CHAPTER III

RESEARCH METHODOLOGY

A. Research Method and Research Design

1. Research Method

This research is aimed to describe current situation ofstudents' profil of nature of science (NOS) in learning interaction of organisms and its environment topic, not including its impact or effectiveness toward students' achievement. Accordingly, descriptive research method is used to fulfill the aim of this research. Descriptive research is concerned with how what is or what exists is related to some preceding event that has influenced or affected a present condition or event (Cohen et al., 2007). Furthermore, Fraenkel, Wallen and Hyun (2007) reveal that descriptive studies describe a given state of affairs as fully and carefully as possible.In this research, the objects of the research are not given any treatment.Then, natural condition is set without any manipulation. It will provide reasonable answer why something is occurred (Arikunto, 2010).

2. Research Design

Non-experimental with natural descriptive design is used in this research to provide a description of phenomena. Seventh, eighth and ninthgrade junior high school students of Sekolah Indonesia Kuala Lumpurwhich consist of 18 students from class 7a, 14 students from class 7b, 15 students from class 8a, 14 students from class 8b, 15 students from class 9a, and 12 students from class 9b are given test item about interaction of organisms and its environment topic without being taught before. The scores are captured as the data of Nature of Science (NOS) and conceptual understanding. Base on those results, the profile of students' Nature of Science (NOS) and conceptual understandingcan be identified. Current situation of research variables are elaborated descriptively and classified based on its types, characteristics or condition, then draw into conclusion (Arikunto, 2010).

B. Population and Sample

The location of this research is at Sekolah Indonesia Kuala Lumpur (SIKL) Malaysia that uses National Curriculum of 2013 for 7thand 8thgrade, while KTSP curriculum of 2006 for 9thgrade. The instruction in classes is mainly conducted in Bahasa.

The population of this research is all SIKL students. The samples are Junior high school students from 7a, 7b, 8a, 8b, 9aand 9bclasses which are 88 students in total. The subject of this research is defined under purposed of the responsible science teacher thatis used to implement the constructed response test in interaction of organisms and its environment topic.

C. Operational Definition

In order to avoid misconception of this research, some operational definitions are explained in this research. Those variables and instruments are explained as follow:

1. Nature of Science (NOS) aspects that is stated by Duschl and Grandy (2013) as well as Matthews (2012) has seven aspects. In this research, only six aspects of Nature of Science that is used, which are (a) the empirical nature of science, (b) the scientific theory and law, (c) the creative and imaginative nature of scientific knowledge, (d) the theory-laden nature of scientific knowledge, (e) the social and cultural embeddedness of scientific knowledge, and (f) the tentative nature of science that is measured using eight questions in the form of constructed response test item.

D. Research Instrument

In this research, instrument is necessary to be used to obtain data. The type of instrument used is subjective test which is constructed response item test that was used to analyze students' Nature of Science (NOS) on interaction of organisms and its environment topic. The test items that

areused are six questions in total which assess the six aspects of nature of science (NOS).

All of the test items have been judged by experts and analyzed using ANATES V4 statistical software after tested to the samples of 7a, 77b, 8a, 8b, 9a and 9b classes of Junior High School students in Sekolah Indonesia Kuala Lumpur (SIKL). The blueprint of constructed response test item before passing instrument analysis step is described in Table 3.1.

Table 3.1 Blueprint of Nature of Science (NOS) and Conceptual Understanding before Validation

Topic	NOS Aspect	Number of Questions
Biotic	Social and cultural embeddedness of scientific knowledge	1
Abiotic	Empirical nature of science	1
Food chain	Creative and imaginative nature of scientific knowledge	1
Food web	Tentative nature of science.	1
Food pyramid	Scientific theory and law.	1
Symbiosis	Myth of scientific metod	1
Classification of Organisms	Theory-laden nature of scientific knowledge	1
	∑ **(7)**	7
	∑ (100%)	100

After conducting instrument analysis, new blueprint of subjective test is gained and it is used as research instrument. The result analysis is attached in appendix. From seven questions that have been judged and revised six questions are used. The blueprint of test items after instrument analysis is shown in Table 3.2.

Table 3.2 Blueprint of Nature of Science (NOS) and Conceptual Understanding after Validation

Topic	NOS Aspect	Number of Questions
Biotic	Social and cultural embeddedness of scientific knowledge	1
Abiotic	Empirical nature of science	1
Food chain	Creative and imaginative nature of scientific knowledge	1
Food web	Tentative nature of science.	1
Food pyramid	Scientific theory and law.	1
Classification of Organisms	Theory-laden nature of scientific knowledge	1
	∑ **(6)**	6
	∑ (100%)	100

E. Data Collection

There are several techniques to obtain the data needed in this research. Those data are purposed to gain the profile of students' Nature of Science (NOS). Towards this, data collection technique is described below.

1. Data of Students' Nature of Science (NOS)

   In order to assess students' Nature of Science (NOS) which consists of six aspects, this research used rubric scoring to assess data from students' answer. Rubric scoring is used to capture students' Nature of Science (NOS) base on constructed response item test given. The blueprint indicator of students' Nature of Science (NOS) is described in Table 3.3.

Table 3.3 The Blueprint Indicator of Nature of Science (NOS)

NOS Aspects	Definition	Indicator
Empirical Nature of Science	Empirical nature of science is based on scientific observation and evidence of the natural phenomena both on quantitative and qualitative data.	Empirical nature of science aspect is measured based on natural phenomena, evidence, data and observation.
Scientific Theory and Law	Scientific theory and law are two different kinds of knowledge which supporteach other and it is based on natural phenomena, evidence as well as the result of scientific observation.	Students implement thetheory to answer the question. Thus, it creates an organized and complete ecological pyramid.
Creative and Imaginative Nature of Scientific Knowledge	Creative and imaginative cannot be apart from science and will stand still together although the discussion of science cannot use imagination and shall base on the fact.Creativity will give the innovation in science.	Answer the questioncreatively using pictures, unique schemes or create a story.
Theory-laden Nature of Scientific Knowledge	Theory-laden nature of scientific knowledge is based on someone's commitments, beliefs, prior knowledge and experience in a way to do the observations and form scientific theories.	Answer the question baseon students' prior knowledge, beliefs and commitments.
Social and Cultural Embeddedness of Scientific Knowledge	Social and cultural embeddedness of scientific knowledge held that science will always be influenced by social and cultural life of the scientists.	Relate the culture of science and/or relates to the influence of societal factors.
Tentative Nature of Science	Science is tentative and will easily change due to the changing of technologies, knowledge and new evidence in natural phenomena.	State the condition of science as they see.

F. Instrument Analysis

The instrument which is used to measure the profile of students' Nature of Science is constructed response test item that measured the six aspects of Nature of Science (NOS). This instrument is in the form of test item. Thus, the analysis of the instrument will be covered validity, reliability, difficulty level, and discriminating power.

1. Validity

Validity has been defined as referring to the appropriateness, correctness, meaningfulness andusefulness of the specific inferences base on the data that have been collected. Additionally, validation is the process of collecting and analyzing the data and evidence to support such inferences (Fraenkel, Wallen and Hyun, 2007). According to Carmines and Zeller (1979),validity concerns the crucial relationship between concept and indicator.

Kaplan and Saccuzzo (2012) describe that validity can be defined as the agreement between a test score and the quality to be measured. The maximum validity coefficient (r_{12max}) between two variables is equal to the square root of the product of their reliabilities, or

$$r_{12max} = \sqrt{r_{11} r_{22}}$$

Where:
r_{11} and r_{22} are the reliabilities for the two variables

(Kaplan and Saccuzzo, 2012)

The validity interpretation is represented below in Table 3.4.

Table 3.4Validity Interpretation

Correlation Coefficient	Validity Criteria
$0,00 < r \leq 0,20$	Very low
$0,20 < r \leq 0,40$	Low
$0,40 < r \leq 0,60$	Satisfactory
$0,60 < r \leq 0,80$	High
$0,80 < r \leq 1,00$	Very high

(Arikunto, 2013)

2. Reliability

Measurement error is common especially in science. Thetest items that are relatively free of measurement error are considered to be reliable and test items that contain relatively large measurement error are considered to be unreliable (Kaplan and Saccuzzo, 2012).

Reliability refers to the consistency of the item tests on scoring, how consistent item tests from one question to another(Fraenkel, Wallen and Hyun, 2007). According to Carmines and Zeller (1979), reliability shows the tendency toward consistency found in repeated measurements of the same path.

Kaplan and Saccuzzo (2012) describe that the reliability coefficient is the ratio of the variance of the true scores on a test to the variance of the observed scores:

$$r = \frac{\sigma^2 T}{\sigma^2 x}$$

Where:

r = The theoretical reliability of the test
$\sigma^2 T$ = The variance of the true scores
$\sigma^2 x$ = The variance of the observed scores

(Kaplan and Saccuzzo, 2012)

The reliability interpretation is represented below in Table 3.5.

Table 3.5 Reliability Interpretation

Correlation Coefficient	Validity Criteria
0,00 < r ≤ 0,20	Very low
0,20 < r ≤ 0,40	Low
0,40 < r ≤ 0,60	Satisfactory
0,60 < r ≤ 0,80	High
0,80 < r ≤ 1,00	Very high

(Arikunto, 2013)

3. Difficulty Index

Item difficulty is defined by the number of people who achieve a particular correct test items especially for a test that measures achievement, ability or skill. The optimal difficulty level for test item is usually about halfway between 100% of the respondents who got the correct answer (Kaplan and Saccuzzo, 2012). Difficulty index, also called facility index or P value.Difficulty index is one of the key parameters or measurements of test item analysis. Difficulty index describes the percentage of the students who correctly answera given test item. Difficulty index ranges from 0 to 100% or 0 to 1.Easytest itemhas a higher difficulty index (Abdulghaniet al., 2014).

Yuan et al. (2013) describes that the difficulty level of atest item is understood as the proportion of the respondents who correctly answer the test item. Difficulty index is calculated by the number of respondents who answer the questions correctly and the result is divided by the total number of the respondents who answerthe questions. This proportion is indicated by the letter *p*, which indicates the difficulty level of the test item. The formula of difficulty level as follow:

$$P_i = \frac{A_i}{N_i}$$

Where:

P_i = Difficulty index of item *i*
A_i = Number of correct answers to item *i*
N_i = Number of correct answers plus number of incorrect answers of item *i*

(Yuan et al., 2013)

Additionally, Tomak and Bek (2014) state that for a particular item, the difficulty index can be defined as the ratio of those who provide correct answers. Abdulghani et al. (2014) state that base on the value of the difficulty index which base on the calculation of above formula, the difficulty index of an item tests can be categorized as below on Table 3.6.

Table 3.6 Difficulty Level Interpretation

Difficulty Index	Interpretation
< 0.2	Very difficult
0.21 – 0.69	Moderately difficult
0.7 – 0.9	Easy
> 0.9	Very easy

(Abdulghani et al., 2014)

4. Discriminating Power

According to Ferrando (2012) the term "discriminating power" refers to the effectiveness of the score to distinguish between high level and low level achiever of the respondents who answer the questions. In a broad sense, discriminating power refers to the degree to which a high level varies with lower level. Yuan et al. (2013) statethat good item shall discriminate between those whoachieve high score and those whoachieve low score. Discrimination index and discrimination coefficient are two ways of determining power of test items. The formula that is used in determining the discriminating power is described below:

$$D = \frac{P_H - P_L}{100}$$

Where:

D = Discrimination

P_H = Average score for the 27% of those with highest test scores

P_L = Average score for the 27% of those with lowest test scores

(Yuan et al., 2013)

Yuan et al. (2013) interpret the discrimination power and categorize them base on the result of above formula.If the number of D>0.39 it means that the quality of the exam paper is excellent. When D is in the 0.30-0.39 range, the exam paper is qualified. If 0.20<D<0.29, it indicates that the quality of the exam paper is passable and need to be improved.

The exam paper should be discarded if D is less than 0.20. Table 3.7concludes the interpretation of D value.

Table3.7 Discrimination power of the answers according to D value

D =	Quality	Recommendations
> 0.39	Excellent	Retain
0.30 – 0.39	Good	Possibilities for improvement
0.20 – 0.29	Mediocre	Need to check/review
0.00 – 0.20	Poor	Discard or review in depth
< -0.01	Worst	Definitely discard

(Yuan et al., 2013)

Furthermore, according to Long et al. (2012) a negative value means that participants got a low score in the test and tended to select the correct options more than a higher scoring participants. Conversely, a positive value for D index means that higher scoring respondents were more likely to select the response more.

Due to the result of limited test, the reliability result of students' Nature of Science (NOS) in learning interaction of organisms and its environment topicis 0.54 which means that the instrument analysis is satisfactory reliable. The numbers of questions that are used with revisions are six questions. In this research, from seven aspects of Nature of Science (NOS) author only uses the six aspects of Nature of Science (NOS). Myth of Scientific method aspect was dropped because it is too difficult for junior high school students to be measured.In assessing myth of scientific method aspect, the students shall directly do scientific method and find their own scientific method to solve the problem. It is in line with the statement of Chen (2006) who states that there is not any universal scientific method that can be used.There are various scientific methods that can be used. The blueprint of limited test of students' Nature of Science (NOS)analysis which is resulted by ANATES is displayed in Table 3.8.

Table 3.8 Blueprint of Nature of Science Limited Test Analysis Result by ANATES

No	New Number	Discriminating Power (%)	Difficulty Index	Validity		Note
				Value	Significancy	
1	4	29,17	Medium	0,451	Satisfactory	Used
2	1	14,58	Easy	0,257	Low	Used with revision
3	3	38,19	Medium	0,488	Satisfactory	Used with revision
4	5	39,58	Easy	0,451	Satisfactory	Used
5	2	32,29	Medium	0,593	High	Used
6	6	23,44	Easy	0,732	High	Used

G. Data Collecting

Data collecting is done by giving students the constructed response test item in the form of essay, short answer question and crossword questions which measure students' Nature of Science (NOS) in learning interaction of organisms and its environment topic. The blueprint of data collecting is shown in Table 3.9.

Table 3.9 Data Collecting Instrument

Dependent Variable	Data Source	Method of Collecting Data	Instrument
The profile of students' Nature of Science on interaction of organisms and its environment topic.	All of junior high school students that have experience learning this topic.	Nature of Science as well as cognitive paper test.	Constructed response test item.

H. Data Analysis Technique

Data analysis is done by calculating the score of constructed response test item in measuring students'Nature of Science (NOS)in learning interaction of organisms and its environment topic.The aspects that will be described on analyzing the profile of students Nature of Science (NOS) is the highest and lowest score, percentage of students who achieve the highest score, the

percentage of the students who achieve the lowest score, as well as the percentage of the students who achieve the medium score.

I. Research Procedures

In order to have a good sequence systematicallyof the research, the research procedure is arranged in three stages that have been done. Those of three stages are preparation stage, implementation stage, and completion stage.

1. Preparation Stage

   In this stage, researcher focused on all of the preparation to conduct and support the research. Here are the steps of preparation stage.

   a. Formulate problems to be investigated.
   b. Determine the focus of variable research.
   c. Conduct literature review of Nature of Science (NOS), interaction of organisms and its environment topic, and constructed response test item.
   d. Arrange the research proposal which is including chapter I, chapter II and chapter III which is presented in proposal seminar.
   e. Revise of research proposal after having suggestions and critics from the lecturers.
   f. Design the blueprint to create the instrument.
   g. Construct research instrument in the form of constructed response test items that is composed of6 questions of Nature of Science (NOS)on interaction of organisms and its environment topic.
   h. Test the validity, reliability, difficulty level, and discriminating power.
   i. Report and make the validation of the research instruments.
   j. Revise the instrument after having validated.
   k. Prepare research license to schools.

l. Determine research subject which are randomly chosen 88 participants of 7a, 7b, 8a, 8b, 9a and 9b classes of junior high school studentsinSekolah Indonesia Kuala Lumpur.

2. Implementation Stage

This is the process of data collecting in the school, when the treatments to students' are implemented

a. Determine the class sample randomly.
b. Deliver the test instrument to 7a, 7b, 8a, 8b, 9a and 9b classesof junior high schoolstudents in Sekolah Indonesia Kuala Lumpur.
c. Take and process the result.

3. Completion Stage

This is the final stage of research design; the step that is conducted in this stage is explained as the following steps:

a. Analyze the result of the research instrument.
b. Discuss and conclude the data analysis result.
c. Arrange the research report.

J. Research Scheme

Scheme of research is a view of how is the result going to be conducted, starting from the preparation, implementation and completion stage which is analysis and conclusion of the research that have been conducted. Detailed of the research scheme will be shown as Figure 3.1.

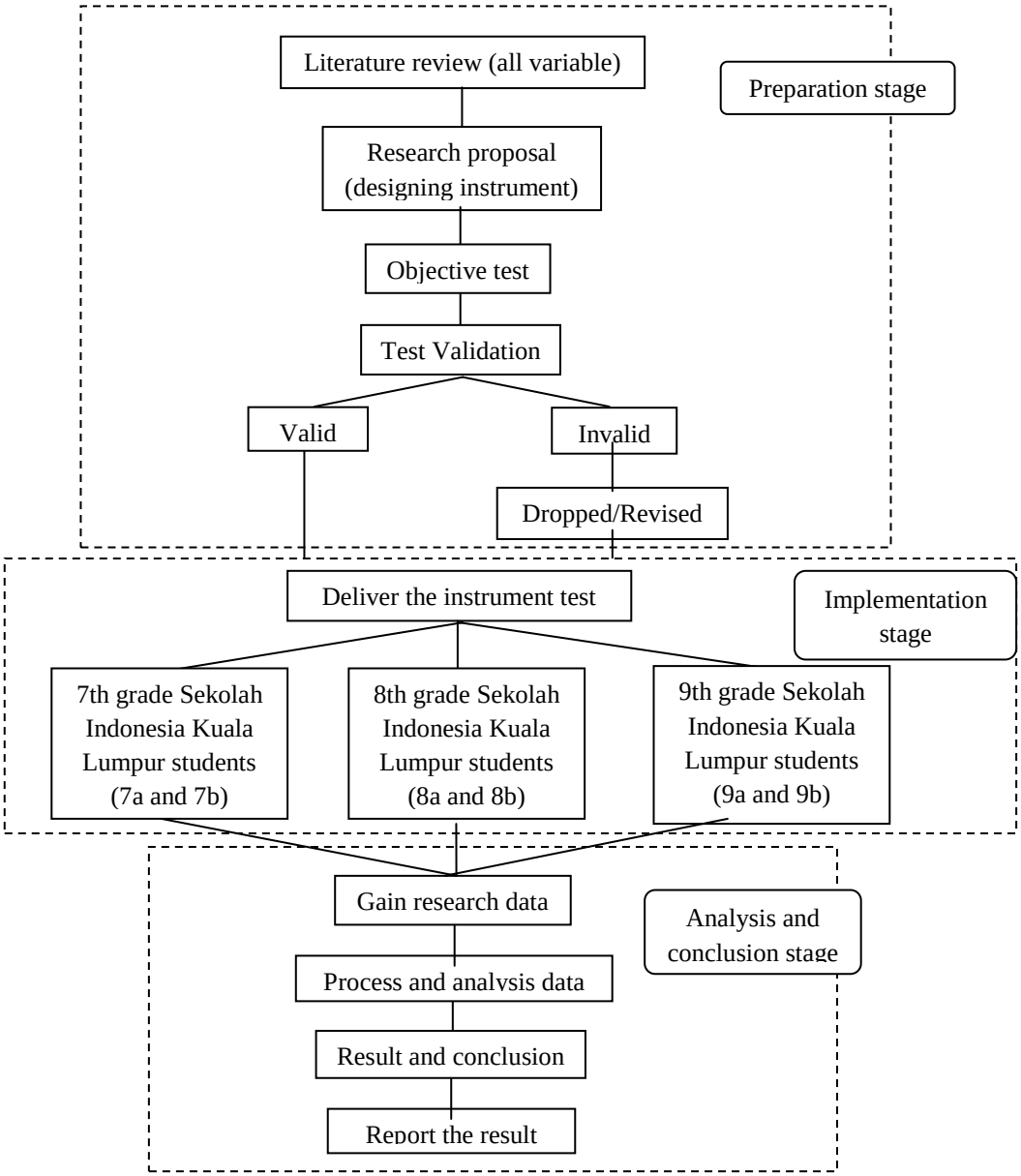

Figure 3.1 Flow Chart of Research Plot