CHAPTER III
METHODOLOGY

3.1 Research Method

This research was conducted in Quantitative Research Method. The purpose of Quantitative Research Method is to seek possible relationship between variables and explain the cause of the relationship (Fraenkel, Wallen, & Hyun, 2013). Quantitative Research Method might be designed for research with intervention or without intervention. Research with intervention tends to have purpose in explaining the impact of intervention towards two opposed groups. While research with no intervention might explains the relation between two variables in one group of subject based on the pattern occurred, or describes the tendency of a population. The method also collects data through instrument that contains questions and responses to be measured or observed. The data later be analyzed through statistic procedures (Creswell, 2012).

3.2 Research Design

Since this research included as a non-intervention one, with purpose is to describe the tendency of a population, a Survey Research Design was employed. Creswell (2012) stated that in survey research design, the researcher needs to deliver a survey to a sample to describe the attitudes, opinions, behaviors, or characteristics of the population. Survey researcher collected quantitative, numbered data using questionnaires and statistically analyze the data to describe the responses to question and to test research questions or hypotheses. The result also be interpreted the meaning of the data by relating results of the statistical test back to past research studies. Survey Research Design also been claimed by Fraenkel et al., (2013) as the most common descriptive method in educational research.

This research addressed two questionnaires to profile the level of Students' Scientific Attitude and to analyze Students' Learning Style. The data were collected through an online platform called typerform.com, students were given links of the forms, the Scientific Attitude Questionnaire link is

https://nabilah8.typeform.com/to/V0lOfO and the VAK Learning Style Inventory link is https://nabilah8.typeform.com/to/wVwuyx. Results then later be analyzed using SPSS software (version 24) to obtain the frequencies of data collected and co-relation between Students' Scientific Attitude and Students Learning Style, it also be presented in forms of tables, diagram, and descriptive texts.

3.3 Population and Sample

This research was conducted in a public school in Kota Bandung. The school is a Junior High School level located in East Region of Kota Bandung. The school employed Kurikulum 2013 for all grades in their daily teaching and learning process as the main and the only curriculum.

The population was students of "X" Junior High School in Bandung on 2018/2019 academic year, the targeted population was the 9th grade students' of "X" Junior High School in Bandung on 2018/2019 academic year. There were eleven classes with total number of the 9^{th} grade students is 418 students. A simple random sampling was used to determine the sample, the sampling allows each and every member of the population to has an equal and independent chance of being selected (Fraenkel et al., 2013). Thus, the samples are randomly chosen by chose ten students from every class that made the total sample size of 110 students.

3.4 Operational Definition

3.4.1 Scientific Attitude

In this research, Scientific Attitude defined as an attitude that consists of five aspects; rationality, curiosity, open-mindedness, objectivity, and aversion to superstition to be measured.

3.4.2 Learning Style

Learning Style in this research defined as students' preference of the way they processed information. Those ways were analyzed by three sensory receivers, that are; visual, auditory, and kinesthetic.

3.5 Research Instrument

There were two instruments employed in this research. The first one is Scientific Attitude Questionnaire and the second one is VAK Learning Style Inventory. Those instruments were employed to profile the level of Students' Scientific Attitude and to profile the profile of Students' Learning Style.

3.5.1 Scientific Attitude Questionnaire

To answer the first research question: "How to design the measurement of Students' Scientific Attitude?" the research was breakdown into processes of developing the Scientific Attitude Questionnaire. The processes were summed up in Figure 3.1.

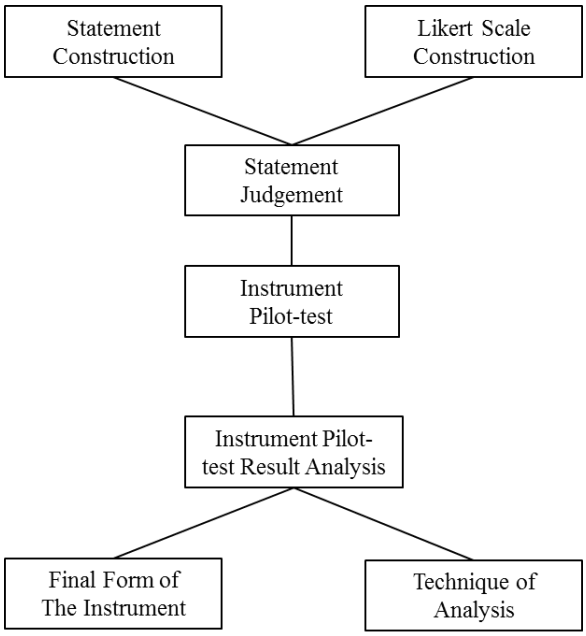


Figure 3. 1 The Processes occur in the Development of Scientific Attitude Questionnaire

Scientific Attitude Questionnaire is an instrument applied in this research which purpose is to profile the level of Students' Scientific Attitude in "X" Junior High School in Bandung. The questionnaire was developed in order to make an instrument that is suitable with the characteristics of the sample. As seen in Figure 3.1 that there are seven processes occur in the development of

Scientific Attitude Questionnaire. Those processes were broke down into descriptive texts below.

3.5.1.1 Statement Construction

In developing the Scientific Attitude Questionnaire, several references were taken from several prior instruments used in other researches regarding the measurement of scientific attitude. There were several experts who developed various instruments to measure scientific attitude; Scientific Attitude Questionnaire by Pitafi & Farooq (2012), Scientific Attitude Questionnaire by Kim, Yang, and Park (in Yoon, Woo, Treagust, & Chandrasegaran, 2015), Inventory of Scientific Attitude by Moore & Sutman (1970), The Scientific Attitude Scale by Billeh & Zakhariades (1975), The Scientific Attitude Inventory by Moore & Foy (1997), and Inventory of Scientific Attitude by Ataha & Ogumogu (2013). The characteristics of each instrument use to measure Scientific Attitude are described in Table 3.1.

Table 3.1

Aspects of Existed Scientific Attitude Measurement that not suited The Characteristics of The Research Subject

Measurement	Aspects	Weaknesses	Needs
Scientific Attitude Questionnaire by Pitafi & Farooq (2012) – 40 items	1) Curiosity 2) Rationality 3) Willingness to Suspend Judgement 4) Open-mindedness 5) Critical mindedness 6) Objectivity 7) Honesty 8) Humility	1) The questionnaire is written in English 2) Can't be used to determine the level of Students' Scientific Attitude 3) Some aspects can be merge into one complex aspect	1) An instrument that is written in the research subject mother tongue – Bahasa Indonesia 2) Able to measure the level of Students' Scientific Attitude in daily activities 3) Suitable to the characteristics of Junior High School Students as the research subject 4) Able to measure specific aspects
Scientific Attitude Questionnaire by Kim, Yang, and Park (1988) – 20 items	1) Curiosity 2) Open-mindedness 3) Critical-mindedness 4) Cooperation 5) Voluntaries 6) Endurance 7) Creativity	1) Originally written in Korean 2) Can't be used to determine the level of Students' Scientific Attitude 3) Using 5-scale Likert Scale 4) Administered for college students 5) Specifically	

Measurement	Aspects	Weaknesses	Needs
		measuring Students' Scientific Attitude in experimental activity	of Scientific Attitude 5) Statements are suitable with current condition of science and technology development
Inventory of Scientific Attitude by Moore & Sutman (1970) – 60 items	1) Positive intellectual 2) Negative intellectual 3) Positive emotional 4) Negative emotional	1) Written in English 2) Administered to High School Students 3) Aspects are too broad 4) Can't be used to determine the level of Students' Scientific Attitude	
The Scientific Attitude Scale by Billeh & Zakhariades (1975) – 36 items	1) Rationality 2) Curiosity 3) Open-mindedness 4) Aversion to superstition 5) Objectivity-intellectual honesty 6) Suspended judgement	1) Written in English 2) Administered to High School Students 3) Can't be used to determine Students' Scientific Attitude	
The Scientific Attitude Inventory by Moore & Foy (1997) – 40 items	1) Positive intellectual 2) Negative intellectual 3) Positive emotional 4) Negative emotional	1) Written in English 2) Administered to High School Students 3) Aspects are too broad 4) Can't be use to determine the level of Students' Scientific Attitude	
Inventory of Scientific Attitude by Ataha & Ogumogu (2013) – 45 items	1) Rationality 2) Curiosity 3) Open-mindedness 4) Aversion to superstition 5) objectivity	1) Written in English 2) Administered to High School Students	

(Source: Ataha & Ogumogu, 2013; Billeh & Zakhariades, 1975; Moore & Foy, 1997; Moore & Sutman, 1970; Pitafi & Farooq, 2012; Yoon et al., 2015)

Table 3.1 has informed that there are aspects and weaknesses that don't fit the needs of this research. Thus a decision was made to referred to Inventory of Scientific Attitude by Ataha & Ogumogu (2013) that is a slight modification from Emina's (1986) as the main reference for developing more suitable Scientific Attitude Questionnaire. Emina's (in Ataha & Ogumogu, 2013) concept of scientific attitude has five aspects; rationality, curiosity, open-mindedness, aversion to superstition, and objectivity, with several indicators constructing each aspect. In each indicators, there were constructed around three to five statements that made the total first statements made was 65 amount of statements. This first statements of Scientific Attitude Questionnaire is attached in Appendix A.1.

Those first 65 statements of Scientific Attitude Questionnaire were constructed based on indicators in each aspect. Each aspect consists of more than one indicator, and each indicator will be represented through 3 to 5 statements. The composition of the statements is drawn in Table 3.2.

Table 3.2

Statements Composition of the First 65 Statement of Scientific Attitude Questionnaire

No.	Aspects	Indicators	Statement Number
1	Rationality	Commitment to rationality in problem solving	1, 2, 3
		Seeking for natural causes of events and identification of cause and effect relationship	4, 5, 6
		Belief in science as means of influencing environment	7, 8, 9
		Awareness of fallibility of human effort	10, 11, 12
2	Curiosity	Challenge of authority	13, 14, 15, 16, 17
		Desire for new knowledge or ideas	18, 19, 20, 21, 22
		Desire for additional information	23, 24, 25, 26
		Seeking for evidence to support conclusions made from scientific materials	27, 28, 29, 30
		Expression of interest in scientific discoveries	31, 32, 33, 34
		Desire of explanations	35, 36, 37
3	Open-mindedness	Willingness to subject data and opinion to criticism and evaluation to others	38, 39, 40, 41, 42
		Willingness to consider new evidence	43, 44, 45
		Rejection of singular and rigid approach to	46, 47, 48, 49

No.	Aspects	Indicators	Statement Number
		people, things, and ideas	
4	Aversion to superstition	Rejection of superstitious beliefs	50, 51, 52, 53
		Preference for scientific explanations	54, 55, 56
		Preference for statements supported by evidence over unsupported ones	57, 58, 59
5	Objectivity	Sensitivity to accuracy of data	60, 61, 62
		Preference for scientific generalization that have withstood the rest of critical reviews	63, 64, 65

As seen in Table 3.2 that there are always more than one statement represent an indicator, the reason is because of the possibility that one or two statements from each indicator is not valid, thus the statement might be completely remove or need to be modified later on.

3.5.1.2 Likert Scale Construction

The Scientific Attitude Questionnaire applied in this research was measured by a Likert scale. Likert scale is a common measurement scale in educational research (Creswell, 2012). The scale was written in number 1 to 4 and each number refer to degree of favor from strongly disagree to strongly agree, respectively.

Table 3.3

Likert Scale of Scientific Attitude Questionnaire

Scale	Criterion	Point
1	Strongly Disagree	1
2	Disagree	2
3	Agree	3
4	Strongly Agree	4

Table 3.3 explains that each scale is representing a criterion and also gain a value of Scientific Attitude point; scale 1 means that student is strongly disagree towards the statement and gain 1 point from his/her choice. A four-scale Likert scale was chosen to avoid neutral statement that might cause several disadvantages towards the final result analyses.

3.5.1.3 Statement Judgement

To be able to determine whether the first 65 statements of Scientific Attitude Questionnaire is already been suitable for Junior High School or not, there is a need for the questionnaire being given different

point of view from some experts. There are two experts joined in this judgement, both have background in education, specifically science education. The first 65 statements of Scientific Attitude Questionnaire addressed to both experts directly, along with the purpose and instruction of statement judgement. Those are attached in Appendix A.2.

Results of the judgement from both experts are consists of grammatical error, contextual aspect, and needs for more information.

Table 3.4

Statements Revision from Expert Judgement

Revision	Statement Number
Contextual aspects	1, 7, 9, 19, 20, 21,
Needs for more information	25, 26, 27, 38, 43, 46,
Grammatical error	45

There are needs of revision toward contextual aspects in several statement number as shown Table 3.4, the experts are asking for more scientific context to be included in the statement because the statement was too general that it can be used in non-scientific field of attitude. While the revision toward needs for more information means that the experts are asking for more specification in the statement, due to insignificant statement for the word “something” or “some” without significant object or subject in the statement. For revision towards grammatical error, the experts are asking for a proper structure of tenses. Details are presented in instrument judgement attached in Appendix A.4.

3.5.1.4 Instrument Pilot-test

The purpose of pilot-test the Scientific Attitude Questionnaire is to make sure that the instrument is ready to be applied to the real research sample. This pilot-test stage of the first 65 statements of Scientific Attitude Questionnaire was addressed to 30 students of independent junior high school. The questionnaire was given them through an online platform called typeform.com. The link for Scientific Attitude Questionnaire was: https://nabilah8.typeform.com/to/OgIqNA. Before the students went to the statements of Scientific Attitude Questionnaire, they need to fill some personal data asked in the questionnaire. Those personal data are

including; name, gender, school origin, grade, and parents' educational background. The data collected were also determined the research sample.

The result obtained from pilot-testing the first 65 statements of Scientific Attitude Questionnaire were then downloaded from typeform.com to Microsoft Excel software. Later, the data were moved to IBM SPSS software to analyze the validity and reliability of the questionnaire. Inter-item correlation analysis in SPSS Software was applied to analyze the correlation between each statement. Statements with inter-item correlation closer to 0 were determined to be removed. There were in total of 20 statements removed as their inter-item correlation value was tending to close to 0.

Table 3.5

Removed Statements from the First 65 Statements of Scientific Attitude Questionnaire

No.	Aspects	Indicators	Removed Statements Number
1.	Rationality	Commitment to rationality in problem solving	1
		Seeking for natural causes of events and identification of cause and effect relationship	4, 6
2.	Curiosity	Belief in science as means of influencing environment	7
		Challenge of authority	17
		Desire for new knowledge or ideas	19
		Desire for additional information	24, 25
		Seeking for evidence to support conclusions made from scientific materials	30
		Expression of interest in scientific discoveries	33
		Desire for explanations	37
3.	Open-mindedness	Willingness to subject data and opinion to criticism and evaluation to others	38, 41
		Rejection of singular rigid approach to people, things, and ideas	48, 49
4.	Aversion to supertition	Rejection of supertitious beliefs	50
		Preference for scientific explanations	54, 56
5	Objectivity	Preference for scientific generalization that have withstood the rest of critical review	63, 64

As shown in Table 3.5 that there are total 20 statements removed as the result of validity in correlation between each statement. Curiosity aspect has the most statements removed (6 statement) and Objectivity aspect has the least statements removed (2 statement). Then, there were 45 statements left to be used as the final form of the Scientific Attitude Questionnaire. Analyses of inter-item correlation are attached in Appendix B.1.

After analyzing the validity of the statements, the Scientific Attitude Questionnaire reliability also need to be measured. Reliability refers to the consistency of the scores gained by an instrument or a consistency of an instrument to be addressed to individuals (Fraenkel et al., 2013). The reliability resulted from 30 students participated in pilot testing stage measured using SPSS software with Cronbach Alpha technique. The reliability coefficient had shown in Table 3.5 shows that the questionnaire has the reliability coefficient of 0.896.

Table 3.6

Reliability Statistics from the Pilot Testing of Scientific Attitude Questionnaire

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.896	.900	65

With .896 value of Cronbach's Alpha reliability coefficient shown in Table 3.6, it can be concluded that the Scientific Attitude Questionnaire has gained its consistency, because the value of Cronbach's Alpha considered as low when the coefficient shows the value below 0.70. Analysis of Cronbach's Alpha Coefficient in IBM SPSS software is attached in Appendix B.2.

3.5.1.5 Final form of The Scientific Attitude Questionnaire

After pilot-tested the questionnaire, there were 20 statements removed from the questionnaire, resulting a final form of the questionnaire. The final form of the questionnaire consists of 45 statements, with four-scale

Likert scale. The composition of statements in each dimension has described in Table 3.7.

Table 3.7

Items of Scientific Attitude Questionnaire

No.	Dimension	Number of statements
1	Rationality	11
2	Curiosity	15
3	Open-mindedness	8
4	Aversion to Superstition	5
5	Objectivity	6
	Total	45

Table 3.7 shows the total statements being included in the final form of the Scientific Attitude Questionnaire. Curiosity aspect has the largest number of statements because the aspect consists of more indicators than other aspect. Also Aversion to Superstition aspect has the smallest number of statements because the aspect consists of only two indicators. Each statement is paired with a four-scale Likert scale.

3.5.1.6 Technique of Analysis

To obtain result from the Scientific Attitude Questionnaire and analyzed the profile of Students' Scientific Attitude, accumulation of the point gained by the students was needed. Students who had answered all 45 statements in Scientific Attitude Questionnaire gained the minimum point of 45 and the maximum point of 180. The range of the point presented in Table 3.8.

Table 3.8

Range of Students' Scientific Attitude Point and its Level

Range	Level
150 – 200	High
100 – 149	Average
50 – 99	Low

(Source: Ataha & Ogumogu, 2013)

The range written in Table 3.8 is the range of point gained by students when they finished answering all the 45 statements in Scientific Attitude Questionnaire. For example, if a student gained 132 points from all the statement he/she answered from the questionnaire, he/she will be profiled as having average Scientific Attitude Level.

3.5.2 VAK Learning Style Inventory

The VAK Learning Style Inventory employed in this research was the VAK Learning Style Inventory developed by Victoria Chislett and Alan Chapman in 2005. This VAK Learning Style Inventory was constructed by 30 statements with multiple choices. Each statement had three different choices that each choice was representing a sensory receiver.

Table 3.9
Example of Choices in VAK Learning Style Inventory
that Represent Each Sensory Receiver

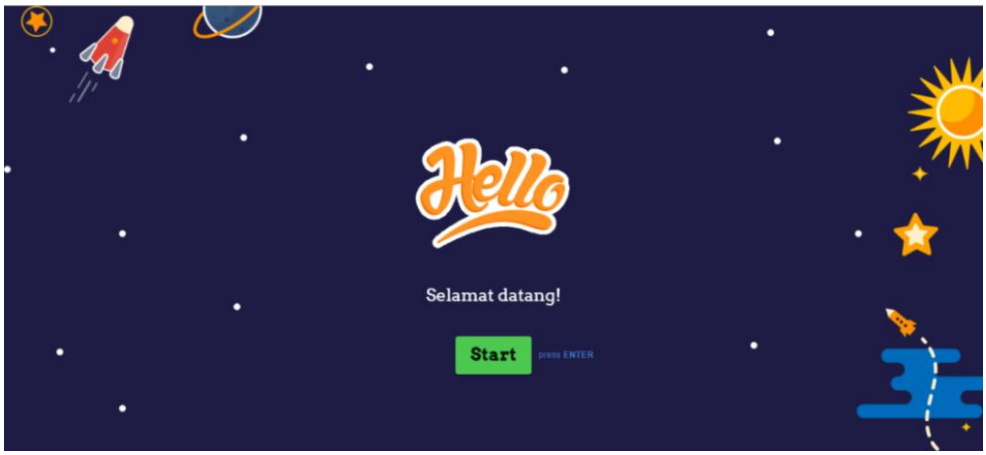
No.	Statement	Choice	Sensory Receiver
1.	When I operate new equipment I generally:	a. Read the instruction first	Visual
		b. Listen to an explanation from someone who has used it before	Auditory
		c. Go ahead and have a go, I can figure it out as I use it	Kinesthetic

Table 3.9 explains that choice 'a. Read the instruction first' is representing visual sensory receiver by it statements that 'reading' as the chosen word in the statement. While choice 'b.' represents auditory sensory receiver as the word 'listen' applied in the statement, and choice 'c.' represents visual sensory receiver as the word 'try' applied in the statement. Those choices are always representing one sensory receiver; 'a.' for visual sensory receiver, 'b.' for auditory sensory receiver, and 'c.' for kinesthetic sensory receiver.

3.6 Data Collection

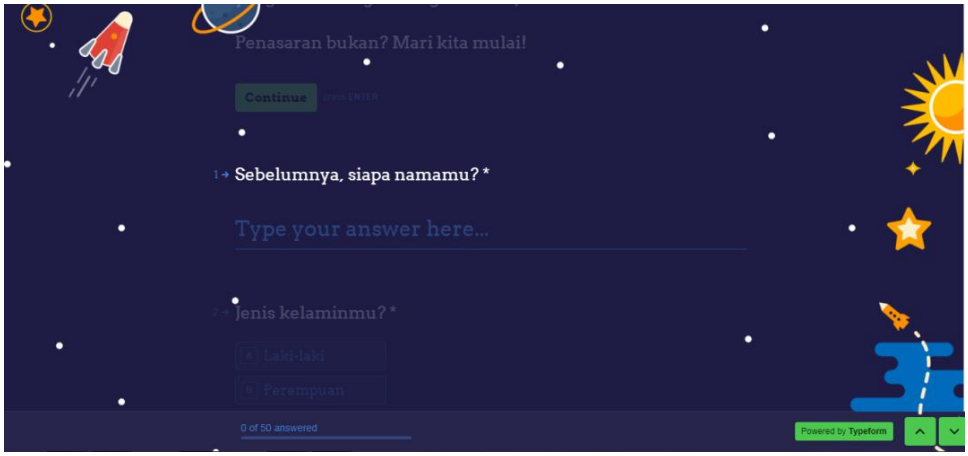
Scientific Attitude and Learning Style data of students in "X" Junior High School in Bandung were collected through two questionnaires that were in online form. Each questionnaire consists of two sections, the first one was personal data section and the second one was the main questionnaire.

The Scientific Attitude Questionnaire addressed to the students was the one that has been back translated to Bahasa Indonesia. Students were accessed the questionnaire in an online form, they visited the link: https://nabilah8.typeform.com/to/V0lOfO to fill the Scientific Attitude Questionnaire. Figure 3.1 displays the online form of the Scientific Attitude Questionnaire.



(a)

(b)



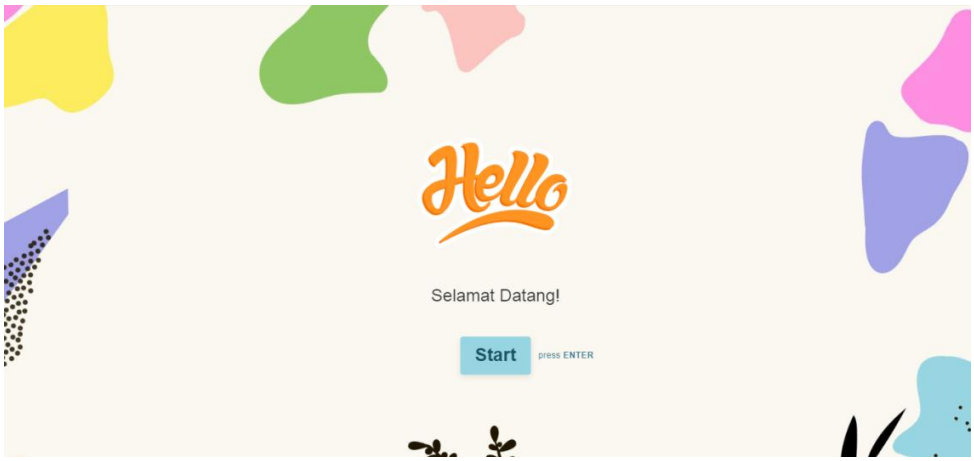
(c)

(d)

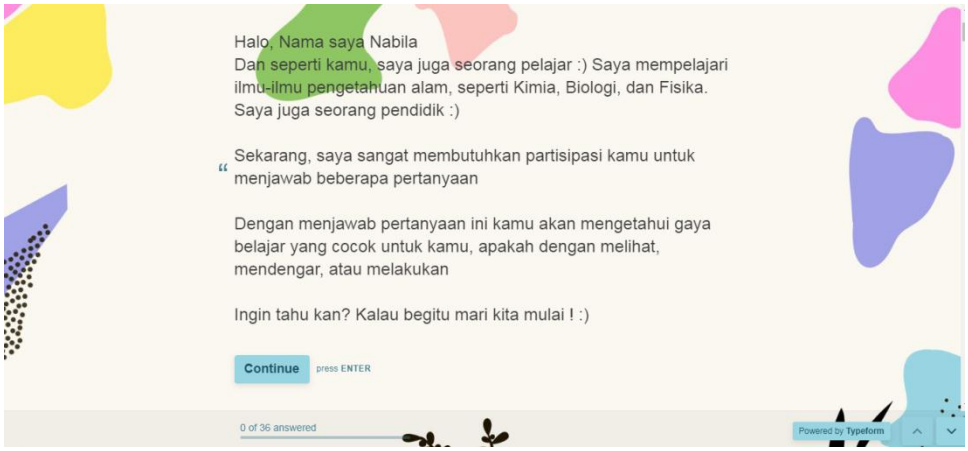
Figure 3. 2 (a) First page of the online form, (b) introduction to students' in Bahasa Indonesia, (c) question example for students' demographic, (d) question of the Scientific Attitude Questionnaire in Bahasa Indonesia

Figure 3.1 displays the design of Scientific Attitude Questionnaire in online form. Figure 3.1 (a) was the first page to enter the whole body of the questionnaire, after clicked the "start" button, students were directed into second pages (Figure 3.1 (b)) as awareness that it was their second questionnaire to be filled – the first one was the VAK Learning Style Inventory. Figure 3.1 (c) displays example of personal questions that students need to answer, the questions include; name, class, gender, and

parents' educational background. Figure 3.1 (d) was the main part of the questionnaire, where later, students were continued to fill until number 45.



(a)



(b)

(c)

(d)

Figure 3. 3 (a) First page of the online form, (b) introduction to students' in Bahasa Indonesia, (c) question example for students' demographic, (d) question of the VAK Learning Style in Bahasa Indonesia

Figure 3.2 displays the online form of VAK Learning Style Inventory in Bahasa Indonesia. VAK Learning Style Inventory was the first questionnaire given to the students. Figure 3.2 (a) was the first page of the online form. Figure 3.2 (b) was the second page or introduction page where the identity of the research explained. Figure 3.2 (c) was the example of personal questions asked to the students, the questions were include; name, gender, grade, parents' educational background, and e-mail address. Students were accessed this link to fill the VAK Learning Style Inventory: https://nabilah8.typeform.com/to/wVwuyx.

3.7 Data Analysis Technique

In order to produce result from the instrument, it needs to analyze the collected data from both questionnaires. Each questionnaire has different technique to be analyzed. The techniques are described below.

3.7.1 Scientific Attitude Questionnaire

To obtain result from the Scientific Attitude Questionnaire and analyzed the profile of Students' Scientific Attitude, points gained by the students first needs to be accumulate. Students who have answered all 45

statements in Scientific Attitude Questionnaire will gain the minimum point of 45 and the maximum point of 180. The range of the point presented in Table 3.10.

Table 3.10

Range of Students' Scientific Attitude Point and Its Level

Range	Level
150 – 200	High
100 – 149	Average
50 – 99	Low

(Source: Ataha & Ogumogu, 2013)

The range written in Table 3.10 is the range of point gained by students when they finished answering all the 45 statements in Scientific Attitude Questionnaire. For example, if a student gained 132 points from all the statement he/she answered from the questionnaire, he/she will be profiled as having average Scientific Attitude Level.

3.7.2 VAK Learning Style Inventory

To be able to analyze the profile of Students' Learning Style, all of the choices made by students need to be summed up. After answering all the 30 statements of VAK Learning Style Inventory, students who have mostly choose a. b. or c. choice will be analyzed. If a student choices are mostly a. means that the student has Visual Learning Style, if a student choices are mostly b. means that the student has Auditory Learning Style, and is a student choices are mostly c. means that the student has Kinesthetic Learning Style. The interpretation displayed in Table 3.11.

Table 3.11

Analysis and Interpretation of Students' Answers in VAK Learning Style Inventory

Students' Answers	Interpretation
Mostly 'a'	Visual Learner
Mostly 'b'	Auditory Learner
Mostly 'c,	Kinesthetic Learner

3.7.3 The Relationship between Students' Scientific Attitude and Students' Learning Style

In order to analyze the relationship of the two variables, Microsoft Excel and IBM SPSS software were applied to analyze, calculate, and find the possible relationship between the two variables. The Microsoft Excel run to convert raw data gained through online questionnaire, analyze the profile of Students' Scientific Attitude and Students' Learning Style, and also to visualized the data. While IBM SPSS software was run to find the possible relationship between two variables using crosstabs Chi-square technique and Cramer's V value.

The Chi-square technique applied to analyze whether a relationship or association existed between two variables because the data collected through the questionnaire were not a nominal data (King, Rosopa, & Minium, 2011). Scientific Attitude Questionnaire resulted an ordinal data (low, average, high), and VAK Learning Style Inventory resulted categorical data (visual, auditory, kinesthetic). The Cramer's V value was applied in order to determine the power or strength occurs in the relationship between variables (Gravetter & Wallnau, 2009).

3.8 Research Procedures

This research was constructed through a systematical arrangement in three stages; preparation, implementation, and completion stages. The stages were summed up in Figure 3.4. During the preparation stage was where the research start to construct. First step was to determine the research problem into the very specific focus of research variables. Those variables then later be studied through review of literatures in order to construct a research proposal. The research proposal then developed as the basic thinking of the research and also to construct instrument needed to analyze the variable. The research proposal then gained several revisions. The instruments were also judged by experts to gained feedback as wider point of view towards the instrument. Before the instruments were addressed to research sample, they were pilot-tested in order to gain the value of

validity and reliability. The result of pilot-test event was the need to revise several aspects in the instruments.

After the instruments were well constructed, the research samples are more focus determined. The data were then collected from the research sample as the school replied permission letter of the research. The collected data were analyzed and discussed to obtain the result. All of the result then written on the research report.

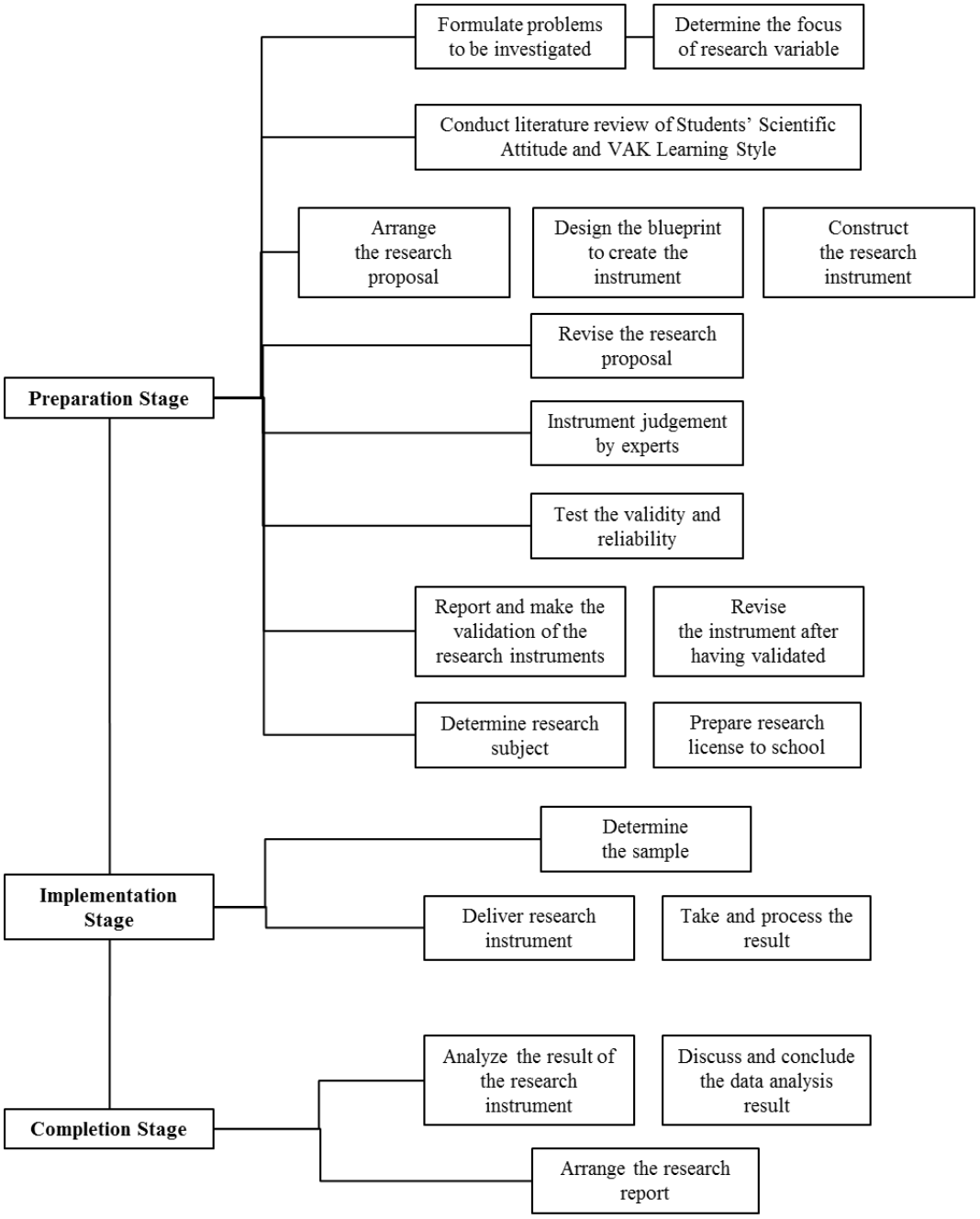


Figure 3. 4 Research Diagram