CHAPTER III
METHODOLOGY

This chapter consists of research method and design, population and sample, operational definition, research instrument, instrument validation result, data analysis, and research procedure.

1. Research Method and Design

The research method that is used is an Experimental Method. The experimental method involves manipulating one variable to determine if changes in one variable cause changes in another variable. This method relies on controlled methods, random assignment and the manipulation of variable to test a hypothesis

One group post-test pre-test design defined as a single group that is measured or observed not only after being exposed to a treatment of some sort, but also before (Fraenkel & Wallen, 2009). A diagram of this design is as follows:

Table 3.1 One-group post-test pre-test Design

Pre test	Treatment	Post Test
O_1	X	O_2

(Fraenkel & Wallen, 2009).

O_1 is a test before learning activity and O_2 is a test after learning. X is a form of learning that treatments using models Problem based Learning with multiple representations approach.

2. Location and Sample

1. Location of Research

The location of this research at National Junior High School in Bandung which is one of National Secondary High School in Bandung, West Java. The school uses bilingual as the main language in the teaching learning process.

2. **Population of Research**

The population was taken is class of Secondary I Ibnu Rusyd, at that National School. The sampling technique that was a purposive sampling because Secondary I Ibnu Rusyd is despite it is the only class that available to be intake in the research. It was due to the class has a high focus on learning. There are 26 students as a sample of this research.

3. Assumption

The assumption as the foundation of this study as follow:

1. Problem based learning model with multiple representation approach enables student to learn diverse representations to solve the physics problem
2. Problem based learning model with multiple representation helps student to used to multiple representation in learning process. In this case, teacher train and trigger students to learn various multiple representations.
3. Problem based learning model with multiple representation will become precious assessment to enhance scientific consistency because using this treatment, teacher know well students' capability in teaching learning process as well verbally, picture, and mathematically.

4. Hypothesis

Hypothesis that is tested in this study are as follow:

1. H_0 : There is no difference of students' scientific consistency in learning heat transfer concept using problem based learning model with multiple representations approach

2. H_1 : There is difference of students' scientific consistency in learning heat transfer concept using problem based learning model with multiple representations approach

1. Operational Definition

In order to avoid misconception about this research, so some operational definitions are explained in this research. Those terminologies are explained as follows:

1. Problem Based Learning model with multiple representation approach means learning to solve the problem with diverse .The application use of this model, expected to be investigating students' scientific consistency. By learning activities PBM performed consists of five phases, namely: 1) Provide an orientation about the problem to the learners, 2) Organize learners to research, 3) Helping the investigation independently and groups, 4) Develop and present their work and 5) Analyze and evaluate the process of overcoming the problem. At each phase is done multiple representation approach.
2. Scientific Consistency is the consistency of students' ability to answer correctly scientifically on the same concept, in the form of different representations. Multiple representation based scientific consistency identified through students' answers during the test multiple representations. Students categorized scientific consistency if the three inputs (verbal, mathematical and picture) are in the category of understanding the concept. Category understand the concept of meaning, the student answered correctly on a given third representative, Then the pretest and posttest data results expressed with the normalize gain, to identify the enhancement of students' scientific consistency.

1. Research Instrument

In this research, instrument is necessary to be used for gaining data. There is one type instrument that is used in this research; it is multiple representations test in multiple choice forms. The instrument is described below.

1. Multiple representation test

Multiple representation test to measure scientific consistency understanding of students, carried out by giving 45 about multiple representation (verbal, picture, and mathematical) test that consists of five concepts such as conduction, convection, radiation, sea breeze, and land breeze. The multiple representation test is formed in multiple choice questions. This test aims to analyze the scientific consistency student. Instruments for research, tested in advance to students who have earned a heat transfer material. Instruments test of scientific consistency with multi representations made only once trial

The multiple representations test is formed in multiple choice questions. This instrument is tested through several statistical test which common use to test the research instrument.

The statistical test have to be tested consist of in terms of validity, reliability, difficulty level, discriminating power, and distractor. It will be explained as follows.

1. Validity

Validity is defined as the extent to which the instrument measures what is designed to measure that emphasizes not on the test itself, but on the result (Arikunto, 2013). Construct Validity is considered to be used in this study since the questions will be formulated based on the level cognitive of Taxonomy Bloom. Arikunto (2013) stated that construct validity measures thinking aspect based on logical, such as classified the question item into

cognitive dimension. The formula to determine the validity is below (Arikunto, 2013).

$$r_{xy} = \frac{N \Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{\{N \Sigma X^2 - (\Sigma X)^2\}\{N \Sigma Y^2 - (\Sigma Y)^2\}}} \quad \ldots\ldots\ldots\ldots\ldots (1)$$

Where:

r_{xy} = coefficientcorrelation or item validity

ΣX = sum of total score of all students for each question item

ΣY = sum of total score of all students for whole test

N = total number of students

X = score of each student for each question item

Y = total score of each student

The validity interpretation is represented in the table below.

Table 3.2 Interpretation of Validity

No.	Value r_{xy}	Criteria
1	$0.80 < r \leq 1.00$	Very High
2	$0.60 < r \leq 0.80$	High
3	$0.40 < r \leq 0.60$	Fair
4	$0.20 < r \leq 0.40$	Low
5	$0.00 < r \leq 0.20$	Very Low

(Arikunto, 2013)

2. Reliability

Reliability is defined as the extent to which a questionnaire, test observation or any measurement procedure produces the same results on repeated trials. In short, it is the stability or consistency of scores over time or across raters (Arikunto, 2013). The split-half method using KR 20 equation is used to calculate reliability of the test by giving score one point for correct answer and zero point for wrong answer. The formula of reliability is described below (Arikunto, 2013).

$$r_{11} = \left(\frac{k}{k-1}\right)\left(1 - \frac{\Sigma pq}{s^2}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where:

r_{11} = instrument reliability

k = the amount of test item

Σpq = multiplication result of p and q

s = deviation standard

The reliability interpretation is represented in the table below.

Table 3.3 Interpretation of Reliability

No.	Reliability Coefficient	Criteria
1	$0.00 < r \leq 0.20$	Very Low
2	$0.20 < r \leq 0.40$	Low
3	$0.40 < r \leq 0.60$	Fair
4	$0.60 < r \leq 0.80$	High
5	$0.80 < r \leq 1.00$	Very High

(Arikunto, 2013)

3. Difficulty Level

The quality of question will be good if it is arranged in balance, it means the proportion should not consist of whole easy or difficult questions, since easy questions will not stimulate students to spend more effort in answering as well as difficult questions will make the students desperate and have no motivation to solve it (Arikunto, 2013). Consideration of difficulty level is based on proportion of problem categories such as easy, medium, and difficult. The formula to determine the difficulty level is described below (Arikunto, 2013).

$$P = \frac{B}{N} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

Where:

P = difficulty level

B = number of students who answer correctly

N = total number of students

The classification of difficulty level is represented in the table below.

Table 3.4 Interpretation of Difficulty Level

No.	Difficulty Value	Criteria
1	0.00 – 0.30	Difficult
2	0.30 – 0.70	Medium
3	0.70 – 1.00	Easy

(Arikunto, 2013)

4. Discriminating Power

Discriminating power is defined as the ability of particular question to distinguish students who are classified as higher achievement and lower achievement. The amount of higher achievement students who can answer more particular questions compared to lower achievement means that those questions have positive discriminating power index (Arikunto, 2013). Discriminating power index shows the scale from minus one until positive one. The negative one represents lower discriminating power index, and vice versa. The formula to determine the discriminating power is described below (Rustaman in Maulidah, 2015).

$$DP = \frac{U-L}{\frac{1}{2}T} \quad \text{..... (4)}$$

Where:

DP = Discriminating Power

U = the number of upper group that answer correctly

T = total number of students in upper and lower group

L = the number of lower group that answer correctly

The Interpretation of discriminating power is represented in the table below.

Table 3.5 Interpretation of Discriminating Power

No.	Discriminating Power Value	Criteria
1	Negative-0.00	Very Poor
2	0.00-0.20	poor
3	0.20-0.40	satisfactory
4	0.40-0.70	Good
5	0.70-1.00	Excellent

(Arikunto, 2009)

5. Distractor

Distractor is considered to have an effect on the result of discriminating power value. The analysis of distractor is done to determine the distractor of each item of multiple choice which is not work well to distract the students from answering the questions correctly. The distractor is considered as a good distractor when it can attract the attention of unwell prepared students' in the test to be chosen, it is chosen by at least 5% of the students. Meanwhile, a distractor is considered as a bad distractor when it is not chosen by any student, it means the distractor is clearly wrong. Hence, even the students who are not mastering the concept will believe that the distractor is totally wrong choice. A distractor can be treated with three ways i.e. accepted, rejected, and rewrite (Arikunto, 2013).

1. Instrument Validation Result

Before using the objective test as the instrument in the research, it needs to be tested in terms of validity, reliability, discriminating power, and difficulty level as explained before. To obtain the data for testing those aspects, limited test need to be done. The test was given to 20 students which have learned about the chapter that will be learned for the research. The limited test consists of 45 multiple representations in form multiple choice questions. The data obtained

from the limited test was analyzed by Software Anatest 4.0. The content validation is very good that analyzed from expert judgement. The reliability of the test item is 0.63 with the interpretation high.

On multiple representations test instrument consists of 45 questions consisting of five concept of heat transfer. All matter in the form of multiple representations consisting of verbal, images and mathematically. Although some questions were on the validity and distinguishing low, matter is not disposed. It is due to the questions required for the purposes of research and has sufficient validity questions.

The instrument from limited test that should be revised is not totally changes the questions. The reason the instrument will be used is not only based on anatest but also from judger recommendations.

2. Data Analysis of Scientific Consistency

Researcher adapted the technical scoring of scientific inquiry from Nieminen (2010), he made the categorize of scientific consistency which students' answer in a given theme were graded in the following way on Table 2.3

After that, calculated the enhancement of scientific consistency in pretest and posttest results using normalized gain equation. Based on Hake (1999) stated the score of *pre-test and post test* could be computed in the equation bellow

$$<g>= \frac{(average\ of\ postest\%\ score)-(average\ of\ pretest\ \%\ score)}{100\%-(average\ of\ \ pretest\ \%score)}$$

Then interpreted into a normalized gain of criteria such as the table 3.7

Table 3.6 Criteria of Normalized Gain

<g>	Kriteria
<g> ≥ 0,7	Tinggi
0,3 ≤<g> < 0,7	Sedang
<g> < 0,3	Rendah

(Hake, 1999)

3. Research Procedure

1. Preparation Stage

The preparation stage of this study consist of analysis every variable related to this study and instrument making. For analysis variables related to this study consists of:

1. 2013 Curriculum as National Curriculum of Indonesia
2. multiple representations in teaching learning process
3. Problem Based Learning when teaching learning activity
4. Concept of heat transfer

For instrument making, this study will use several kinds of instruments i.e. draft of multiple representations in multiple choice form, lesson plan of Problem Based Learning with Multiple Representations Approach, and worksheet, observation sheet

A draft of multiple representations in multiple choice form will be acquired through the process of expert validation, revision, limited test, and analysis by anatest. Meanwhile a draft of lesson plan, worksheet, and observation sheet will be acquired through the process of consult to expert judgement then revision.

5. Implementation Stage

The implementation stage of this study will be described as follows.

1. Giving the pre test
2. Conducting the learning process using problem based learning with multiple representations approach
3. Observing the teaching learning activity using observation sheet.

4. Completion Stage

The completion stage of this study consists of data analysis and drawing the conclusion. Analyze the improvement of scientific consistency of the students in problem solving then conclude the result of the study ;there is improvement or not.

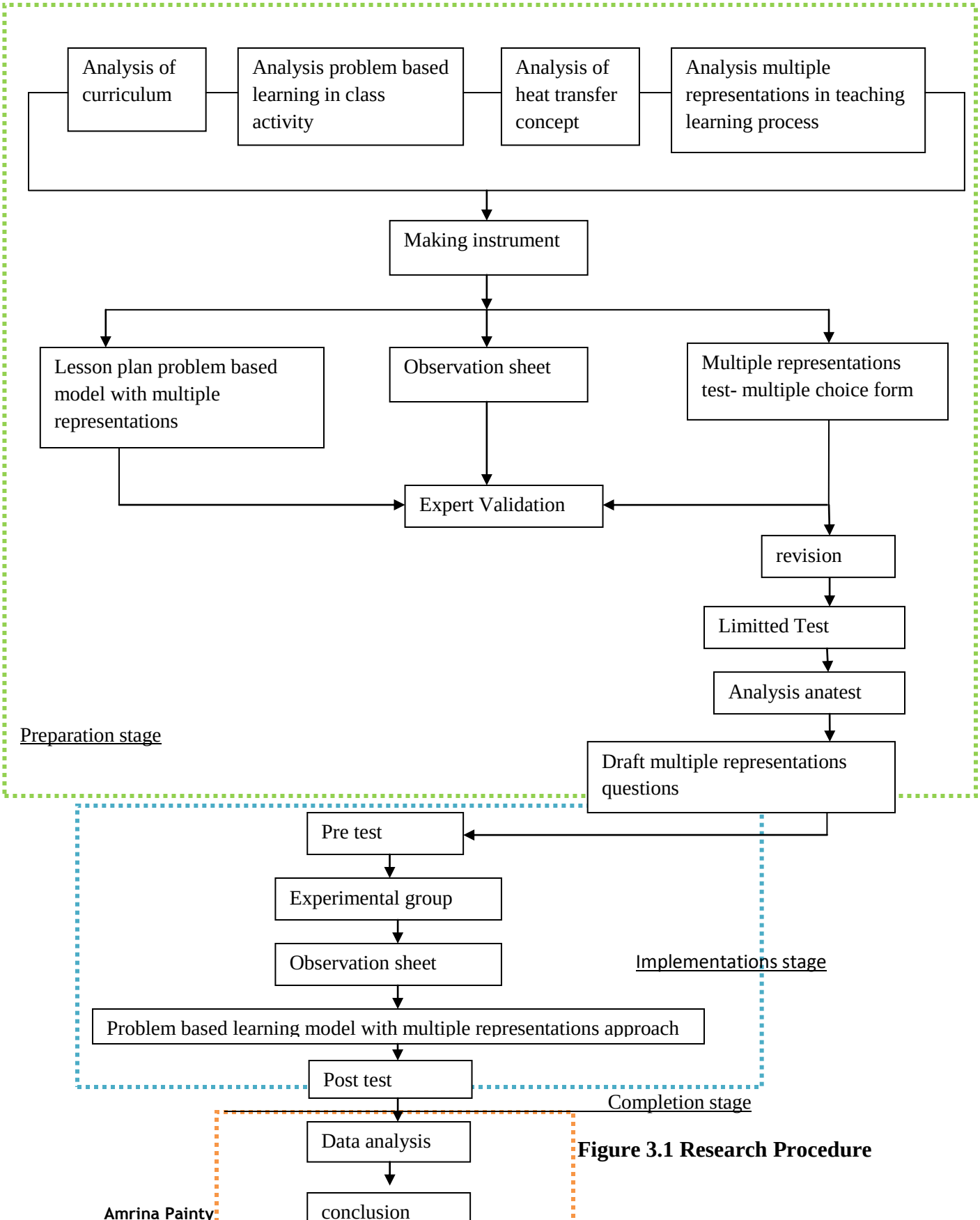

Figure 3.1 Research Procedure