CHAPTER III
RESEARCH METHOD

A. Research Method and Design

1. Research Method

In general, the research method is defined as a scientific way to get the data with the purpose and specific uses. How meaningful scientific research activities are based on the characteristics of science, namely rational, empirical, and systematic (Sugiyono, 2007: 1). Various methods can be used to obtain research data. However, taking into account the objectives of this research are to determine the differences of students conceptual mastery based on gender differences through virtual laboratory learning media in optic topic. The method is used method of Quasi experiments. In this method, the research carried out on two groups of students VIII Grade, girls class (VIII B) and boys class (VIII A)

2. Research Design

The design used in this research are two groups pretest-posttest design (Fraenkel and Wallen, 2007: 253), it can be called matching pretest-posttest comparison group design (Sukmadinata, 2011: 208), because in this design, there is no control class. Both of class become experiment class by non-random taken a group.In this design, both of class are given a pretest before learning. Pretest in this research can become as statistical control and also can be used to see the effect to the gain score.

Here is the study design matching pretest-posttest comparison group design are illustrated in tabular form (Sukmadinata, 2011: 208).

Table 3.1

Research Design: Matching Pretest-Posttest Comparison Group Design

Class	Pretest	Treatment	Posttest
Experiment class (Female)	O_1	X	O_2
Experiment class (Male)	O_3	X	O_4

$O_1 =$ Pretest for female class

$O_2 =$ Posttest for female class

$O_3 =$ Pretest for male class

$O_4 =$ Posttest for male class

$X =$ Using virtual laboratory learning media

B. Operational Definition

In order to avoid misconception about this research, so in this research will be explained about some operational definition. Those terms are:

1. Conceptual mastery in this research is the competences of students when they answer the conceptual question that is measured by multiple choices question for about 30 questions. Type of question consist of level cognitive from C1 (Remembering), C2 (Understanding), C3 (Applying), C4 (Analyzing), C5 (Evaluating).

2. Virtual laboratory that is used in this research is software that consist of animation, simulation, sound in one package. This software is given to the students in each computer on computer laboratory.

3. Interest in physics is how far the students interest in physics lesson. It is measured by questionnaire that 20 statements which is given to the students.

C. Population and Sample

The population is the totality of all the values which can be complicated, the results of counting and measurement, quantitative, and qualitative characteristics of certain of the set of objects is limited by a certain criteria or restrictions, while the sample is a part of the population (Kumar, 2005: 165).

The population in this study was VIII Grade Junior High School students Pribadi Bilingual School year 2012/2013. After observation, the sample was taken two classes in the eighth grade, there are VIII A and VIII B as single-sex class. As follow, VIII B is Female class and VIII A is Male class both of them are given the same treatment that is virtual laboratory learning media. Sampling were selected by purposive sample technique. Purposive sampling technique is the sampling that is used by the researcher if the researcher has the specific objective in the research (Kumar, 2005: 179).

D. Research Location

The location of this research is Junior High School of Pribadi Bilingual Boarding School. This school is very special. First, this school has a word "Bilingual" but not in usual terms. Bilingual in usual terms is the teaching learning process using dual language i.e. Indonesian Language and English Language, but in this school, the terms bilingual means that system of teaching and learning itself. When students learn Science, Mathematics, and Computer the language of learning is English, while for the other subject such as Indonesia Language, Civic education, sports, and etc are using Indonesia language. The second is this school very appropriate being a location of research because they do the separating classes based gander, so this school is single-sex school. Means that Female students and Male students has different classes.

E. Research Instrument

To obtain primary data in this study, the use of test instrument was for measure conceptual mastery of students on the topic optics and questionnaires for students interests in physics subject.

1. Objective Test

Test was used to evaluate the conceptual mastery of students in learning physics, especially optics topics using virtual laboratory. Conceptual test is multiple-choice with 4 options with the cognitive value as C1 (Remembering), C2 (Understanding), C3 (Applying), C4 (Analyzing), C5 (Evaluating). The test is for about 30 questions. It was tested two times to the students as pretest and posttest.

Blueprint of objective question before doing instrument analysis item test is shown in table 3.2:

Table 3.2

Blueprint of Objective Question Before Doing Instrument Analysis Item Test

Concept Theme	Conceptual mastery				
	C1	C2	C3	C4	C5
Concept of refraction(law of refraction)	2,5,7	1,6,4	-	12, 13	11
Refraction index	10	3,9	8	41	-
Characteristic of converging lens	15,16	14,17,18,19, 49,50	-	25	24
Image formation of converging lens	-	20,22	21,23,26, 42,43,44	-	27
Characteristic of diverging lens	40	29,30,34,36,37	-	28	-
Image formation of diverging lens	-	32	31,35,38, 45,46,47,48	33	39
Total	**7**	**19**	**14**	**6**	**4**

After doing instrument analysis item test, so blueprint of conceptual mastery objective questions are shown in this table below:

Table 3.3

Blueprint of Objective Question After Doing Instrument Analysis Item Test

Concept Theme	Conceptual mastery				
	C1	C2	C3	C4	C5
Concept of refraction(law of refraction)	2,9	4,3,1	-	8,10	7
Refraction index	-	5,6	-	-	-
Characteristic of converging lens	12,11	13	-	18	19
Image formation of converging lens	-	20,14	15,16,17	-	-
Characteristic of diverging lens	21	22,23	-	-	-
Image formation of diverging lens	-	24	25,26,27,28,30	29	-
Total	**5**	**11**	**8**	**4**	**2**

2. Questionnaire

Questionnaire is used to determine students' interest in physics lesson especially on optic topics. How the interest of girls students and boys students is. There are 20 statements, 5 statements in this questionnaire include in negative statement to control students answer. The questionnaire using Likert scale. The blueprint of interest in physics questionnaire is:

Table 3.4

Blueprint of Interest in Physics Questionnaire

No	Indicator	questions
1	Indicate interest in physics learning through virtual laboratory learning media.	1,2,4,16,19
2	Indicate student's interest toward layout and facilities of virtual laboratory in physics learning.	3,5,17,18,20
3	Indicate students interest and optimistic in learning physics.	6,7,8,12,14
4	Indicate students are not interested and pessimist in learning physics.	9,10,11,13,15

This questionnaire uses likert scale form. That consist of 5 category of scale, Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D), Strongly Dissagree (SD). The computation of questionnaire using MSI (Measurement Successive Interval). Point of the scale in this questionnaire are divided into two. First, positive statement from Strongly Agree (SA) until Strongly Disagree (SD) are given point 5 until 1 orderly and vice versa for negative statement.

3. Virtual Laboratory Learning Media

Virtal laboratory learning media that is used is a software which is developed by the researcher. First, storyboard should be made based on curriculum, optic topics material, and characteristic of junior high school students. Then, the storyboard is judged. After revision, virtual laboratory learning media can be made by using macromedia flash helped by animator based on the storyboard. After that, it trial first and judged by the expert. Then, make it in one package software to apply at school for the treatment in the research.

F. Instrument Analysis

In the preliminary study, the research instrument for cognitive test that is construct to know how far the conceptual mastery of the students will be tested before used as pretest and posttest. It will be tested to the students that has already got the material or the topic that will be taught in this research, optic topic. So, it will be given to the IX B and IX A. The analysis of instrument covers validation, discriminating power, level of difficulty, reliability using Microsoft Excel.

1. Discriminating Power

Analysis discriminating power is to examine whether such questions have ability to distinguish between students who fall into the category that have a high achiever and low achiever. Thus, the question that have discriminating power, if

given to high achiever students, results show higher than if given to students who lower achiever (Arikunto, 2010: 211).

The formula that is to analyze discriminating power 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, 2010: 213)

Table 3.5

Discriminating Power

Value	Criteria
0,00 – 0,20	Poor
0,20 – 0,40	Satisfactory
0,40 – 0,70	Good
0,70 – 1,00	excellent

(Arikunto, 2010: 218)

This is the following of discriminating power result from instrument analysis test:

Table 3.6

Discriminating Power Result

| Category | Frequency | | No.question |
	Sum	Precentage(%)	
Negative	10	20	5,18,19,27,28,29,31,39,42,44
Poor	8	16	4,10,14,21,23,41,49,50
Satisfactory	12	24	2,7,8,12,13,20,30,34,36,40,43,45
Good	19	38	1,3,6,9,11,15-17,22,24,25,32,33,35,337,38,46-48
Excellent	1	2	26
Total	50	100	

2. Level of Difficulty

The assumptions used to obtain good quality problem is to balance the difficulty level of questions. Difficulty level of ability or seen about the student's ability to answer questions, not from the perspective of a teacher.

There are some basic considerations in determining the proportion of problem categories easy, medium and difficult. The first consideration is the balance, which is about the same amount for all three categories. That is, the number of questions is easy, medium, and hard numbers balanced. The second consideration for the proportion of about three categories based on the normal curve. Means that, most of the problems are in the medium category, some are included into the category of easy and difficult with balanced proportions (Arikunto, 2010: 207).

The formula that is used in this research to determine the level of dificulty in the question is :

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

P = difficulty level

B = number of students who answer correctly

N= Total number of students

(Arikunto, 2010: 208)

The criteria used when smaller index obtained, more difficult questions. Conversely, the greater index gained, the easier of question . The difficulty index criteria as follows:

Table 3.7

Difficulty Level

Value	Criteria
0 – 0,29	difficult
0,30- 0,69	middle
0,70 - 1,00	easy

(Arikunto, 2010: 210)

This is the following of difficulty level result after instrument analysis test:

Table 3.8

Difficulty Level Result

Category	Frequency		No. question
	Sum	Percentage(%)	
Easy	3	6	3,4,30
Medium	41	82	1,2,6-26,28,31-38,40,42-48,50
Difficult	6	12	5,27,29,39,41,49
Total	50	100	

3. Validity

Validity test is a measurement that confirm an instrument is valid and it can measure what it will be measured (Arikunto, 2010: 64). Validity test that is used is content validity, so validity test is done by comparing between content with subject material that has been taught. To know the suitability of instrument with the material, it is done by correlation product moment equations.

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

r_{xy} = items correlation coefficient.

X = items scores

N = amount of subject

(Arikunto, 2010: 72)

Here is the interpretation of validity criteria comparing the result to this table.

Table 3.9

Validity Interpretation

Correlation Coeficient	Validity Criteria
$0,80 < r \leq 1,00$	Verry high
$0,60 < r \leq 0,80$	High
$0,40 < r \leq 0,60$	Enough
$0,20 < r \leq 0,40$	Low
$0,00 \leq r \leq 0,20$	Verry low

(Arikunto, 2010: 75)

This is the following of Validity test result after instrument analysis test:

Table 3.10

Validity Test Result

Category	Frequency		No.question
	Sum	Percentage(%)	
Not valid	4	8	10,19,29,42
Verry low	7	14	5,18,31,39,44,47,50
Low	15	30	4,8,13,14,20,21,25,27,28,34,36,41,45,48,49
Enough	15	30	2,3,6,7,11,12,15,17,23,24,26,32,33,35,43,
High	7	14	1,16,22,30,37,40,46
Very high	2	4	9,38
Total	50	100	

4. Reliability

Reliability test is a measurement which stated about consistence of the measurement tools that is used. Arikunto (2010: 86) stated that reliability tends to a definition about trusted instrument which is used as collecting data tools because of that instrument has already good. The technique that is used in this research is used Alpha Cronbrach method because this equation can be used in the answer that has scale or dicotomic scale as like true (1), wrong (0). The split-half method formula as follow:

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

Notes :

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,2010:109)

The instrument can be called reliable in this technique, if coefficient reliability (r_{11}) > 0,6 or it can be compared with r table (product moment). If Alpha Cronbach reliability coefficient value higher than r table, so that this

instrument is reliable and vice versa. Here is the table of reliability level to interpreted reliability calculation result :

Table 3.11

Reliability Interpretation

Correlation Coefficient	Reliability Criteria
$0,80 < r \leq 1,00$	Very high
$0,60 < r \leq 0,80$	High
$0,40 < r \leq 0,60$	Enough
$0,20 < r \leq 0,40$	Low
$0,00 \leq r \leq 0,20$	Very low

(Arikunto, 2010: 75)

The result of reliability test in instrument analysis test is 0,87. It means that the items test are reliable. The criteria of reliability interpretation is very high. For recapitulation of all instrument data analysis is displayed in table below:

Table 3.12

Recapitulation of Instrument Data Analysis Result

No	Instrument Test Result						Decision
	Difficulty Level	Category	Discriminating Power	Category	Validity	Category	
1	0,63	M	0,4	G	0,69	H	Used
2	0,6	M	0,27	S	0,42	En	Used
3	0,8	E	0,53	G	0,56	En	Used
4	0,77	E	0,2	P	0,39	L	Used
5	0,17	D	-0,2	Neg	0,13	VL	Dropped
6	0,4	M	0,47	G	0,47	En	Used
7	0,47	M	0,33	S	0,42	En	Used
8	0,5	M	0,33	S	0,28	L	Dropped
9	0,6	M	0,4	G	0,88	VH	Used
10	0,67	M	0	P	-0,58	NV	Dropped
11	0,6	M	0,67	G	0,49	En	Used
12	0,43	M	0,33	S	0,42	En	Used
13	0,43	M	0,33	S	0,37	L	Used
14	0,3	M	0,2	P	0,26	L	Dropped
15	0,4	M	0,47	G	0,47	En	Used
16	0,43	M	0,6	G	0,77	H	Used
17	0,67	M	0,53	G	0,42	En	Used
18	0,7	M	-0,06	Neg	0,04	VL	Dropped
19	0,43	M	-0,47	Neg	-0,28	NV	Dropped
20	0,6	M	0,27	S	0,39	L	Used
21	0,3	M	0,2	P	0,29	L	Dropped
22	0,67	M	0,47	G	0,7	H	Used
23	0,5	M	0,2	P	0,43	En	Used
24	0,33	M	0,6	G	0,58	En	Used
25	0,67	M	0,4	G	0,37	L	Used

26	0,47	M	0,93	Ex	0,42	En	Used
27	0,1	D	-0,2	Neg	0,31	L	Dropped
28	0,37	M	-0,07	Neg	0,25	L	Dropped
29	0,2	D	-0,4	Neg	0,13	NV	Dropped
30	0,73	E	0,33	Sy	0,65	H	Used
31	0,53	M	-0,27	Neg	0,01	VL	Dropped
32	0,5	M	0,47	G	0,44	En	Used
33	0,67	M	0,4	G	0,57	En	Used
34	0,47	M	0,27	S	0,28	L	Dropped
35	0,5	M	0,47	G	0,4	En	Used
36	0,3	M	0,33	S	0,21	L	Dropped
37	0,37	M	0,4	G	0,73	H	Used
38	0,53	M	0,4	G	0,96	VH	Used
39	0,17	D	-0,2	Neg	0,13	VL	Dropped
40	0,67	M	0,33	S	0,7	H	Used
41	0,27	D	0,13	P	0,31	L	Dropped
42	0,37	M	-0,33	Neg	-0,4	NV	Dropped
43	0,6	M	0,27	S	0,56	En	Used
44	0,53	M	-0,27	Neg	0,17	VL	Dropped
45	0,57	M	0,33	S	0,37	L	Used
46	0,67	M	0,4	G	0,7	H	Used
47	0,33	M	0,53	G	0,05	VL	Dropped
48	0,47	M	0,53	G	0,42	L	Used
49	0,27	D	0	P	0,31	L	Dropped
50	0,63	M	0,2	P	0,16	VL	Dropped

G. Research Procedure

The steps to be performed in this study there are three phases, including planning, implementation, and final stage. It is described as follows:

1. Planning

There are several activities on planning steps:

a. Preliminary Study

Preliminary study is to identify the problem. What happens to the current study is primarily learning activity activity in optic topics in junior high school grade VIII Pribadi Bilingual Boarding School Bandung. Then determine the purpose of the study based on the research to be conducted. After that, formulate problem, after that formulate hypothesis based problem.

b. Literature Review

Literature Review is the search for theories that appropriate with research variable as follows: virtual laboratory, conceptual mastery, and gender differences in education, as well as a review of previous studies. In addition to reviewing this, the standard of competence, basic competence, and learning on the topic of optical indicators were assessed.

c. Design The Research Instrument

Research Instrument as a tools for doing a research, one of them is Virtual laboratory as learning media. Researcher make storyboard and then make software helped by programmer, then make a revision after it is judged by expert. Research instrument also is designed as tests and questionnaires. Test will be used to gain an understanding or conceptual mastery of the concepts in learning optics i.e. before learning and after learning and in the learning activity. Before the test is distributed to the students, it has to be judged first. After the test has already distributed, it should be collected and analyzed. The test will be tested by using instrument analysis, Discriminating power, and level of difficulty, validity, and reliability with computation using Ms.Excel. Then, revision of instrument to get valid and reliable instrument that has to be selected as instrument test objective.

While the questionnaire is used to determine how students' interest in physics after using virtual laboratory media.

2. Implementation

Activities undertaken at this stage is the implementation of the pretest, learning activities, and posttest implementation. In learning activity, there is the use of virtual laboratory learning media in both of class VIII A as male class and VIII B as female class. While the pre-test is given before treatment and post-test is given after treatment, both of them entirely on the concept of optical topics to measure conceptual mastery or achievement of students. Implementation of this research is three times for each class in each times is two hours lessons. Also the students are given questionnaire about their opinion of their interest in physics after learn physics lesson using virtual laboratory.

3. Final Steps

In final stage consists of data processing, data analysis, and make conclusions, and make a final report. Data analysis consisted of normality test homogeneity test, and hypothesis test.
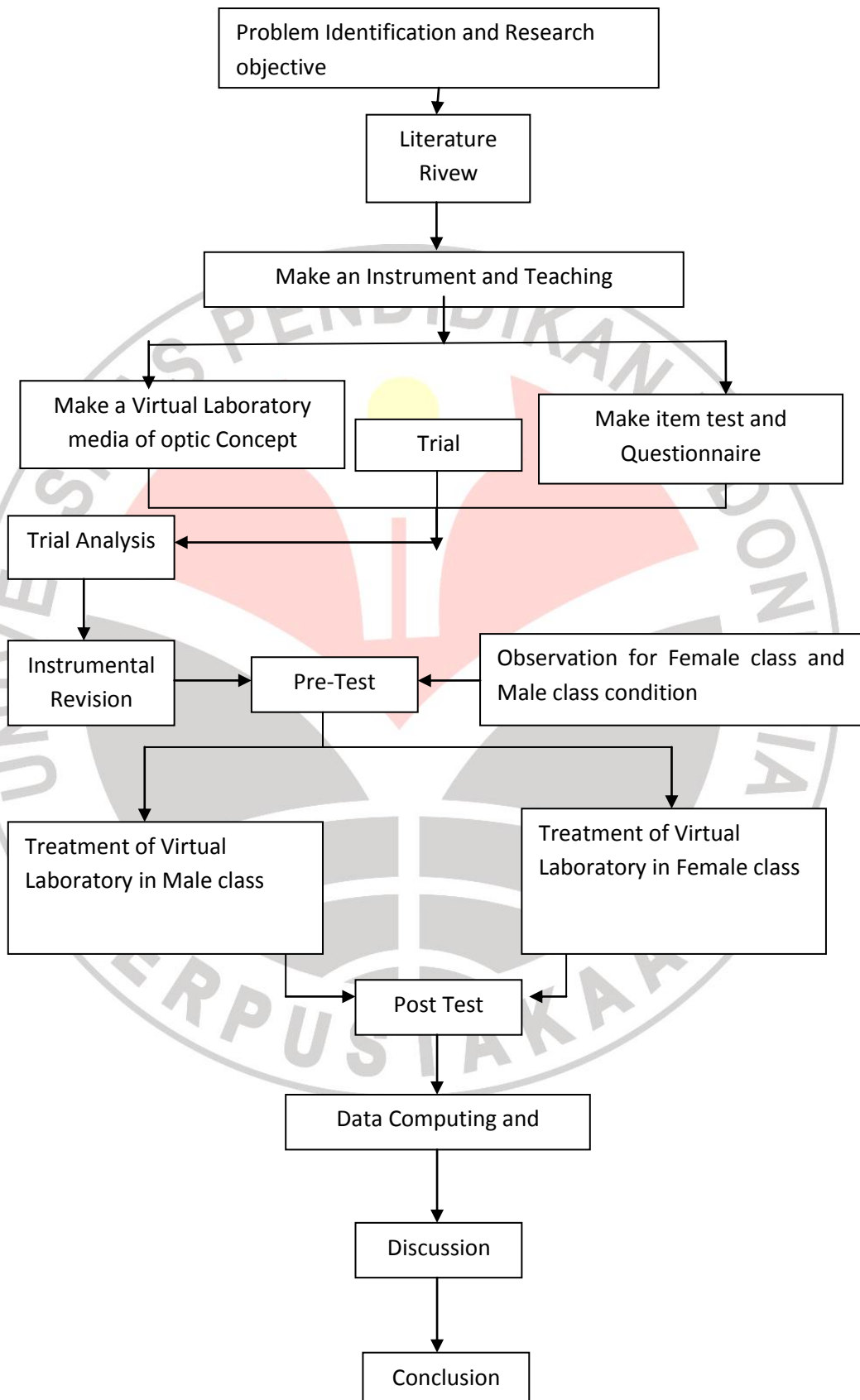
4. Research Flow


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┌─────────────────────────────────────┐
│ Problem Identification and Research  │
│ objective                            │
└─────────────────────────────────────┘
                   │
                   ▼
        ┌────────────────────┐
        │ Literature         │
        │ Rivew              │
        └────────────────────┘
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    ┌──────────────────────────────────┐
    │ Make an Instrument and Teaching   │
    └──────────────────────────────────┘
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Make a Virtual Laboratory media of optic Concept

Trial

Make item test and Questionnaire

Trial Analysis

Instrumental Revision

Pre-Test

Observation for Female class and Male class condition

Treatment of Virtual Laboratory in Male class

Treatment of Virtual Laboratory in Female class

Post Test

Data Computing and

Discussion

Conclusion

Figure 3.1
Flow of Research

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H. Data Analysis and Hypothesis Test

1. Normality test

Using of parametric statistic has a deal with assumption that each variable in this research that will be analyzed form a normal distribution. If, the data is abnormal so, the parametric technique can not be used. It has to use non-parametric statistic. Normality test is to know whether the sample comes from population that has normal distribution or not. In this research, Normality test is uses statistic test from SPSS 18, ***Kolmogorov-Smirnov*** with significancy level (α) is 0,05. The criteria is when significance value > 0,05 so, H0 will be accepted and H0 will be rejected or denied if significance value < 0,05 (Sarwono, 2012: 96). The hypothesis are:

H_0 : Sample comes from population that has normal distribution.

H_1: Sample comes from population that has not normal distribution.

2. Homogenity test

Homogenity test or used for determine a sample from population that originated from two classes that homogen. Homogenity test that is done in this research is Test of Homogenity of Variance in SPSS 18.0. Significancy level (α) is 0,05. The criteria is when significance value > 0,05 so, H_0 will be accepted and H_0 will be rejected or denied if significance value < 0,05 (Sarwono, 2012: 206). The hypothesis are:

H_0 : Each group has the same variance (Homogen).

H_1: Each group has not the same variance (Not homogen).

3. Hypothesis test

a. T-test

To test the hypothesis, so it will use *t* test, using this test will determine also differences of average between girls and boys result. This test is used in several condition, the sample has to be distributed normally and each group has to have the same variance or homogen (Sarwono, 2012: 150). Because the data is already homogen and normal distribution in this research, so this test will be used

by using SPSS 18.0. Criteria of this test is when $t_{computaion} > t_{table}$, so H_0 will be rejected. If $t_{computaion} < t_{table}$, so H_0 will be accepted (Sarwono, 2012: 150). This test is tested in pretest and posttest result of students in boys class and girls class. Here there are the hypothesis to test the difference of average pretest result in boys class and girls class:

H_0 : There is no differences of average pretest result between boys class and girls class.

H_1: There is differences of average pretest result between boys class and girls class.

This test also tested in posttest result of boys class and girls class. Here there are the hypothesis to test the difference of average posttest result in boys class and girls class:

H_0 : There is no differences of average posttest result between boys class and girls class.

H_1: There is differences of average posttest result between boys class and girls class.

b. Calculation of *Gain* score and *N-Gain* score

Gain is calculated to know the differences between pretest score and posttest score, so that the improvement of learning can be seen or it can be called can show the changes that happened before and after learning. Calculation of actual *Gain* by posttest score minus pretest score. Then, *Gain* score that is obtained after that calculate normalization Gain.(*N-gain)*. This score that will be used for comparison test if there is pretest score which is significant.

N-Gain can show meaningful improvement rather than actual *Gain*. Because using *N-Gain* the improvement of higher achiever students and lower achiever students can be shown clearly. The formula of *N-Gain* can be shown as bellow:

$$<g> = \frac{Spost - Spre}{Smax - Spre}$$

Notes :

$\langle g \rangle$ = *N-Gain*

Spost = Posttest score

Spre = Pretest score

Smax = Maximum score

Then, the value of *N-Gain* is determined based on criteria below

Table 3.13

Criteria of N gain Improvement

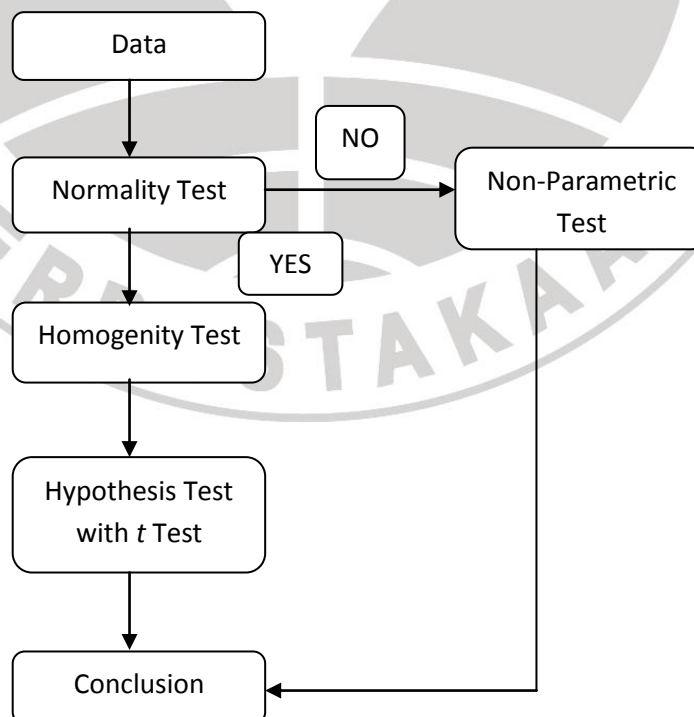| Normal gain $\langle g \rangle$	Improvement criteria
$\langle g \rangle < 0{,}3$	Low
$0{,}3 \leq \langle g \rangle \leq 0{,}7$	Medium
$\langle g \rangle > 0{,}7$	High

(Hake, 1998)

4. **Flow of Data Analysis**

Figure 3.2
Flow of Data Analysis