CHAPTER III
RESEARCH METHODOLOGY

3.1 Research Method

This study was using Quantitative research. According to Creswell (2012), one of the characteristics of the quantitative research is collecting numeric data from a large number of people by using the instrument with a preset question. This quantitative method was using a quasi-experiment type. In quasi-experiments, the researcher cannot artificially create groups for the experiments so researcher uses the group (class) that the school already arranged to take data (Fraenkel, Wallen, & Hyun, 2012). The dependent variable of this study was students' scientific and information literacy while the Project in Problem-Based Learning is the independent variable. This method was appropriate for the purpose of the study which was to investigate the influence of a Project in Problem Based Learning on students' scientific and information literacy in learning the human excretory system.

3.2 Research Design

A non-randomized group pre-test-post-test design was used for this study. According to Creswell (2012), the study can apply pre-test and post-test design when using a quasi-experiment as the method. The classes were randomly assigned to the experimental and control group. By using this design, both the control and experimental group will have pretest and posttest but the only experimental group will have treatment activities (see Figure 3.1). This study will conduct the same pretest to the control and experimental group with the same preset questions. Then, the experimental group will have an article project as the treatment and get a module of information literacy, while control group only have a regular problem based learning without any project and doesn't have a module. The Project in Problem-based learning was implemented in two weekly lessons of 5 hours each. In the first

meeting, both groups conducted the learning topic with different treatment. The experimental group get a module of information literacy and completing a

worksheet of Problem-based learning (Appendix A.2). The control group was having a direct instruction of information literacy such as how to find a reliable source related to the worksheet that they would like to complete. The lesson was given on a weekly basis in the period of March 2018. In the second meeting, the experimental group got a project to create an article about human excretory system. So, they were pretended to be a health care of society who wants to explain about human excretory system. In explaining the human excretory system, they need to create an article. Besides, the control group was discussing with their group to make a summary of human excretory diseases and how to prevent it. Pre-test data on scientific and information literacy multiple-choice questions were collected before the students learn about the human excretory system topic. Post-test data on the same variables were collected a month later, right after the intervention. Data were collected and analyzed by using the Independent T-test on SPSS software.

Treatment group	*M*	*O*	*X*	*O*
Control group	*M*	*O*	*C*	*O*

Figure 3.1 The Matching-Only Pretest-Posttest Control Group Design
*(*Source: Fraenkel, Wallen, & Hyun, 2012*)*

Based on Figure 3.1 above, both the control and treatment group subjects have been matched. The M in this design means that both groups have the same start point or the equivalent level of achievement. This was proven by the p-value on the pre-achievement test in both scientific and information literacy which showed a p-value > 0.05. Then, after the subjects had been matched, they have conducted the same pre-test. The subjects in the treatment group were conducting the human excretory system by using PBL model with a project at the end of the class meeting. Project in Problem-based learning refers to the article about a human excretory system which they sought the information freely on many resources. The students were guided by the module of information literacy made by the teacher. In another hand, the control group was conducting the learning with the PBL model without a Project at the end of the class meeting. Instead of taught by PBL model,

students in the control group were also got the direct instruction about the information literacy.

3.3 Population and Sample

The population were 8th-grade students attending the one of private secondary school, located in the city of Bandung, comprising 110 students in 5 classes. The school works on the basis of the *Kurikulum* [Curriculum] 2013 developed by Indonesia Ministry of Education and Culture. The samples were two classes of 8th grade. The experimental group consisted of 24 students and the control group consisted of 26 students. The students who were following the treatment from the beginning to the end were only 19 students in experimental class and 20 students in control class. The sampling technique used was purposive sampling because the researcher needs two classes with the same average score in science since the research is using quasi-experiment.

3.4 Operational Definition

In order to avoid misconception about this research, some operational definitions are explained in this research. This terminology is explained below:

1) Project in problem-based learning is Problem-Based learning in which at the end of the study, students will have a project that requires information resources such as an article. The instructional process itself following the 5 steps of Problem-based learning, they are (i) ideas (considering the problem); (ii) known facts (defining the problem); (iii) learning issues; (iv) action plan, and (v) evaluate. The PBL instructional process will be observed and assessed by the observational sheet.
2) Scientific literacy is the ability to understand scientific processes and to engage meaningfully with scientific information available in daily life (Fives, Huebner, Birnbaum, & Nicolich, 2014). The scientific literacy has four domain which are context, knowledge, competencies, and attitude. The knowledge, competencies, and attitude that used was in the context of human excretory system. The

scientific literacy was assessed by multiple choice in 8th grade of junior high school area.

3) Information literacy is information literacy is a critical set of competencies to find, use, manage, and communicate information effectively and efficiently for specific purposes (Igwe, Emezie, & Uzuegbu, 2014). Since the subject of the study was junior high school students, so the information literacy that was delivered was just about how to locate the information effectively and legally. The information literacy was assessed by multiple choice.
4) The human excretory system is one of science subject that available in 8th grade of Junior High School. The topic tends to Biology subject and not integrated with another science topic. The subtopics that will be taught during the research are the structure and function of the human excretory system, the mechanism of excretion system in every organ, the human excretory system disease, and the way to maintain the health of the human excretory system. This topic becomes a limitation for scientific and information literacy which will be assessed by multiple choice.

3.5 Assumption

The assumptions as the foundation of this study as follow:

1) Project in Problem-based learning is a student-centered active learning which means the learning process will involve the students' participation. Through this involvement, students will be more engaged in the topic being taught and they will give more attention. This condition assumes Project in PBL is able to increase students' achievement.
2) Project in Problem-based learning uses the problem as the key in the learning process. As the problem solved and article is completed, students will also collect the knowledge related to the topic. This will help students to minimalize the concept of memorization since they find the knowledge by themselves and increase their achievement in scientific literacy.

3) Project in Problem-based learning requires many resources to solve the problem. From the various information provided in those resources, students should be information literate to be able to locate, select, and evaluate the appropriate information to be used as the answer to the problem. As the information needs also vary, students' information literacy will be increased.

3.6 Hypothesis

This study aims to measure two variables which were scientific and information literacy. So, the hypothesis was divided into two, they are:

3.6.1 Scientific Literacy Hypothesis

The hypothesis of scientific literacy that is tested in this study are as follow:

H_0 : There is no significant difference in students' scientific literacy in learning the human excretory system between the experiment and control class.

H_1 : There is a significant difference in students' scientific literacy in learning the human excretory system between the experiment and control class.

3.6.2 Information Literacy Hypothesis

The hypothesis of information literacy that is tested in this study are as follow:

H_0 : There is no significant difference in students' information literacy in learning the human excretory system between the experiment and control class.

H_1 : There is a significant difference in students' information literacy in learning the human excretory system between the experiment and control class.

3.7 Research Instrument

The instruments used in this research is an objective test. The objective test is used to evaluate students' students scientific and information literacy in learning the human excretory system. The objective test is given in a form of multiple choice. The study administered 40 multiple choice test items of scientific literacy and 40 multiple choice test items of information literacy, then it would be discussed and

selected based on analysis result of the pilot-test instrument. Total question number that will be used for pre-test and post-test are 25 questions for scientific literacy and 25 questions for information literacy which each multiple-choice item is given a numeric value of one to correct answer and zero for incorrect. The blueprint for these multiple choices are as follows:

Table 3.1
The Blueprint of Scientific Literacy Question

No.	Subtopic	Scientific Literacy Domain			Total Question
		Knowledge	Competencies	Attitude	
1	Structure and function of human excretory system	10, 11, 13, 14	8, 18, 19	-	7
2	Mechanism of excretory system in every excretory organ	4, 12, 21	1	-	4
3	Diseases in human excretory organ	3, 15	5, 9, 16, 17, 20,	23, 25	9
4	The Effort to maintain the health of the excretory system	-	2, 6, 7	22, 24	5

Table 3.2
The Blueprint of Information Literacy

No.	Subtopic	Number in Questions	Total Question
1.	The student will identify the task and determine the resources needed.		
	a. Define the problem	1,2,3,4,5,6	6
	b. Identify information resources needed	7,8,9,10	4
	c. Evaluate and select appropriate resources	11,12,13,14	4
2.	The student will locate sources, use information, and present findings		
	a. Locate multiple resources using search tools	15,16,17	3
	b. Locate information within multiple resources	18	1
3.	The student will use information safely, ethically and legally		

No.	Subtopic	Number in Questions	Total Question
	a. Legally obtain, store and disseminate text, data, images or sounds	19,20	2
	b. Appropriately credits ideas and works of others	21,22,23	3
	c. Participate and collaborate in intellectual and social networks following safe and accepted practices	24,25	2

3.8 Validation of Instruments

To validate the instrument in this study, the steps were done are instrument judgment, pilot-test instrument, and instrument analysis. In the instrument judgment step, when the instruments have already arranged then it was directly reviewed and judged by the experts. The experts were a lecturer of Biology and Pedagogy who expert in the assessment. Based on judgment, the researcher got some suggestions and revision for the instrument. Before the instruments are used for research implementation, the instruments were tested for the students who have already learned about the human excretory system (pilot-test administration). In this case, the researcher chose grade VIII as the instrument administration participants. After the instruments have already judged and tried to other students, the results then analyzed to get its validity, reliability, difficulty level and discriminating power for then selected for pre-test and post-test.

3.8.1 Validity

Validity refers to the appropriateness, meaningfulness, correctness, and usefulness of the specific interferences researchers make based on the data collected (Cohen, Manion, & Morrison, 2007). There was three validity that the researcher already conducted, they are content validity, construct validity and criterion validity.

Content validity is related to the content knowledge that the researcher is going to take (Fraenkel, Wallen, & Hyun, 2012). Since there are two variables measured in this research, so the content validity include scientific and information literacy. About the scientific literacy, the content is about a human excretory system

which topic is following the syllabus of *Kurikulum* [Curriculum] 2013 and the standard is following the PISA. Besides, the information literacy is following the standard of Montana Office of Public Instruction for grade 8 of Secondary School. Since the topic is about the human excretory system, the item of information literacy is also attaching the knowledge of the topic but the question itself is not content-based. The multiple-choice questions itself consist of easy, medium, and hard questions. The language used in the question is *Bahasa* Indonesia [Indonesian language] because the school uses *Bahasa* Indonesia [Indonesian language] as the main language. The term used was considered as a general term so that students can understand, or the scientific term that was already explained orally or written. The content validity has already judged and validated by the three experts each in Biology and Information concept. From the results of the judges, the researcher concludes that for the scientific literacy, there were some questions that are not fit with the indicators, some questions were irrelevant, and the questions are too long. Whereas, for the information literacy, some questions are not in line with the indicators.

Construct validity is the characteristic measured by the instrument (Fraenkel, Wallen, & Hyun, 2012). In this research, the questions and the items are constructed in the long text so that to get the high score on scientific literacy and/or information literacy test, students should read the whole text whether in the questions or in the options carefully. Besides, the instruments have already judged by the experts and all of them indicate that all items on the test require scientific and information literacy, and the questions also relevant and representative of the human excretory system.

Criterion validity refers to the comparison of a score obtained from the instrument being validated with others (independent criterion) (Fraenkel, Wallen, & Hyun, 2012). In this research, the researcher will compare the score of the instruments with the grade-point averages. If students have a high score on the test, then they will also have high grade-point averages. This validity is measured by using the software of ANATES and the result is attached in the Appendix B.

3.8.2 Reliability

Reliability is the consistency of scores obtained. It is such a how consistent the questions for each individual from one set of items to another (Cohen, Manion, & Morrison, 2007). To get the number of reliability, the researcher used ANATES software.

$$KR_{21} = \frac{k}{k-1}\left(1 - \frac{\hat{\mu}(k-\hat{\mu})}{k\hat{\sigma}^2{}_x}\right)$$

(Source: Crocker & Algina, 2008)

Where $\hat{\mu}$ is the mean total score, $\hat{\sigma}^2{}_x$ is the total score variance, k is the number of items on the test. The interpretation of the score gained for the calculation is shown in the Table 3.3.

Table 3.3
The Interpretation of Reliability Coefficient

Reliability	Interpretation
0.90 and above	Excellent; at the level of the best-standardized tests
0.80 – 0.90	Very good for a classroom test
0.70 – 0.80	Good for classroom test; in the range of most. The few items could be revised
0.60 – 0.70	Somewhat low. Some items probably should be revised
0.50 – 0.60	Suggests the need for revision of the test, unless it is quite short items.
0.50 or below	Questionable reliability. It needs revision.

(Source: University of Texas, 2003)

The researcher uses the test-retest method to check the consistency of the questions (Fraenkel, Wallen, & Hyun, 2012). It was tested in the same group to get the reliability coefficient. The test-retest was done because, in the first trial test, the researcher uses 40 questions for each item of scientific and information literacy. Since the questions for pretest are only 25 each, then the researcher did the retest administration in the same group for 25 questions each to get the reliability coefficient. The 25 questions were taken from the result of ANATES in the first administration and consider the expert judgment suggestions.

3.8.3 Difficulty level

The difficulty level measures the difficulty of each item. The good item will have the same proportion of easy, medium, and hard questions (Crocker & Algina, 2008). This study arranged the items for pre-test and post-test from the difficulty level of question. The easy question was 25%, the medium was 50%, and the hard question was 25%. Crocker & Algina (2008) added that the value of difficulty level range from 0.00 to 1.00 which means the closer the score to point 1.00, the good the difficulty level is. To measure the difficulty level, it can be obtained by the following formula:

$$\mu_p = \frac{(\mu_x)}{k}$$

(Source: Crocker & Algina, 2008)

Where μ_p is the difficulty index, μ_x is the amount of students who answer the question correctly, and k is the number of items on the test. The calculation was done by using ANATES software and the result can be seen in the Appendix B. Based on the calculation, the results of the difficulty level are classified into:

Table 3.4
The Interpretation of Difficulty Level

Scale	Category
DL < 0.25	Very Easy
0.26 – 0.30	Easy
0.31 – 0.70	Fair
0.71 – 0.80	Difficult
DL > 0.81	Very Difficult

(Source: Nitko, 1996)

3.8.4 Discriminating power

Discriminating power used to identify the high and low achiever from the results of the test item (Crocker & Algina, 2008). The discrimination (D) is computed as:

$$D = p_u - p_l$$

(Source: Crocker & Algina, 2008)

Where p_u is the proportion in the upper group who answer the item correctly and p_l is the proportion in the lower group who answer the item correctly. The

calculation was done by using ANATES software and the result can be seen in the Appendix B.

The interpretation of D-values when the groups are established with total test score is described in the following table:

Table 3.5
The D-Values for Discriminating Power

D value	Category
$D \geq 0.40$	The item is functioning quite satisfactory
$0.30 \leq D \leq 0.39$	Little or no revision required
$0.20 \leq D \leq 0.29$	The item is marginal and needs revision
$D \leq 0.19$	The item should be eliminated or completely revised

(Source: Crocker & Algina, 2008)

3.8.5 Distractor

In a multiple-choice test, the researcher used four options those are A, B, C, and D. There are one correct answer and three incorrect options which called a distractor. According to Kaplan & Sacuzzo (2005), when most of the students answer the right option, it means that the distractors are not working and it affects the result of reliability and validity. When the researcher arranged the 25 questions for pre-test and post-test, the researcher considers the distractor in which researcher took the item that is chosen by the students in each option. To measure the distractor, it is used the following formula:

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

(Source: Kaplan & Sacuzzo, 2005)

Where R is the number of right responses, W is the number of wrong responses, and n is the number of choices for each item. The calculation was done by using ANATES software and the result can be seen in the Appendix B.

3.9 Data Analysis Technique

3.9.1 Scoring

Scoring is used to give a score to students' scientific and information literacy. The score given is 1 for the right answer and 0 for the false answer. Since

each test provides 25 multiple choice test items and the score should be 0-100, so the researcher uses the following formula so that the highest score is 100.

$$students'score = \frac{total\ right\ answer}{25} \times 100$$

3.9.2 Independent Samples t-Test

The independent-samples *t*-test evaluates the difference between the means of two independent groups. The independent sample *t*-test used because the test variable is normally distributed, the variances of the normally distributed test variable for the populations are equal, and the cases represent a random sample from the population and the scores on the test variable are independent of each other. The independent samples *t*-test was calculated through the SPSS software.

3.10 The result of the Pilot Test Instrument

The instruments were administered to Grade IX at one of the Private Schools in Bandung who has already learned about the human excretory system. The instruments were to measure students' scientific and information literacy in which all of them are in the form of multiple-choice test items. The questions consisted of 25 multiple choice test items each.

From the trial instrument results, the researcher analyzed the result to get its validity, reliability, difficulty level, discriminating power, and distractor. The researcher analyzed the item by using ANATES *Pilihan Ganda* [multiple choice] Version 4.1.0. The recapitulation result of the validity, difficulty level, and discriminating power of scientific and information literacy are shown in Table 3.6 and 3.7.

Table 3.6
Recapitulation of Item Test for Students' Scientific Literacy

Question Number	Discriminating Power	Criterion Validity	Difficulty Level	Significance Correlation
1	Good	Enough	Easy	Significant
2	Good	Low	Fair	-
3	Sufficient	Low	Fair	Significant
4	Sufficient	Enough	Very Easy	Significant

Question Number	Discriminating Power	Criterion Validity	Difficulty Level	Significance Correlation
5	Not Appropriate	Invalid	Difficult	-
6	Good	Enough	Fair	Significant
7	Poor	Low	Easy	-
8	Sufficient	Low	Easy	-
9	Sufficient	Low	Easy	-
10	Sufficient	Low	Easy	-
11	Sufficient	Low	Fair	-
12	Sufficient	Low	Fair	-
13	Good	Low	Fair	-
14	Good	Enough	Fair	Very Significant
15	Good	Enough	Fair	Very Significant
16	Excellent	High	Fair	Very Significant
17	Good	Enough	Easy	Very Significant
18	Good	Enough	Easy	Significant
19	Sufficient	Low	Fair	-
20	Poor	Invalid	Difficult	-
21	Sufficient	Low	Fair	-
22	Excellent	Enough	Fair	Significant
23	Sufficient	Low	Fair	-
24	Sufficient	Low	Difficult	-
25	Poor	Very Low	Difficult	-

Note. The Item Reliability is 0.55

Table 3.7
Recapitulation of Item Test for Students' Information Literacy

Question Number	Discriminating Power	Validity	Difficulty Level	Significance Correlation
1	Poor	Very Low	Very Difficult	-
2	Good	Low	Fair	-
3	Sufficient	Low	Fair	-
4	Good	Enough	Easy	Very Significant
5	Poor	Low	Very Easy	Significant
6	Good	Enough	Fair	Significant
7	Poor	Enough	Very Easy	Significant
8	Poor	Low	Very Easy	-
9	Poor	Enough	Very Easy	Very Significant
10	Good	Enough	Fair	Very Significant
11	Excellent	High	Fair	Very Significant
12	Good	Enough	Fair	Significant
13	Good	Low	Fair	Significant
14	Good	High	Very Easy	Very Significant

Question Number	Discriminating Power	Validity	Difficulty Level	Significance Correlation
15	Poor	Low	Very Difficult	-
16	Sufficient	Low	Fair	-
17	Good	Enough	Fair	Very Significant
18	Poor	Enough	Very Easy	Significant
19	Good	High	Easy	Very Significant
20	Poor	Very Low	Very Difficult	-
21	Excellent	Enough	Fair	Very Significant
22	Sufficient	Low	Fair	-
23	Sufficient	Low	Fair	-
24	Sufficient	Low	Fair	-
25	Poor	Very Low	Difficult	-

Note. Item Reliability: 0.78

3.11 Research Procedure

The research procedures were arranged into three stages in order to be a good systematic research. Those three stages are preparation stage, implementation stage, and completion stage.

3.11.1 Preparation Stage

During the preparation stage, a researcher concerned to all preparation steps to conduct and support the research. At the first, researcher formulated the problem to be investigated, determined the focus of variable research, then did some literature review from the digital and printed media sources about Project Based Information in Problem Based Learning, students' scientific literacy, students' information literacy. After getting an idea about the research topic, the researcher designs the research instrument and construct the previous step in a research proposal. The research proposal then was presented in a proposal seminar and had some revision. The revision was consulted with the supervisor together with constructing the instrument. After the instrument had already constructed, it was judged and validated by expert judgments. The revised instrument was validated for 9th-grade students to get the results. The result from the trial test was analyzed by using ANATES software to get the validity, reliability, difficulty level,

discriminating power, and distractor value. After that, the researcher took 25 questions by considering the result of the analysis then doing a retest to the same group.

3.11.2 Implementation Stage

The implementation stage explains how the research was implemented. The implementation stage starts with conducting pretest in control and experimental class. In the next meeting, each class will get the human excretory system topic for learning by using Problem-Based Learning model. The experimental class will have Project in which at the end of the class students should make an article about the human excretory system and they should find the information from the credible and reliable sources. They will also have a module of information literacy and get some explanation of the module content. Besides, the control class will have a regular Problem-Based Learning without a project and they did not have a module of information literacy. The control class only got some instruction about information literacy. During the learning process, students' behavior was observed by the researcher to relate with their result later after the test. Besides, teacher performance was also observed by the observers to investigate whether or not the implementation of Problem-Based Learning run well. After the learning process had already conducted, both class will have post-test to know the improvement in scientific and information literacy.

3.11.3 Completion Stage

Through this stage, the obtained data were reported in a research paper. Together with arranging the research paper, the data of pre-test and post-test were collected then analyzed by using SPSS Software. The result then discussed by the supervisor and the research paper was completed.

The whole process of the research procedure is simplified into the flowchart as seen in Figure 3.2.

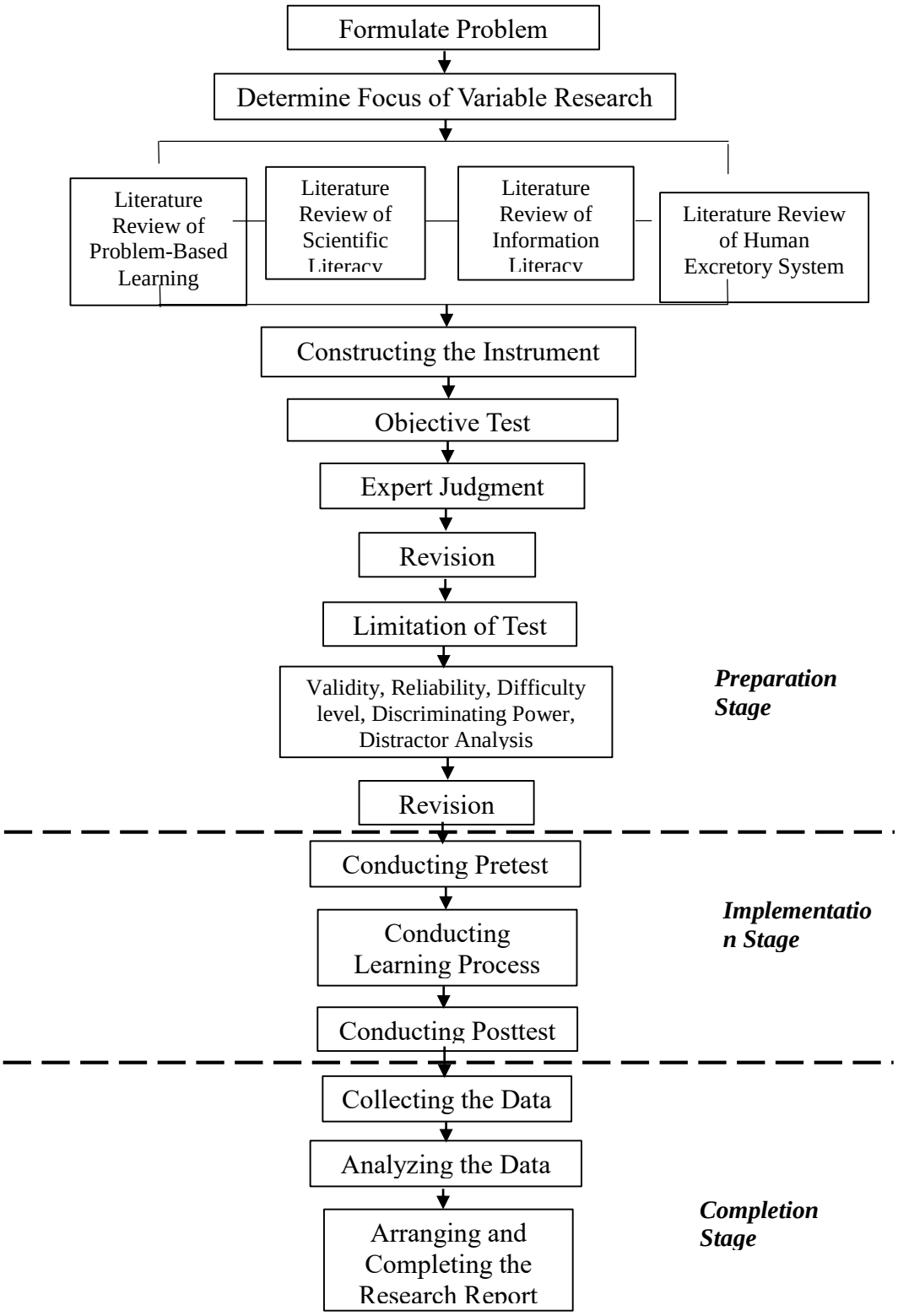

Figure 3.2 The Flowchart of Research Procedure