CHAPTER III
RESEARCH METHODOLOGY

3.1 Research Method and Design

To conduct this study, the researcher requires a specific method and design to achieve the desired result. The use of method and design help the researcher to follow step by step in conducting the research. The method and design of the research are described below:

3.1.1 Research Method

In this research, the improvement of students' scientific literacy was analyzed in learning food additives topic. Based on that purpose, the pre-experimental is used. Pre-experimental is a research method that includes observing a subject or a group after a treatment has been applied to see the treatment has the potential to affect change (Frey, 2018). During the research, the researcher observes a specific group and intervenes (Creswell, 2014). Besides the implementation of ethnoscience, this research aims to investigate the students' scientific literacy before and after learning the food additives topic.

3.1.2 Research Design

One group pretest-posttest was used as a research design. A single group is measured before and after being exposed or giving treatment (Fraenkel, Wallen, & Hyun, 2012). This design involves a group as a subject and the improvement of the treatment given is indicates a good result. The design of this research is shown in Table 3.1. Prior knowledge of students is tested in the pretest. Then the all participants are given treatment which learning food additive topic with an ethnoscience approach. After given treatment, the result of the post-test is analyzed and compared to the pretest's results. The intervention is assumed to be the cause of any changes in the outcome of interest (Frey, 2018). The changes in pre and post-test would be discussed to draw the conclusion.

Table 3.1

One group pre-test post-test design

O	X	O
Pre-test	Treatment	Post-test

Note:

Treatment = Ethnoscience Approach

3.2 Population and Sample

This research has conducted in one of Bandung's private school at 8th grade which used Cambridge Curriculum. The consideration of choosing that school is from the school's annual plan. It means the students in 8th grade haven't learned the food additives topic. The total of students as the sample of this research is 34 students. There are 14 male students and 20 female students. The distribution of participants is shown in Table 3.2. The sample was taken by convenience sampling, a method of collecting data from a nearby population and available to the researcher (Rahi, 2017). So, the sampling is selected the nearest individual to act as respondents and follows the process until the sample has been obtained (Cohen, Manion, & Morrison, 2007).

Table 3.2

The list of participants

Gender	Number of Students	Percentage
Male	14	41.2%
Female	20	58.8%
Total	34	100%

3.3 Operational Definition

The specific limitation of variables and general technique is explained as follows:

a. Ethnoscience Approach

As a learning approach, ethnoscience is used by related the topic to cultural issues. In the food additives topic, traditional food is the suitable content to use ethnoscience approach. Surabi becomes the context for opening the class. Surabi could help students to identify and classify the ingredients contains. Also, another traditional food is discussed during the learning process. This aims to determine how students solve same problem in different object. The use of national news about traditional food is also given to the students.

b. Students' Scientific Literacy

Assessment in students' scientific literacy follows the PISA framework. The results would be process and divide based on two domain that play a role in students such as scientific competence and attitude toward science. The researcher uses 25 multiple choice questions with 4 options to test the students. Blueprint distribution of questions was also provided to determine the level and competence knowledge of the questions. The question is distributed by online form using Google Form for pretest and Nearpod application for posttest. The online form of the question is filled by students and the result is collected in Microsoft Excel. Lastly, the IBM SPSS application is required to analyze the data.

3.4 Hypothesis

The following are the hypotheses that will be tested in this study:

a. H_0: There is no enhancement in students' scientific literacy with the ethnoscience approach in learning food additives.

H_1: There is enhancement in students' scientific literacy with the ethnoscience approach in learning food additives.

3.5 Research Instruments

In this research, instruments are needed to obtain the required data. Science competence and students' attitude toward science can be measured through an instrument. Those two domains become the main

assessment of student's scientific literacy. Even so, all domains are including in the construction of scientific literacy objective test.

3.5.1. Scientific Literacy Objective Test

To answer the research problem, the improvement of student's scientific literacy can be seen by testing students before and after learning. The prior knowledge of students is determined in the result of pretest while the impact of treatment is shown in the post test result. Pretest and post-test became the objective test in this research. The steps of making an objective test are described in Figure 3.1 below.
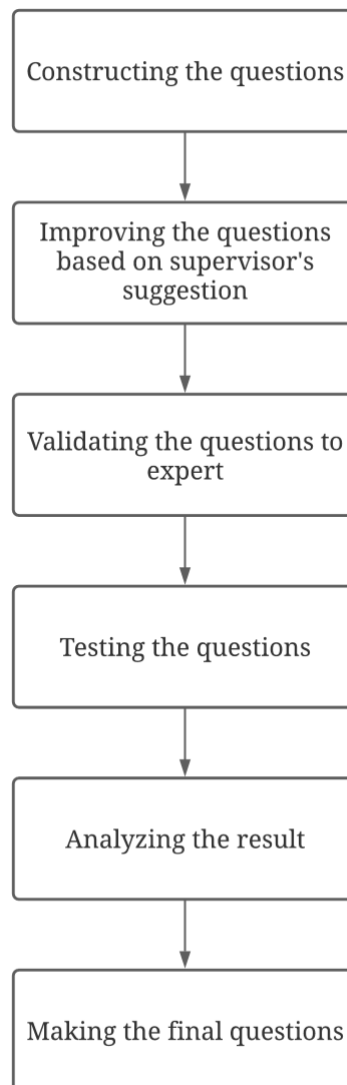

Figure 3.1 The flowchart of the instrument process

In Figure 3.1 displayed six steps of making instrument. Each step describes the development of question. The question follows the Scientific Literacy Test framework according to PISA 2018 which is in line with research purposes. The detail of main object in the scientific literacy test will be presented in the next following section.

a. Blueprint of Scientific Literacy Test

Before making questions, several domains must be adjusted according to the assessment on PISA. There are four domains in scientific literacy test such as competence, knowledge, context, and attitude. All the domains were including in the scientific literacy test. While main discussion in this research is concerned with two domains of scientific literacy, which are Scientific Competence and Attitude toward Science. After learning, students can enrich the scientific knowledge which absorbed and implement the application to their daily life.

First, the food additives topic is analyzed to find out the objective learning. In school annual plan, the food additive topic is already divided into some main idea. Based on that idea, the learning objective is made and the additional idea is added to complete the food additive topic. Some main idea in the school's annual plan is similar with the basic and competence in national curriculum but the school added international issue which is the use of Acceptance Daily Intake (ADI). Then, the distribution of aspect in the blueprint has adjusted to represent each domain. The consideration of the placing one aspect for one to five questions is based on the objective and indicator. The indicator of the learning is stated as sub topic in Table 3.3. The complete question given to the expert for checking the indicator in line with the subtopic. After revision, the researcher takes 30 questions of competence and 6 questions of attitude. The recapitulation of question distribution is shown in Table 3.3.

Table 3.3

The blueprint of the scientific literacy test

Subtopic	Explaining phenomena scientifically			Interpreting data and evidence scientifically			Evaluating and designing scientific inquiry			Attitude	
	C	P	E	C	P	E	C	P	E	I	E
Food additives function	14, 16, 18	-	-	3	-	-	-	-	2, 15, 22	31	32
The effect of food additives	-	27	5	-	-	21	25	-	-	33	34
Choosing safe food	12	20	-	11	-	-	29	-	26	35	36
Natural and synthetic food additives	1, 6, 7, 17, 28	4, 30	-	10	-	-	8, 13, 17, 23	-	9, 19, 24	-	-

The questions that have been made will be judged by experts to see the scope of the questions according to the domain. From the experts' notes, several questions do not match with the indicator and competencies. As in number 2 of the question, the competency aspect is changed from evaluating and designing scientific inquiry to explaining phenomena scientifically. One of the experts asked to change the material into deeper. But, the researcher explains the reason of choosing basic topic. Because in secondary school, students learn food additives to shape student's awareness. Overall, the revision given refers to adjusting the level of questions with several domains. Three experts are very helpful with their suggestions that align with the usefulness of the test item. After revised the test item based on experts' suggestions, the test item is tested on the students at grade 8th in the different school from the subject. The test in different school is helped the researcher to analyze questions. The online form is used in the testing test item due to pandemic conditions. So, the

researcher ask teacher to distributed the link of Google Form to the students who have learn food additive topic.

b. **The Analysis of Scientific Literacy Test on Competency**

The result from the test item's testing is analyzed using IBM SPSS to find out the validity, reliability, difficulty level, difference power. The purpose of the validity test is to determine how well the instrument is suited to be tested (Martina et al., 2020). The correlation between the score is presented in the validity test. Then, the analysis shows the reliability score of the test item in the Cronbach's Alpha result. The Cronbach's alpha result is 0.795 which includes acceptance reliability (Heale & Twycross, 2015). The analysis of 30 questions in scientific literacy on competence is presented in Table 3.4.

Table 3.4

Recapitulation of scientific literacy test on competence

Question	Pearson Correlation	Sig. (2-tailed)	Mean	Validity	Difficulty Level	Difference Power	Decision
1	0.301	0.113	0.69	INVALID	Medium	Enough	Revised
2	0.438	0.017	0.34	VALID	Medium	Good	Accepted
3	0.471	0.010	0.41	VALID	Medium	Good	Accepted
4	0.168	0.382	0.83	INVALID	Medium	Bad	Rejected
5	0.551	0.002	0.59	VALID	Medium	Good	Accepted
6	0.459	0.012	0.83	VALID	Easy	Good	Accepted
7	0.314	0.098	0.41	INVALID	Medium	Enough	Revised
8	0.550	0.002	0.48	VALID	Medium	Good	Accepted
9	0.696	0.000	0.34	VALID	Medium	Good	Accepted
10	0.655	0.000	0.72	VALID	Easy	Good	Accepted
11	0.283	0.136	0.28	INVALID	Difficult	Enough	Revised
12	0.570	0.001	0.62	VALID	Medium	Good	Accepted
13	0.292	0.125	0.48	INVALID	Medium	Enough	Revised
14	0.159	0.411	0.21	INVALID	Difficult	Bad	Rejected
15	0.163	0.400	0.48	INVALID	Medium	Bad	Rejected

16	0.156	0.421	0.14	INVALID	Difficult	Bad	Rejected
17	0.328	0.082	0.59	INVALID	Medium	Enough	Revised
18	0.490	0.007	0.45	VALID	Medium	Good	Accepted
19	0.295	0.120	0.45	INVALID	Medium	Enough	Rejected
20	0.066	0.732	0.59	INVALID	Medium	Bad	Rejected
21	0.119	0.539	0.59	INVALID	Medium	Bad	Revised
22	0.749	0.000	0.45	VALID	Medium	Excellent	Accepted
23	0.439	0.017	0.31	VALID	Medium	Good	Accepted
24	0.471	0.010	0.28	VALID	Difficult	Good	Accepted
25	0.143	0.459	0.41	INVALID	Medium	Bad	Revised
26	0.675	0.000	0.66	VALID	Medium	Good	Accepted
27	0.243	0.203	0.31	INVALID	Medium	Enough	Revised
28	0.444	0.016	0.52	VALID	Medium	Good	Accepted
29	0.161	0.404	0.38	INVALID	Medium	Bad	Rejected
30	0.465	0.011	0.34	VALID	Medium	Good	Accepted

The valid question consists of 15 questions which means the questions are accepted. In 15 questions, it has represented each category on difficulty level even most of the question in the medium category. For difference power, the acceptance questions have good distractor and one from 15 is excellent. Meanwhile, to construct good test item which represent the scientific literacy aspects, 5 questions which is not valid have to be revised. So, the total of the scientific literacy test consisted of 20 questions. The revision is considered to experts' suggestions and the distribution of several aspects on the question. Because, the distribution of the aspect would influence the interpretation of scientific literacy result. Additionally, some students didn't get the point of the question become the factor of invalid questions. Another factor is the multiple-choice answer which constructed too easy or too hard. To overcome those factors, changing the main question and the multiple-choice answer are the way of the

question's revision. The final test item for competence is used 20 multiple choices as presented in the Table. 3.5

Table 3.5

The blueprint of final scientific literacy test on competence

Subtopic	Explaining phenomena scientifically			Interpreting data and evidence scientifically			Evaluating and designing scientific inquiry		
	C	P	E	C	P	E	C	P	E
Food additives function	11	-	1	2	-	-	-	-	13
The effect of food additives	-	18	3	-	-	12	16	-	-
Choosing safe food	10	-	17	9	-	-	-	-	-
Natural and synthetic food additives	4, 5, 14, 19	20	7, 15	8	-	-	6	-	-

c. **The Analysis of Scientific Literacy Test on Attitude**

In attitude questions, the form of multiple-choice is different from the competence's question. The choice is determined by their opinion of the problem asked. Four scales to reflect their attitude is used such as strongly agree, agree, disagree, and strongly disagree. It is commonly known as the Likert scale. So, the scale would present as number 1 for strongly disagree to 4 for strongly agree. To do validity on this test item, Pearson product-moment is used. Pearson r is designed for use with interval or ratio data (Fraenkel, Wallen, and Hyun, 2012). Because the participants who filled the test are 29 students, the r table is 0.367 with 5% significant value. The result of

the r value would compare to the r table. To calculate r value, the spreadsheet application is helped to count it. In table 3.6 shows the result of the calculation and analysis.

Table 3.6

Recapitulation of scientific literacy test on attitude

Question	r value	r table	Indication	Decision
1	0.294	0.367	INVALID	Revised
2	0.505	0.367	VALID	Accepted
3	0.256	0.367	INVALID	Rejected
4	0.463	0.367	VALID	Accepted
5	0.410	0.367	VALID	Accepted
6	0.664	0.367	VALID	Accepted

From the 6 question, there are two invalid question. The final test only takes 5 questions which already present each aspect in attitude toward science. To overcome this, only one question has been considered the r value and plan to be revised. Experts' opinions also ask to revise question number 1 because the greater of r value. So, question number one is revised by changing he social issue and got the final attitude questions.

3.5.2 Analysis Technique

Data on students' scientific literacy is collected through online forms. Because in this research, scientific literacy focuses on two domain which is scientific knowledge and attitude toward science, the form of the question is different for each domain. The competence domain used multiple choice question with 4 different answer while the attitude used 4 different answers to indicates the level. Even though the distribution in the online form is combined, but the score has a different analysis.

For the competence test, students who answer the question correctly will get 1 point. If the students answer correctly for all questions, they will get 20 points and then times to 5 so the score is 100. Besides the final score, the analysis of questions wrong can determine the difficulties of

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students in the specific aspect. If most students are wrong in question number 5, it means they still lack on certain aspects. Because each question has a different science proficiency level that reflects the assessment of students' scientific literacy. After the data collected, IBM SPSS is used to analyze the normality of data. If the data was distributed normally, the next process is analyze using Paired Sample T-Test. For further analysis, N-Gain is used to categorize the level of students' scientific literacy on competence domain.

On the attitude test, students just choose based on their opinion without telling the reason behind it. The result of it will be present in diagram and it will not be calculated in the final score. Because the aims to analyze how the students' attitude toward some social science issue in that question. After the data obtained, the researcher has collected to the spreadsheet and processed the diagram for each question. Then, data were described and showed the factor of the different opinions from the students and analyze how the student's attitude on scientific literacy.

3.6 Research Procedure

There are three stages in the research procedure which apply by the research. The research procedure aims to describe the activity systematically. The three stages include preparation, implementation, and completion stage which explain as follow:

3.6.1 Preparation Stage

In the preparation stage, the researcher focuses on defining the problem and finding more references. The activity in the preparation stage is explained below:

a. Determining the research problem and finishing the title of the research.

b. Finding many studies as literature review which have the same variable such as about ethnoscience approach, students' scientific literacy, and chemistry learning. The form of literature mostly from article or journal, but there is some book also to strengthen the argument.

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c. Making objective test as the research instrument. The test item about food additives is constructed.

d. Validating the final test item to the expert judgment and then testing it to the students who have learned the food additives topic.

e. Analyzing and making revisions on the test item based on the experts' notes and student's results. After that, the final question can be used in the next stage.

3.6.2 Implementation Stage

Due to the pandemic situation, the learning process is conducted online. Zoom meeting and WhatsApp group is the main application for the learning process. The detail activity is described as follows:

a. Making the lesson plan for three meeting.

b. Filling the pre-test to know the prior knowledge of students in the first meeting.

c. Applying the approach in the class for second meeting.

d. Distributing the link for post-test in third meeting.

e. Collecting all data to the spreadsheet.

3.6.3 Completion Stage

After the data is collected, the analysis of the result is included in this stage as shown below:

a. Analyzing the data collection.

b. Describing and discussing with the supervisor for the result.

c. Drawing the conclusion for completing the research paper.

d. Finishing the research paper to be reported.

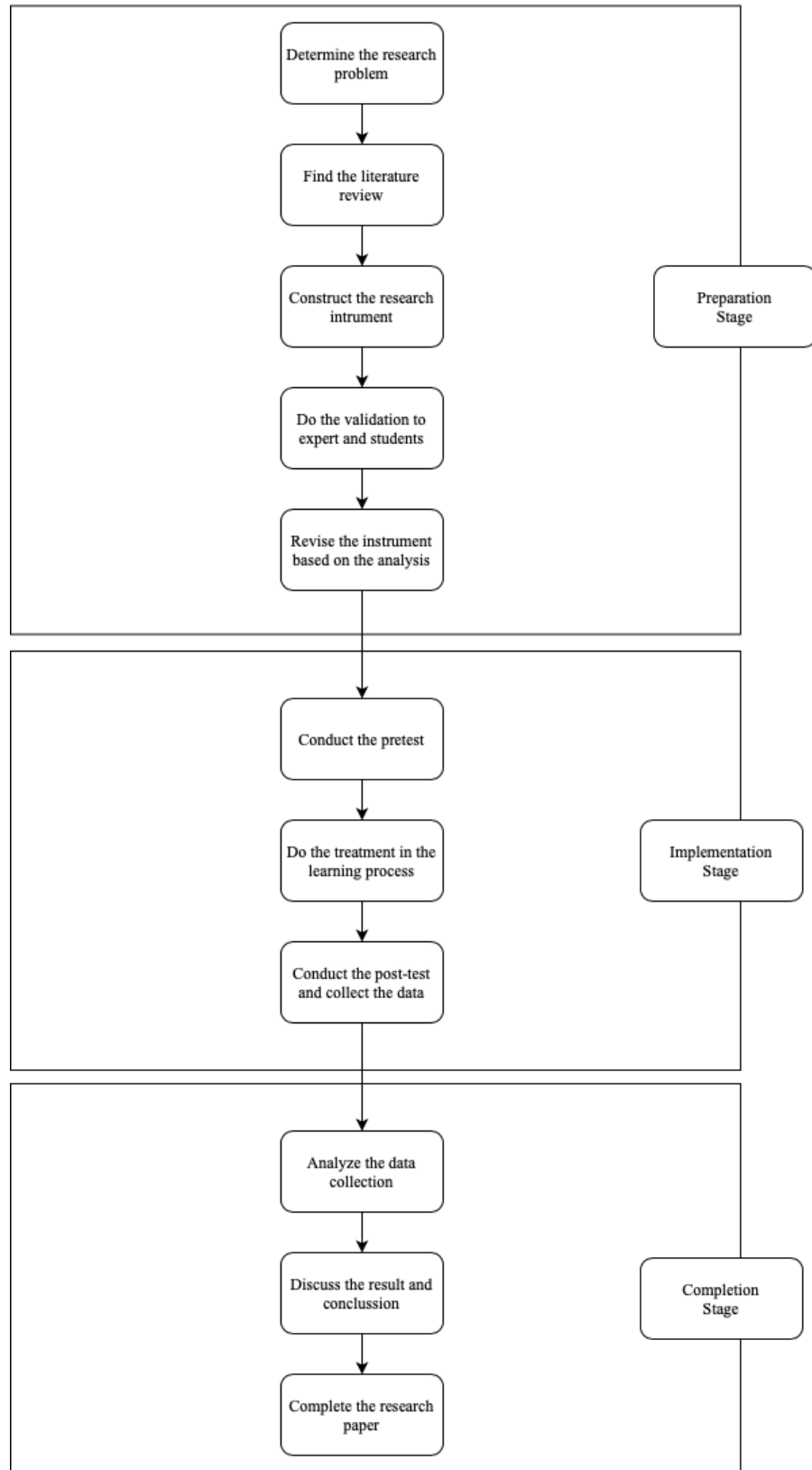### 3.6.4 Flowchart

A flowchart is made to summarize the whole process of the research.

Figure 3.2 The flowchart of the research procedure