

CHAPTER III

RESEARCH METHODOLOGY

A. Research Method

As non-experimental study, the method used in this present study is descriptive. This method is appropriate since the main purposes of this study are to describe or capture secondary student's critical thinking profile in general and based on science topic, to examine critical thinking difference among independent variables and to find out the correlation between student's critical thinking and other variables. Therefore, this research utilizes data collection and analysis technique that yields reports concerning the measures of tendency, variation, correlation, and comparison.

By using descriptive method, it allows the researcher to collect and describe the data systematically, factual, and accurate about the characteristic of specific population from literature and in the field (McMillan and Schumacher, 2001). Descriptive research also involves gathering data that describe events and then organizes, tabulates, depicts, and describe data collection.

In detail, this present study also compiles both descriptive correlational and descriptive comparative method. Descriptive correlational studies examine variables in their natural environments and do not include researcher-imposed treatments. Correlational studies display the relationships among variables by such techniques as cross-tabulation and correlations (Simon, 2011). Meanwhile, Descriptive comparisons focus on the degree of similarity and difference between two or more cases (Caramani, 2008). Descriptive comparison aims at describing and perhaps also explaining the invariances of the objects. It does not aim at generating changes in the objects, on the contrary, it usually tries to avoid them. Descriptive comparison study is one of the most efficient methods for explicating or utilizing tacit knowledge or tacit attitudes. The final goal of this kind of research is usually to reveal the systematic structure, invariance, that is true not only for the cases that were studied, but for the entire group (population) where the cases came from. In other words, the goal is to generalize the findings.

B. Population and Sample

The research was conducted in Cirebon West Java at April, 18th – 23rd, 2016. The population of this present study were public lower secondary schools in Cirebon city and regency. The sampling technique used was cluster sampling method, which occurs when the researcher wants to generate a more efficient probability sample in terms of monetary and/or time resources. Instead of sampling individual units, which might be geographically spread over great distances, the researcher samples groups (clusters) that occur naturally in the population, such as neighborhoods or schools or hospitals (Teddlie, & Yu, 2007).

There were 5 public lower secondary schools in Cirebon involved in this study, which literally named as School A, B, C, D, and E. Since the Cirebon regency has larger area rather than city region, 2 schools were generated from city area and 3 others were from regency area. On each school, 2 classes of VII grade were used. Overall, there are 331 number of respondents, with the same proportion number of sample on each cluster.

During the process, when the targeted schools have been determined, the research permission or administrative process was conducted. Then, the author and science subject teachers discussed for determining two VII grade classes randomly, proper schedules, and the technique during data collection.

C. Operational Definition.

In order to avoid misconception, the terminologies used in the study are described as follows:

1. The critical thinking used in this study is adopted from Inch et al (2006) that includes the functional interconnected eight elements of critical thinking. Those elements are generates purpose, raises question at issue, makes assumption, embodies a point of view, uses information, utilizes concepts, makes interpretation and inference, and generates implication and consequences. In this study, it is measured by Science Virtual Test on Living things and Environmental Sustainability theme which is developed by Firman

Nur Ida Maulida, 2016

The Profile of Students' Critical Thinking Skill Measured by Science Virtual Test on Living Things and Environmental Sustainability Theme

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

and Rusyati (2015). Then, the critical thinking attainments of the students are categorized on three following levels; low (Score < 43.74), moderate ($43.74 \leq \text{score} < 74.59$), and high ($\text{score} \geq 74.59$), which are based on standard deviation and the mean score (Arikunto, 2010).

2. The standardized Science Virtual Test used in this study is consisted of multiple choice test items that made based on Inch' (2006) Critical Thinking elements with 2 or 3 representative indicators and also have more than "prosperous" interpretation in validity and reliability
3. In this study, gender arise as independent variable or viewpoint for investigating critical thinking difference, refers to Male and Female group. Arends (2008) explained that there are differences of cognitive ability between male and female. The males are more rational, has enthusiasm directed to the things that intellect, abstract, such that they are better in logical thinking and more critical. Meanwhile, the females are more accurate and detail in making decisions, her memory is better, more emotional, and interested more in verbal skills. In this research, the gender data was collected from the respondents identity form attached on the instrument' answer sheet.
4. Academic achievement is appeared as independent variable or viewpoint for investigating the critical thinking profile difference. Achievement is the output that a person reveals in the face of a mission that he chooses, reaching a conclusion, a behavior for accomplishing a goal. Academic achievement is defined as the level of knowledge and skills which students gained in academic studies (Ülgen, 1988; Karagöl, & Bekmezci, 2015). In this research, the students' academic achievement level data was obtained through student' national examination score on primary level.
5. Cognitive development level is also appeared in present study as independent variable or viewpoint for investigating critical thinking profile difference. It refers to the ability to thinking logically. Piaget defines logical thinking as mental procedures that one utilizes when an unknown situation (problem) occurs (Karplus, 1977). Among Piaget's cognitive stages of development,

logical thinking is a skill included in the concrete operational and formal operational stages. In this research, the students' formal reasoning level was measured by conducting Test of Logical Thinking (TOLT) which is developed by Tobin and Capie (1982).

D. Research Instrument

The main data gathering instrument used in this study are Science Virtual Test and Test of Logical Thinking (TOLT).

a. Science Virtual Test

Science Virtual Test is a standardized virtual critical thinking test that have been developed by Firman and Rusyati (2015). It have been validated through several stages. Began when the layout have been processes by the programmer, judgments on biology content experts, critical thinking and science education experts, and computer-based media experts were conducted. Then, it was followed by readability and limited validation tests. After reliability and validity of test items have been revealed, the acceptance and rejection of the items was identified. At the end, the revised, valid, and reliable Science Virtual Test is ready to use with high reliability (Cronbanch's Alpha 0.651), and moderate difficulty level.

This instruments is necessary to be used for gaining student's critical thinking skill data. It contains 28 multiple choice test items that comprised eight elements of critical thinking skill (Inch, 2006): Generates purpose, raises question at issue, makes assumption, embodies point of view, uses information, utilizes concept, makes interpretation and inferences, and generates implication and consequences. In addition, those items was also made based on living things and environmental sustainability theme on VII grade science, encompasses living things characteristic, biodiversity, energy resources, ecosystem, environmental pollution, and global warming topic. For the further detail, Table 3.1 shows the distribution of Science Virtual Test' items. While the captures of the real used Science Virtual Test items is attached on the Appendix A.1

Table 3.1 Distribution of Science Virtual Test Items.

No	Critical Thinking Elements	Topic's Number (Total)						Total
		Living Things Characteristic	Diversity	Energy Resources	Ecosystem	Environmental Pollution	Global Warming	
1	Purpose a. Clearly stated the purpose b. Distinguish primary purpose c. stated purpose on target d. stating significant and realistic purpose	1 (1)	2,7 (2)	3 (1)	8 (1)	4, 5 (2)	6 (1)	8
2	Question at Issue a. Stating the problem b. Asking the question in several way c. stating sub- question d. Identifying the problem	10 (1)		9 (1)		11, 12 (2)		4
3	Assumption a. Identifying assumption b. Considering how the assumptions able for shaping the point of view of the author				13, 14 (2)			2
4	Point of View a. Identifying point of view b. Identifying the strength and the weakness of the point of view c. Being fair in evaluating all point of view.		15 (1)			16 (1)	17 (1)	3
5	Information a. generating support based on facts, b. identifying the supporting and opposing	18 (1)	19 (1)				20 (1)	3

Nur Ida Maulida, 2016

The Profile of Students' Critical Thinking Skill Measured by Science Virtual Test on Living Things and Environmental Sustainability Theme

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

No	Critical Thinking Elements	Topic's Number (Total)					Total	
		Living Things Characteristic	Diversity	Energy Resources	Ecosystem	Environmental Pollution		Global Warming
	information, c. using a clear, accurate, and relevant information to the question at issue							
6	Concepts a. identifying key concepts, b. considering alternative concepts or alternative definition of concepts, c. using care and precision concept	22 (1)			21 (1)		23 (1)	3
7	Interpretation and Inference a. inferring based on the evidence implies, b. checking inferences for their consistency with each other, c. Identifying assumption that lead to inferences.				25 (1)	2 (1)		2
8	Implication and Consequences a. tracing the implication and consequences that follow from reasoning b. identifying negative and positive implication, c. considering all possible consequences					26, 27, 28 (3)		3

b. Test of Logical Thinking (TOLT)

Nur Ida Maulida, 2016

The Profile of Students' Critical Thinking Skill Measured by Science Virtual Test on Living Things and Environmental Sustainability Theme

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

To get measures of formal reasoning level of the students, Test of Logical Thinking (TOLT) is applied. It is originally designed by Tobin and Capie (1982). It has high validity (0.62), moderate difficulty level, moderate discriminating power (52.8%), and high reliability (0.77).

The test consist of ten items, related to proportional reasoning (Number 1 and 2), control of variables (3 and 4), probability (5 and 6), correlation (7 and 8), and combinational operations (9 and 10). The first eight questions have two levels: Multiple choice question and list of optional reasons. Those two parts have to be answered correctly in order to be considered as correct. On the other hand, the last two questions are relating to combinational analysis, they are opened semi structured answer.

According to the level of formal reasoning, there are different ways of division. Valanides (1998) distinguished four levels; concrete corresponds to a score from 0 to 1, transitional level from 2 or 3, formal level from 4 to 7, and rigorous formal level from 8 to 10. Surprisingly, Valanides (1997) made another division; concrete (0 and 1), transitional (2 and 3) and formal (4 to 10).

E. Data Analysis

Data analysis is conducted based on the defined research questions:

1. Scoring Procedure and Data analysis for student responds regarding critical thinking test

Since there is an unequal allocation of items for each critical thinking elements, the raw score for each elements needs to be converted into proper scale score by taking the average. The average score count with the total number divided total of questions of the element (Arikunto, 2010).

In an effort to build the critical thinking profile, the main data analysis procedure involved was the descriptive analysis, which focused on the mean value. In this case, the means and the standard deviations were computed for each of the eight critical thinking elements and the overall score to provide the critical thinking skill profile.

Nur Ida Maulida, 2016

The Profile of Students' Critical Thinking Skill Measured by Science Virtual Test on Living Things and Environmental Sustainability Theme

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

Based on the Mean of each critical thinking element and the overall score, each student's attainments can be categorized as low, moderate, and high according to these following definition:

Table 3.2 Interpretation of Students' Attainments

Interval	Category
$X \geq \bar{x} + SD$	High
$\bar{x} - SD \leq X \leq \bar{x} + SD$	Moderate
$X < \bar{x} - SD$	Low

Where,

X = Students' score

\bar{x} = Overall students' Mean score

SD = Standard Deviation

(Arikunto, 2010)

Based on the category interpretation above, the critical thinking attainments of the students can be categorized on three following levels; low (Score < 43.74), moderate ($43.74 \leq \text{score} < 74.59$), and high (score ≥ 74.59).

2. Examine the critical thinking difference on defined variable

The difference is analyzed by statistical analysis using IBM SPSS 23. For two variables, t-test or Mann Whitney test can be applied. While for more than two variables, one way ANOVA test or Kruskal Wallis test might be applied.

In this study, critical thinking difference is examined within gender (male and female group) variable, previous achievement levels (low, middle, and high achiever groups), and formal reasoning levels (concrete, transitional, and formal reasoning level groups). Appears on all independent variables, the score data of each critical thinking elements are not normally distributed, hence the significant difference is tested by using Mann-Whitney and Kruskal Wallis. In contrast, all overall score data shows a normal distribution. Hence, the t-test and One way ANOVA.

3. Examine the Correlation between two variables

Correlational test is conducted to see the correlational and effects of one variable to another. In this study, correlation test is applied to find out the relationship between critical thinking skill towards students' academic achievement and formal reasoning level. Since the overall score data is normally distributed, the Pearson Correlation test is applied.

The degree of relationship determined how closely the variables are related. This is usually expressed as a number between -1 and +1, and is known as the correlation coefficient (Simon, 2011). A zero correlation indicates no relationship. As the correlation coefficient moves toward either -1 or +1, the relationship gets stronger until there is a perfect correlation at the end points.

F. Research Procedures

Generally, the research procedures conducted on this study are preparation stage, implementation stage, and completion stage.

1. Preparation Stage

- a. Defining variables of the research
- b. Literature review about critical thinking, students achievement, and formal reasoning
- c. Determining research instruments
- d. Determining sample and population
- e. Constructing and revising research proposal
- f. Conducting research administration and determining the schedule

2. Implementation Stage

This is the process of collecting research data in the school, which the steps as follows:

- a. Profiling critical thinking skill of students
- b. Testing logical thinking of the students to get formal reasoning level of the students
- c. Gathering students' national examination score data

3. Completion Stage
 - a. Processing collected data
 - b. Analysis the data
 - c. Discussing the finding
 - d. Constructing conclusion

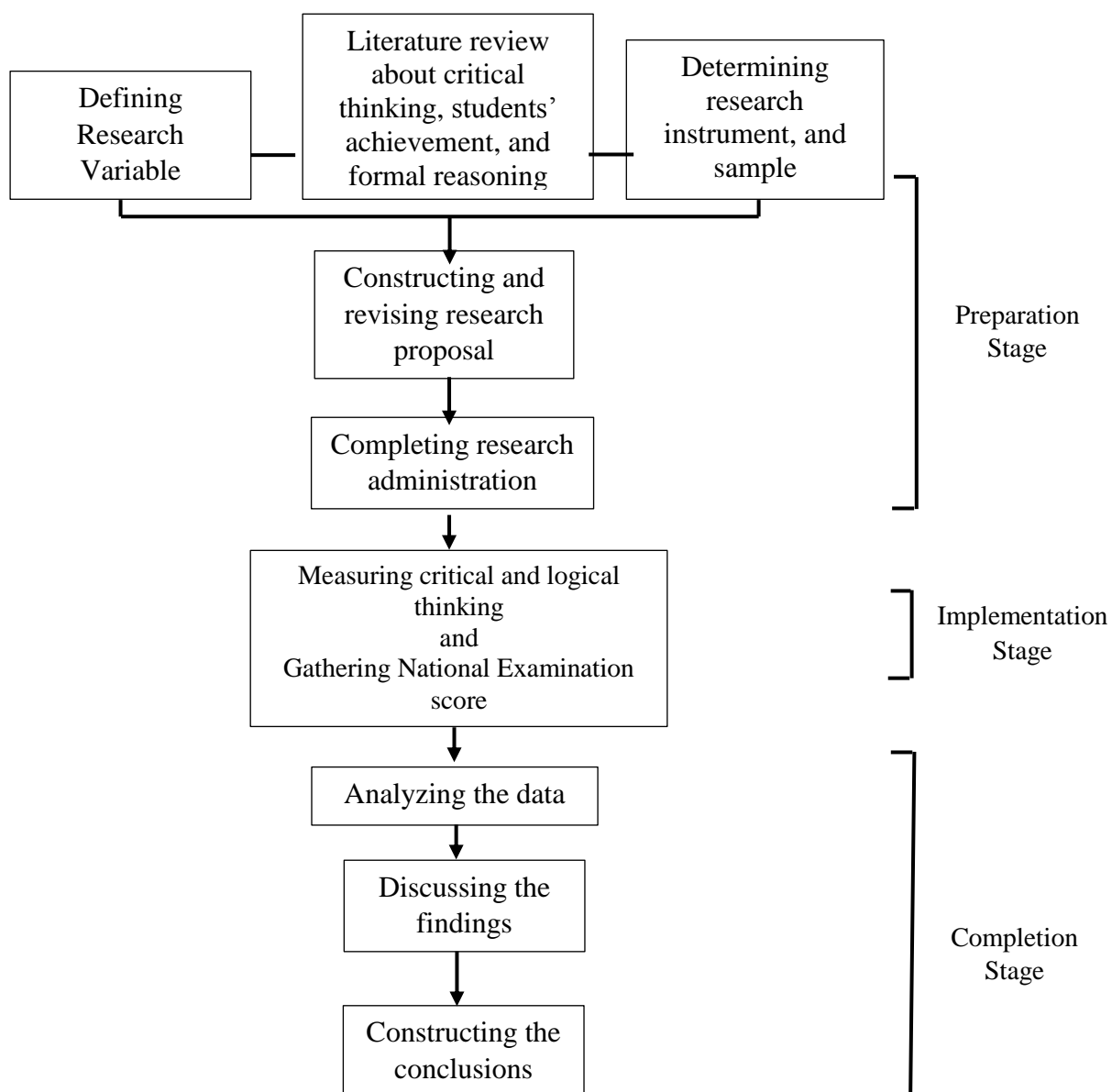


Figure 3.1. Flow Chart of Research' Plot

Nur Ida Maulida,

The Profile of Students' Critical Thinking Skill Measured by Science Virtual Test on Living Things and Environmental Sustainability Theme

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

