analysis, the choice of distractors is critically important. Studies have shown that it is rare to find items for which more than three or four distractors operate efficiently. Based on the Arikunto (2012), the distractor is usable if the distractor is chosen by 5% of all the respondent.

The formula to correct for guessing on a test is

$$corrected\ score = R - \frac{W}{n-1}$$

Where,

R = the number of right responses

W = the number of wrong responses

n = the number of choices for each item

(Kaplan and Saccuzzo, 2012)

F. Research Procedure

In order to make this research systematically arranged, there are three stages of research procedure that have been conducted including the preparation, implementation, and completion. Then, the research plot can be seen on Figure 3.1.

a. Preparation

1) Formulating problem to be investigated and research objective determined

2) Conducting analysis of critical thinking by Inch

3) Conducting literature review about the critical thinking, science virtual test, living things and environmental sustainability, and curriculum 2013

4) Constructing the instrument (multiple choice test) based on the 8 element of critical thinking by Inch

5) Designing story board of science virtual test

6) Designing the science virtual test by using Adobe Flash 9.0 software by technician

7) Validating the instrument (expert judgment) by the expert (lecturer) of content, media, and critical thinking by inch

8) Revising the instrument based on expert judgement and analysis.

b. Implementation

1) Testing the instrument (science virtual test) that has been revised in three international school (large test)

2) Testing the legibility of test instrument by the students

3) Collecting the research data

4) Analyzing the data by ANATES and SPSS to check the validity and reliability of the test item including the difficulty level, discriminating power, and distractor of test item.

c. Completion

1) Making a result and discussion

2) Making a conclusion based on data analysis

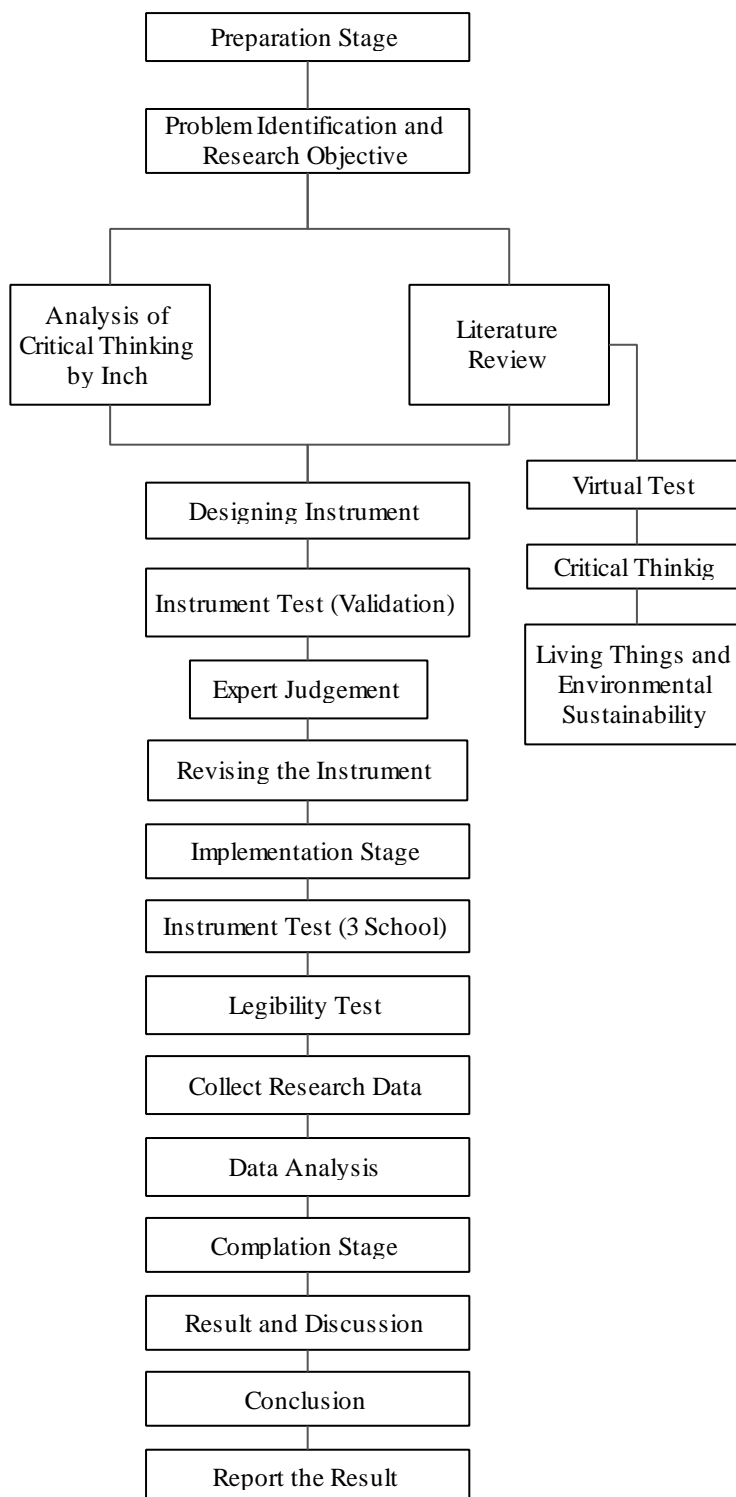3) Reporting the result.

G. Research Plot

Figure 3.1 Research Plot