CHAPTER III

METHODOLOGY

A. Location and Sample/Population

The population of this research was seventh grade in one of Islamic Bilingual School in West-Bandung. Researcher conducted in one class that learning the topic with problem-based learning, as the experiment class. One class as control class, that learns the topic without problem-based learning as treatment.

B. Research Design

The design for this research that used was two groups pretest-posttest design. Between the treatment there are pre-test and post test. Firstly, students would be given pre-test (O_1) before treatment to know students' prior knowledge about the topic and problem solving skill, then the next step students would be given problem-based learning model as treatment (X), then after treatment students would be given post-test regarding to topic and problem solving skill in experimental and control class. Therefore, the differences between pre-test and post-test assumed as the effect of problem-based learning.

Table 3.1 Research Design

Group	Pre-test	Treatment	Post-test
Experimental	O_1	X	O_2
Control	O_1	-	O_2

Description:

O_1 : test before treatment
X : treatment (problem-based learning)
O_2 : test after treatment

(Arikunto, 2010)

C. Research Method

Research method that already used in this research was quasi experimental method. Since it has not met the requirements of the scientific experiment (Arikunto, 2010). This method was carried out on two class in Secondary school. Firstly, researcher prepared lesson plan, learning material, problem that would be posed, and instrument of this research that needed. Then, researcher implements problem-based learning in experimental class, in other hand control is given lecturing.

D. Operational Definition

In order for getting the expected goals and also to avoid misunderstandings in the interpretation of existing terms in this study, would require an explanation of some terms, those are:

1. Problem-based learning is a learning model that begins with a problem and the teacher as a facilitator. The syntax of problem-based learning by Arends (1997) that consist of: (1) presenting orientation about problem to students, (2) organize students to observe, (3) help individual investigation and group, (4) develop and present the works, and (5) analyze and evaluate the process to overcome the problem. From that syntax, teacher can measure the quality of problem-based learning.
2. Problem solving is an activity of making a way out so that there is a match between the expected results. Problem solving involves comparing things, but always intended to come to a solution. The fundamental principle of problem solving can be as the assessment, those are: are identifying the fundamental principle(s), solving, and checking or reflecting. Learning will be conducted and assessed by observation sheet of problem solving skill that adapted according to Gok (2010) and pre-test and post-test.
3. How students understand the concepts that have been studied, also classify objects into examples and non-examples were measured by using the test, it will be multiple

choices and essay. Concept comprehension already conducted by pre-test and post-test

E. Research Instrument

Table 3.2 Blueprint of Students' Concept Comprehension (multiple choices)

Indicator	C1	C2	C3	C4	Total
Identifying pollution	1				1
Identifying types of pollution	2				1
Analyzing impact of pollution by observation		3			1
Identifying the causes of pollution	5, 7				2
Giving example of pollution in environment	6	8			2
Explaining of pollution impact to organism		4, 9, 10, 13	11	12, 14, 15	8
Total	33.33 %	40 %	6.66 %	20 %	100 %

Table 3.3 Blueprint of Students' Impression to Learning by Problem-based Learning

Nu.	Indicator	Item
1.	Students' response toward problem-based learning	1, 8, 15
2.	Students ability to solve problem	2, 12, 14
3.	Students' response toward the topic that learned by problem-based learning	4, 6, 7
4.	Students' concept comprehension	3, 9, 10, 13
5.	Indicates students that interest in learning science	5, 11

Table 3.4 Blueprint of Students' Problem Solving Skill (Essay)

Indicator	Item	Total
Identifying the fundamental principle	1, 2	2
Solving	3	1
Total		3

Table 3.5 Blueprint of Observation Sheet

Indicator problem solving according to Gok (2010)	**Steps**	**1**	**2**	**3**	**4**
Identifying the Fundamental Principle(s)	1. Understand the problem accurately. 2. Interpret the problem.				
1 = if students do not understand the problem and cannot interpret the problem. 2 = if students understand and cannot interpret the problem. 3 = if students understand the problem and can interpret the half problem. 4 = if students understands the problem and can interpret the problem perfectly.					
Solving	1. Choosing some useful sub-problems. 2. carrying out the solution of these sub-problems. 3. Making decision to solve problem.				
1 = if students are poor to choose some useful sub-problems and carrying out the solution of these sub-problems and making decision to solve problem. 2 = if students are able to choose some useful sub-problems, carrying out the solution of these sub-problems but poor in making decision to solve problem. 3 = if students are able to choose some useful sub-problems, carrying out the solution of these sub-problems and making decision to solve problem imperfectly. 4 = if students are able to choose some useful sub-problems, carrying out the solution of these sub-problems and making decision to solve problem.					
Checking/reflecting	1. Check the solution to assess whether it is correct and				

	satisfactory and to revise it properly if any failure are detected				

1 = Cannot give any explanation weather the solution should be tested
2 = student give explanation why the solution should be tested.
3 = students be able to review the effectiveness of the solution
4 = students be able to review the effectiveness of the solution and give explanation why the solution should be tested.

Adapted from Gok (2010)

F. Instrument Development

Validation, discriminating power, level of difficulty, reliability using Anates that used to analyze the instrument.

1. Validation

A good assessment the data should accordance to reality. The instrument of research should be valid, in order to get valid result (Arikunto, 2012). Validity that will be used is content validity. Content validity is used to measure particular purpose which is parallel with the material given. So, formula that will be used is correlation product moment equation.

$$r_{xy} = \frac{n(\sum XY) - (\sum X)(\sum Y)}{\sqrt{[n(\sum X^2) - (\sum X)^2][n(\sum Y^2) - (\sum Y)^2]}}$$

r_{xy} : coefficient correlation between variable X and variable Y
X : items scores
N : amount of subject

(Arikunto, 2012)

2. Level of Difficulty

A good test is test that not really difficult or easy (Arikunto, 2012: 222). Difficult or easy of test is indicated by the index. Difficulty index is between 0.00 to 1.0. 0.0 shows the test is too hard, otherwise index of 1.0 indicates the test is too easy.

The formula to find difficulty level as follow:

$$P = \frac{B}{JS}$$

P : difficulty level
B : number of students who answer correctly
JS : Total number of students

(Arikunto, 2012)

For multiple choices by using Anates software, there are sixteen items test that categorized into very easy. Two items test is easy. Nine items test is categorized to medium level. Two is categorized to difficult item test and one is very difficult. For essay, three items test is categorized to medium level, two items test is easy level and one is categorized to difficult level.

3. Reliability

Arikunto (2012: 100) stated that a test can be said to have good that if such tests can provide consistent of results.

> "A reliable measure in one that provides consistent and stable indication of the characteristic being investigated."
>
> (Anderson in Arikunto, 2012: 101)

The formula that will be used to determine reliability in objectives test is alpha formula:

$$r_{11} = \left[\frac{n}{n-1}\right]\left[1 - \frac{\sum \sigma_i^2}{\sigma_i^2}\right]$$

r_{11} = Instrument reliability

n =Amount of question

$\sum \sigma_i^2$ = Amount of Varian score in each item

σ_i^2 = Varian total

(Arikunto, 2012)

For reliability result is written in appendix.

4. Discriminating Power

Discriminating power is the ability of question to distinguish between high-ability students with low ability students (Arikunto, 2012: 226). Discriminating power is

indicated by the discrimination index. The discrimination index ranges between 0:00 to 1:00 (Arikunto, 2012). It is same with difficulty level). The formula to determine discrimination index is as follow:

$$DP = \frac{Ba}{Ja} - \frac{Bb}{Jb}$$

DP : Discriminating Power
Ba : The number of upper group that answer correctly.
Ja : Total of students in upper group
Bb :The number of upper group that answer incorrectly .
Jb :Total of students in lower group.

(Arikunto, 2012)

The classification of discrimination power

D: 0.00 – 0.20: poor
D: 0.21 – 0.40: satistifactory
D: 0.41 – 0.70: good
D: 0.71 – 1.00: excellent

(Arikunto, 2012)

The discriminating power in multiple choice result by using Anates, three from thirty items obtained 100% index discriminating power. Three items test

obtained 66.67% for index discriminating power. For more detailed can be seen in appendix.

G. Data Processing

By using statistics, data is processed. The explanation of data processing, as follow:

1. Pre-test and post-test analysis

Pre-test and post-test results would be gained by the result of normalized gain. The process to get normalizes gain, as follow:

a. Scoring Process

In this research, there are 15 items of multiple choice for pre-test and post-test. Score one will be given if the answer is correct, and zero for incorrect answer. Also, there are three essays. For scoring the essay, the range is from 1 – 5 depending of the criteria. For scoring result is attached in appendix.

b. Calculating Gain Score

Gain value could be obtained from the differences between pre-test and post-test result. By using this formula, gain was obtained:

$$\mathbf{G = S_f - S_i}$$

Description:

G = gain
S_f = post-test
S_i = pre-test

(Hake, 1999)

For concept comprehension item test, the experimental class obtained 17.7 as the gain score and -10.1 is gain score in control class. in other hand, for problem solving skill in experimental class is 23.47 and 13.04 for control class.

c. Normalized Gain

The gain score would be used to determine normalized gain score. The effectiveness of problem-based learning toward students' problem-solving skill and concept comprehension would be seen by result of normalized gain. Normalized gain of each student <g> defined as following formula:

$$< g >= \frac{\%G}{\%Gmax} = \frac{(\%S_f - \%S_i)}{(100 - \%S_i)}$$

Description:

$<g>$: Normalized gain
G : Actual gain
G_{max} : Maximum gain possible
S_f : Post-test score
S_i : Pretest score

The criteria are:

0,00 – 0,29	Low
0,30 – 0,69	Medium
0,70 – 1,00	High

(Hake, 1999)

The result of normalized gain in experimental class for concept comprehension is 0.5, In other hand in control class is -1.1. for problem solving skill in experimental class is 0.31 as the normalized gain, while in control class is 0.14.

d. t Test

The formula for measuring experimental result that use pre-test and post-test:

$$\mathbf{t} = \frac{m_x - m_y}{\sqrt{\left(\frac{\sum x^2 + \sum y^2}{n_x + n_y - 2}\right)\left(\frac{1}{n^x} + \frac{1}{n^y}\right)}}$$

Description:

m : mean from difference between pre-test and post-test (post-test – pre-test)
n : subject in sample
x : deviation in each x_2 and x_1
y : deviation in each y_2 and y_1

Formula to find deviation:

$$\sum x^2_d = \sum d^2 - \frac{(\sum d)^2}{N}$$

Then, see the significance in table t.

(Arikunto, 2010)

Testing hypotheses of problem solving skill by SPSS software is obtained 1.757, it means H_0 is rejected automatically H_1 is retained. For concept comprehension testing hypotheses is obtained 0.0 it also means H_0 is rejected automatically H_1 is retained.

2. Likert Scale Analysis

Percentages of questioner would be obtained by:

$$\mathbf{P = \frac{f}{n} \times 100\ \%}$$

Description:
P : Percentage
F : Frequency of the answer
N : Total of response

(Sugiyono, 2011)

The result of likert scale is mostly students give positive attitude in learning.

3. Observation Sheet Analysis

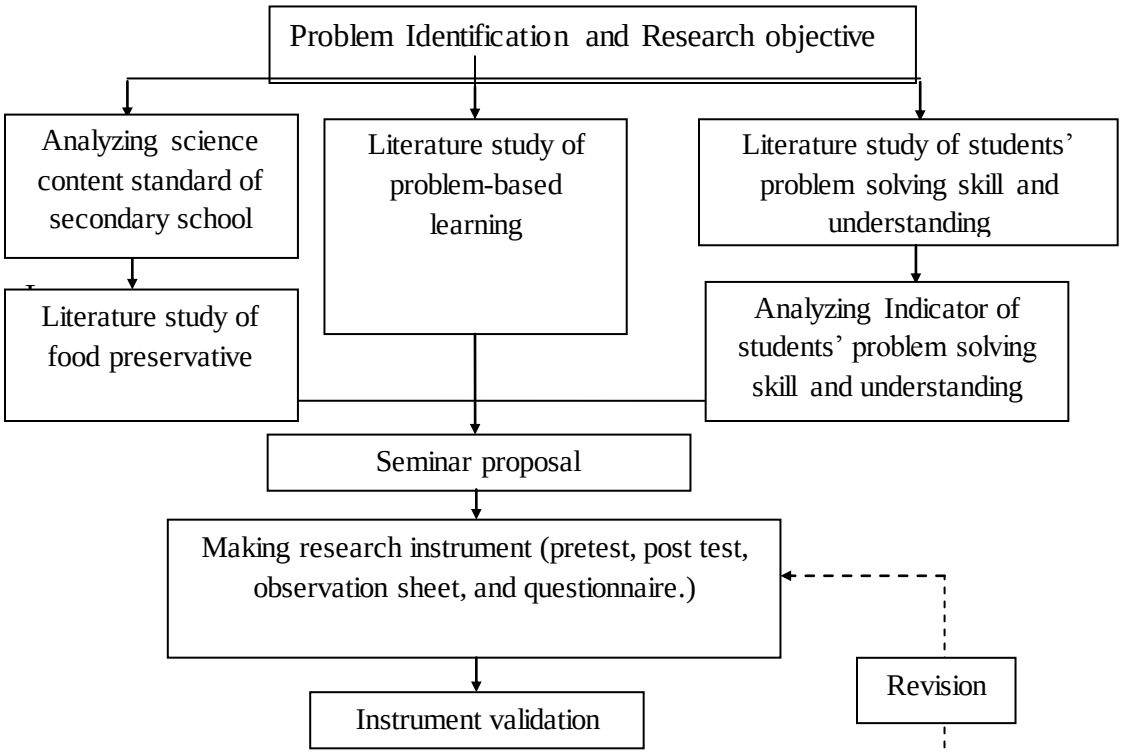
For analyzing the observation sheet

$$\mathbf{Score = \frac{raw\ score}{maximum\ score} \times 100\ \%}$$

(Kunjaraningrat, 1993)

The observation sheet result shows that experimental class obtained 8.91 and control class obtained 4.56.

H. Research Procedure



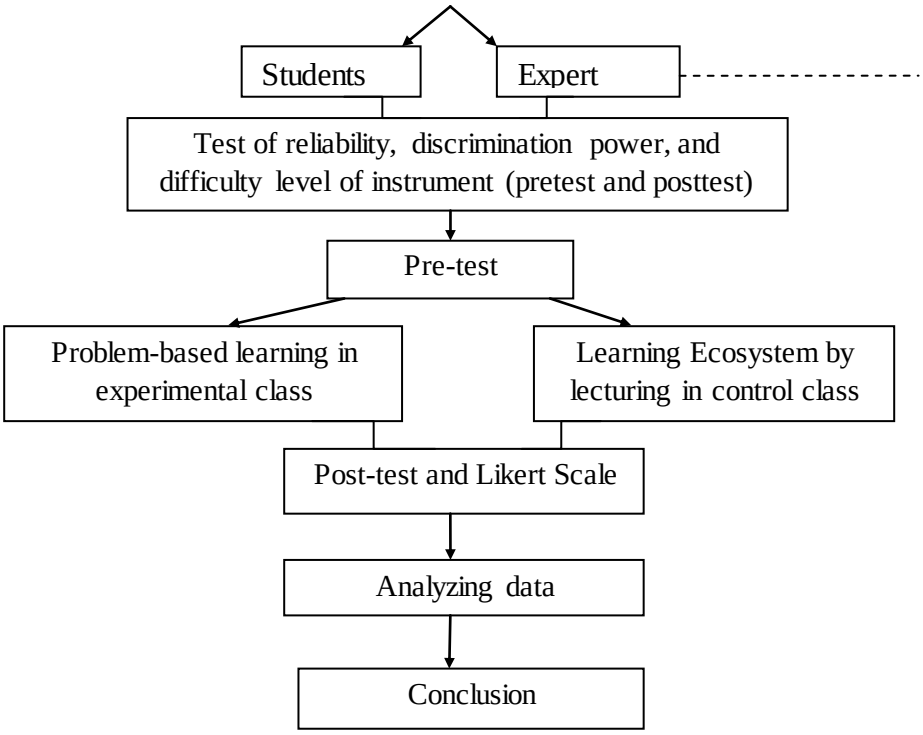


Figure 3.1 Research Procedure