

CHAPTER III

RESEARCH METHODOLOGY

A. Research Design

This research uses quantitative approach, based on research objectives that want to be achieved then research method that chosen by researcher is quasi-experimental. In this research determines the differences of learning achievement of students when using simulation and using PowerPoint presentation as media in the learning process. In conducted quasi-experimental it used two group, there are experimental group and control group.

The research design in this paper is Matching Pretest-Posttest Control Group. Research designs of this research uses two group, there are experimental group and control group. Experimental group is given the treatment by using PhET simulation as media in learning process, otherwise for control group is given the treatment by using PowerPoint presentation as media in the learning process.

In this design, pretest is given to both of groups then experimental group given the treatment by using PhET simulation for three meeting. Meanwhile control group given the treatment by using PowerPoint presentation. After both of group was given the treatment, then they give posttest. Test instrument that used for posttest is same as instrument in the pretest.

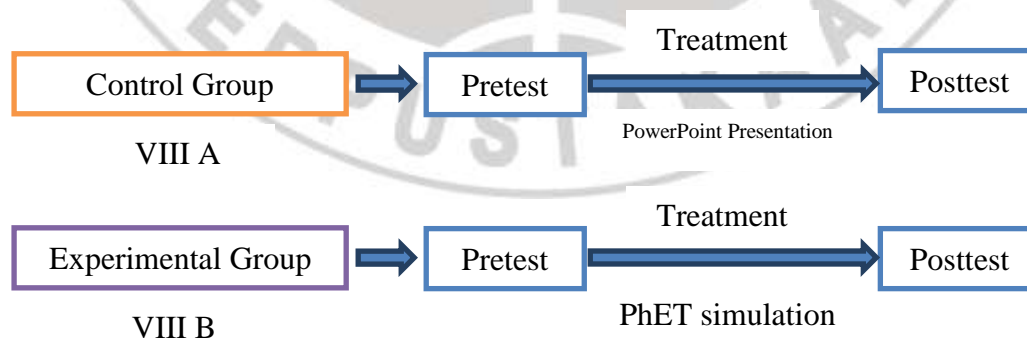


Figure 3.1 Research Design

B. Research Subject

This research was conducted at one of Junior High School in Cimahi. This research was conducted in the second semester in 2012/2013 academic year. This research was conducted for two weeks at least 4 meetings in May. Population in this research is all of students in 8th grade. Every class consists of 27 students, so number of population in this study is 243 students that spread out in nine classes.

Sample is the representative of population. In this research, researcher used two groups from population as the sample of study. Sample is chosen by random sampling technique, researcher did lottery to determined experimental group and control group. Researcher took two pieces of paper which have been written the name of all class. After researcher did the lottery, finally the sample of this research is VIII A and VIIB that have the same total number of students is 27 students. Group of VIII A is chosen as control group and group of VIII B is chosen as experimental group.

C. Definition of Terms

Operational definition in research is necessary because to avoid misunderstanding between researcher and the reader. There is some terms that must be explained from this study, as follow as :

1. PhET Simulation

PhET is an interactive computer simulation for teaching and learning physics, chemistry, math, and other sciences. PhET simulations can be run online or downloaded (offline mode) from the PhET website. The simulations are animated, interactive, and game-like environments where students learn through exploration. They emphasize the connections between real-life phenomena and the underlying science, and help make the visual and conceptual models of expert scientists accessible to students. In learning process PhET simulation is used by students in group activity. Students work

in pairs with their own computer and manipulate the sim by themselves. Even though they work and manipulate the sim by themselves, they are guided by students' worksheet and teachers' explanation.

2. PowerPoint Presentation

Presentation is a way that used to describe something in the form of PowerPoint that have summarized and packed with interesting visualization. In addition, presentation is an active activity where narasumber explain and communicate information to the audients. Presentation is created in the form of PowerPoint presentation that contains text, picture, graph, table and etc. PowerPoint presentation should be able to attract the attention of the audience and have good quality

3. Learning Achievement

Learning achievement is a result or level of ability of students that have been achieved after participating in learning process in the form of changes in behavior skills, and knowledge at certain time then will be measured by using test and assessed into score or statements. In this study, to measured students' achievement by using pretest and posttest. The type of question that used in pretest and posttest is multiple choices. It consists of six cognitive domain based on Revised Bloom Taxonomy from C1 until C6. There are 20 questions and it is used in pretest and posttest.

D. Instructional Tools

1. Lesson Plan

Lesson plan is the design of instructional arrangement that used to conduct the learning process. It is used to be teacher's guidance in conduct learning process to achieve the intended learning outcome and learning objectives. The objective of the learning in both of group are`not much different, it is due to the experimental group is using PhET simulation and control group is using PowerPoint Presentation as treatment in this study. The differences of lesson plan

it can be seen in Appendix A.1 for experimental group and Appendix A.4 for control group.

2. Learning Scenario

Learning scenario is briefly illustration of lesson plan. Learning scenario is the design of classroom activity for each meeting that describes initial activity until closing activity. Learning scenario in experimental group and control group is different. For experimental group is using PhET simulation in the learning process it showed in Appendix A.2, meanwhile control group is using PowerPoint in the learning process it showed Appendix A.2 and Appendix A.5.

3. Students Worksheet

Students' worksheet is an additional tool to help students in using PhET simulation in the learning process. Students' worksheet is used to be students' guidance during using PhET simulation. It consists of steps that must be followed by students in using PhET simulation and there is question refer to PhET simulation that should be solved by students. There is three design of students' worksheet for each meeting. It showed in Appendix A.3 for experimental group and Appendix A.6 for control group.

E. Treatment

In this study used two kind of treatment, first is PhET simulation and second is PowerPoint Presentation. Both of treatment is used in different group, PhET simulation used in experimental group and PowerPoint Presentation used in control group.

1. PhET Simulation

PhET simulation is a software that provides learning situation that resembles the real situation or real phenomena by using computer. PhET provides many simulation in science concept. The concept that used in this study is light refraction. The concept of light refraction divided into two sub topic, first topic is about Laws' of Light Refraction and second topic is about Light Refraction on Lenses. Both of sub topic are presented in PhET software. Two sub topic that

explained to the students available in PhET simulation as Bending Light Simulation and Geometric Optic Simulation. It is showed in figure 3.2 and 3.3.

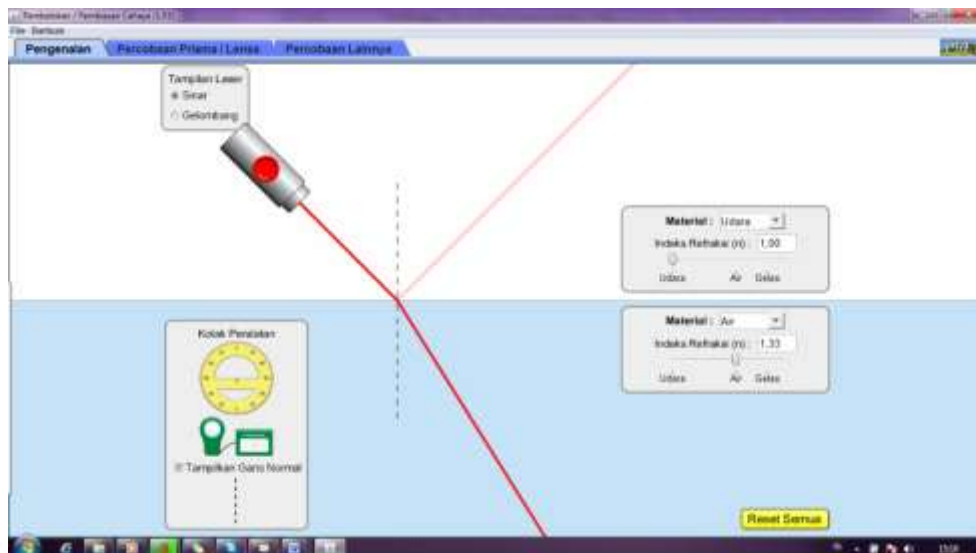


Figure 3.2 Screen Capture from PhET Simulation Software - Laws' of Light Refraction Concept

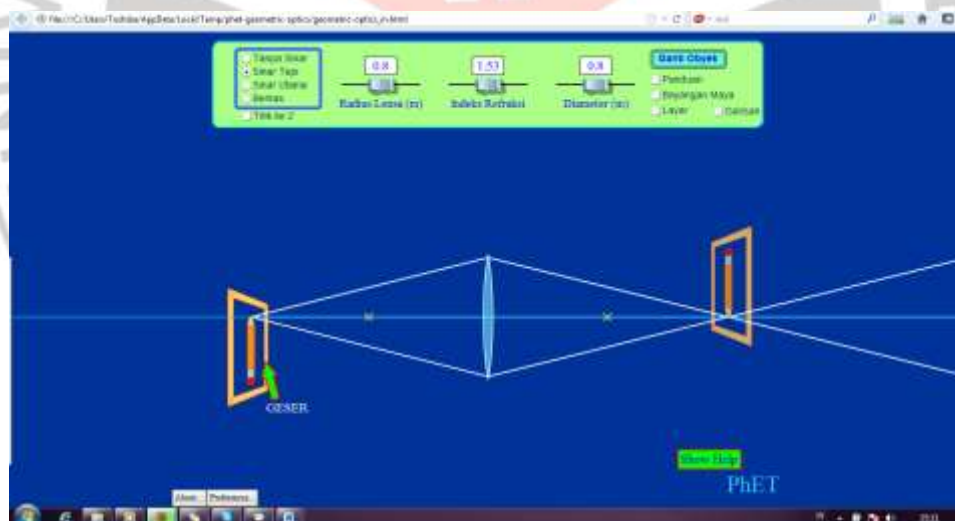


Figure 3.3 Screen capture from PhET Simulation Software - Light Refraction on Lens

In figure 3.2 students asked to find The Laws' of Light Refraction. They also found the components that influence in light refraction process such as material or solution, angle of incidence, angle of refraction, and index of refraction. They find the concept of laws' of refraction by themselves but it was guided by students' worksheet. They can change the button in PhET simulation

freely as long as they follow the procedures. In this simulation, students asked to change the type of material in first medium and second medium, then they analyze what happen with the light when pass through into second medium. Beside that they also find the formula of refraction index based on their finding. This simulation also provide protractor ruler to make students easy when measure the incidence angle or refraction angle.

In figure 3.3 students asked to analyze the process of light refraction in lenses. Same as in the previous simulation, in this simulation students can change the button freely as long as they follow the procedures. In this simulation, they can set the object to find the image in lenses or set the distance of focal length. Students can change picture of the object, there are three options such as pencil, star, and smile animation. In this simulation students asked to analyze the forming of image in refraction of lenses. This simulation also provide ruler to make students easy when measure the distance of object and the distance of image.

2. PowerPoint Presentation

Microsoft PowerPoint is a presentation program in computer that developed by Microsoft in the Microsoft Office application package. Microsoft PowerPoint is an application that is widely used for presentation purpose, such as seminar, promotion of products, as well as scientific activity. PowerPoint is an application program that is used to create presentation in the form of text, table, picture, graph, diagram and etc. Presentation is a way that used to describe something in the PowerPoint application which have summarized and packed with interesting visualization. In addition, presentation is an active activity where narasumber explain and communicate information to the audience. PowerPoint presentation should be able to attract the attention of the audience and have good quality. In control group PowerPoint Presentation is used to describe two sub topic of Light Refraction. PowerPoint Presentation that used in this research it showed in Figure 3.4 and 3.5.

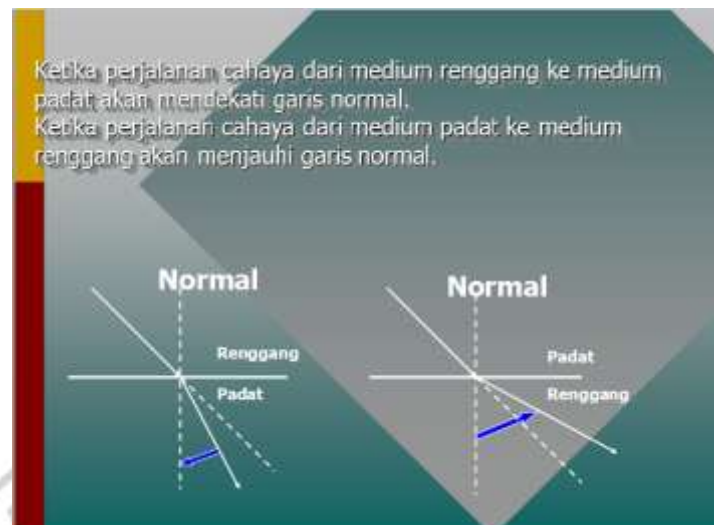


Figure 3.4 Screen Capture from PowerPoint Presentation - Laws' of Light Refraction Concept

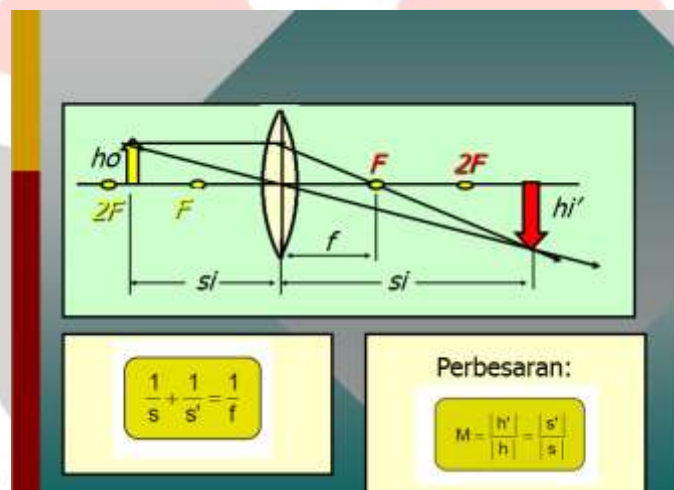


Figure 3.5 Screen Capture from PowerPoint Presentation - Light Refraction on Lenses

In PowerPoint Presentation that used in this study divided into two kind of PowerPoint Presentation Slide, first is about Laws' Light Refraction it shown in figure 3.4 and second is Light Refraction on Lenses it shown in figure 3.5. PowerPoint Presentation shows the explanation about the concept. The explanation contains key point about the concept such as definition of refraction, or terms that taught in light refraction concept. In both of PowerPoint Presentation Slide student doesn't participate in the learning process means that students only

listen teacher's explanation through PowerPoint Presentation. They don't find the concept by themselves. Beside explanation, in PowerPoint Presentation slide also provides picture to help student when understand the concept such as when teacher explains the forming of images in lenses it will be helped by picture.

F. Research Instrument

Research instrument according to Arikunto (2002) is a tool which is chosen and used by researcher in their activity in order to collect the data so their activity become systematic. Instrument that used in this research is a learning achievement test (pretest and posttest) and questionnaires

1. Learning Achievement Test (Pretest and Posttest)

Learning achievement test is an instrument that used to collect the development of students' learning achievement in the concept of light refraction in cognitive domain. Learning achievement test that used in this study in the form of pretest and posttest.

Pretest is conducted before students using PhET simulation in the learning process. Pretest is to investigate basic knowledge of the students in both of group in the concept of light refraction.

On the other hand, posttest is conducted after students already have using PhET simulation in the learning process. The purpose of conducting posttest is to measure the development of students' achievement after using PhET simulation. Posttest activity could be conducted immediately after given the treatment.

The type of question that used in pretest and posttest is multiple choices about light refraction concept. It consists of six cognitive domain based on Revised Bloom Taxonomy from C1 until C6. There are 20 questions and it is used in pretest and posttest. Those of questions spread of in six cognitive domains and have indicator for each question. Blueprint of pretest and posttest is provided on the table 3.1 is shown below.

Table 3.1
Blueprint of pretest and posttest

Indicator	Test Item Number
Describe the process of light refraction	1
Describe the Snellius' Law of Light Refraction	2
Draw the process of light refraction in the different medium	3
Apply the concept of light refraction in the daily activity	4
Make the diagram of light refraction that have different of refraction index	5
Interpret the relationship between incident angle and refraction angle	6
Analyze the type of medium in the process of light refraction	7
Calculate the refraction index in medium	8
Deduce the value of refraction index of medium	9
Identify the characteristics of convergent lens	10
Analyze special rays in lens	11
Design the product to solve the problem	13, 19, 20
Analyze the characteristics of image in convergent lens	14
Apply the formula of lens to solve the problem	15
Predict the relationship between refraction index, distance of image, and height of the image	12
Remember the characteristics of special rays in divergent lens	16
Describe the characteristics of image in divergent lens	17
Deduce the characteristics of lens in the certain problem	18

Instrument or test items should be tested before given to the students in both of groups to know the quality of instrument. Scarvia B. Anderson (Arikunto, 2002) stated that "A test is valid if it measure what is purpose to". Testing of instrument that conducted in this research is validity and reliability of instrument. Testing of instruments that have characteristics of both and must comply with several rules include :

1. Validity of Test Items

“Validity of instrument is accuracy of instrument toward the concept that will be measured, so an instrument is called valid if it measure what is purpose” (Suherman, 2003: 102). An evaluation instrument said to be good when having high validity. High and low validity of the instrument can be calculated with the validity and is considered to be a validity coefficient. Validity of item test in this study is using judgment from the subject matter expert. The expert who judge the item test in this study is physics experts, they are two physics lecturers from Universitas Pendidikan Indonesia and physics teacher from SMP Negeri 1 Cimahi. In this study, judges evaluate the appropriateness of item test with the criteria such as indicator, level of cognitive domain and knowledge dimension. According to Lawshe, “if more than half the judges indicate that an item test is essential, that item test has at least some content validity. Greater levels of content validity exist as larger numbers of judges agree that an item is essential”. The item test could be rejection or repaired. Because of the judgment in this study 3 experts, so the item test will be rejection if only one person who agree with the item test. They judge 36-item test, every item test have their indicator, cognitive domain and knowledge dimension. After judge with the expert, 12-test items are rejection, 6-test items are repaired, 18-item are accepted.

Table 3.2
Result of Validation Item Test

Test item	Indicator		Knowledge Dimension		Cognitive Domain		Note
	Yes	No	Yes	No	Yes	No	
1	I	II	I	II	I	II	Not used
2	II	I	III		II	I	Used
3	I	II		III	I	II	Not used
4	II	I	II	I	II	I	Used
5	II	I	III		II	I	Used
6	II	I	II	I	II	I	Used
7	II	I	III		III		Used
8	I	II	III		III		Used
9	II	I	III		I	II	Repair
10	II	I	III		III		Used
11	III		III		III		Used
12	I	II	I	II	I	II	Not used
13	I	II	III		II	I	Not used
14	I	II	III		III		Repair
15	II	I	II	I	I	II	Repair
16	I	II	II	I	II	I	Repair
17	II	I	III		III		Used
18	I	II	III		III		Repair
19	II	I	II	I	III		Used
20	I	II	III		III		Repair
21	I	II	III		II	I	Not used
22	I	II		III	III	III	Not used
23	I	II	III		III		Repair
24	II	I	II	I	II	I	Used
25	I	II		III	I	II	Not used
26	II	I	II	I	II	I	Used
27	III		III		III		Used
28	II	I	III		III		Used
29	II	I	III		III		Used
30	II	I	III		III		Used
31	II	I	III		III		Used
32		III		III		III	Not used
33	I	II	III		I	II	Not used
34		III	III		III		Not used
35		III		III		III	Not used
36	III		III		III		Used

2. Reliability

Reliability of an instrument is intended as a tool that gives the same results if the measurement is given on the same subject although done by different people, at different times and different places (Suherman, 2003: 131). It is not affected by the behavior, circumstances, and conditions. High reliability measurement tool called a reliable gauge. Reliability of item test is conducted by test it to the students after test item was evaluated by the experts. Students who test the item doesn't come from experimental group or control group. It used 24-test items to calculate reliability. In this study, calculating reliability is using SPSS 18.0 to make it efficient.

Table 3.3
Reliability of Item Test

Reliability Statistics	
Cronbach's Alpha	N of Items
.722	25

Table 3.3 shows the result of reliability of item test. Reliability value in this table can be seen in the Cronbach's Alpha column, it is about 0,722. As general interpretation, if the reliability value $> 0,6$ it means that the test item which used is reliable.

Those all test item that have been validated in this study is written on Table of Specification of Test Items, it can be seen on Appendix B.2. After instrument has been tested, it is given to experimental group and control group in the form of pretest and posttest. Pretest is given to determine prior knowledge of students in both group, meanwhile posttest is given to shows the development of students' learning achievement in both group. All test items spread out into six cognitive domains, as follow as :

Table 3.4

Distribution of Test Items in Cognitive Domain

Cognitive Domain	Test Item
C1 – Remembering	2,10,16
C2 – Understanding	1,3,17
C3 – Applying	4,8,15
C4 – Analyzing	5,7,11,14
C5 – Evaluating	6,9,12,18
C6 – Creating	13,19,20

2. Questionnaire

Questionnaire is used as an instrument in order to determine students' response about the effectiveness of using PhET simulation as media in learning process and it is given in the last meeting after students do the posttest. Questionnaire in this study divides into 3 categories, there are usability, understandability and enjoyable. Questionnaire could be conducted immediately after students did the posttest in the experimental group. This questionnaire contains four selections of answers Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD).

Table 3.5
Design of Questionnaire in the Use of PhET Simulation

No	Indicator	Answer				
		SA	A	N	D	SD
Usability						
1	Object or picture in the simulation can be changed					
2	I can operate the buttons in the simulation easily					
3	I can measure the distance of object, image, height of object and image by using ruler that provides in simulation easily.					
4	I can see the path of light when formed an image clearly					
5	The image that formed in simulation can be seen clearly					
Understandability						
6	Simulation can clarify the abstract concept become more real and easy to understand					
7	Simulation gives the simple way to recall the concept of light refraction					
8	Simulation that shown in the computer can help me to understand and analyze the phenomena in refraction concept					
9	Simulation can help me to know the key terms in the concept of light refraction					
10	After learning by using simulation as media, I can construct the equation that taught in the concept of light refraction.					
Enjoyable						
11	Learning environment by using simulation is fun and enjoy so I am really curious to learn physics					
12	By playing simulation, my motivation and curiosity in					

	learning physics is increasing					
13	In use of simulation still need teacher's explanation					
14	Learn by using simulation can make good interaction between students and teacher					
15	Learn by using simulation can make me more active in the learning process					

F. Research Procedures

There are three stages that have done in this research procedure; first is preparation stage, second is data implementation stage, third is data analysis stage, and the last is completion stage that described as follows:

1. Preparation Stage

Before conduct the research, the researcher should prepare all the things that needed in the research. In preparation stage are mainly about the steps when the researcher preparing all instrument being used in research, as follow :

- a. Identify issues to be used as research material through observations or problem that happening nowadays.
- b. Reading some literature study such as journal as the foundation to determine the research problem of this study
- c. Determine the material that will be used in the research. In this research, researcher chooses Light Refraction Concept because this concept is one of abstract concept that students get difficulties to be learned.
- d. Designing lesson plan and learning scenario appropriate with the material taken and PhET simulation used in the learning process
- e. Designing instrument that will be used in the research. In this research, some instruments needed in order to support the research to be conducted such as Learning Achievement Test (Pretest and Posttest) and Questionnaire.
- f. Before the instrument used, it must be validated first. In this research used expert judgment, it is to judge the instrument is suitable to use in the

learning process or not. Unfortunately only pretest and posttest that was validated by the expert.

- g. Doing revision of the instrument to revise some mistakes or incomplete term made by the researcher after judged by the expert.
- h. Validating the instrument pretest and posttest by tested it to the students.
- i. Calculating the reliability of test items after tested to the students.
- j. Ignore the test item that not fulfill the validity and reliability criteria.
- k. Determine research sample by using random sampling technique.

2. Research Implementation Stage

In the conduct of research done stages as follows:

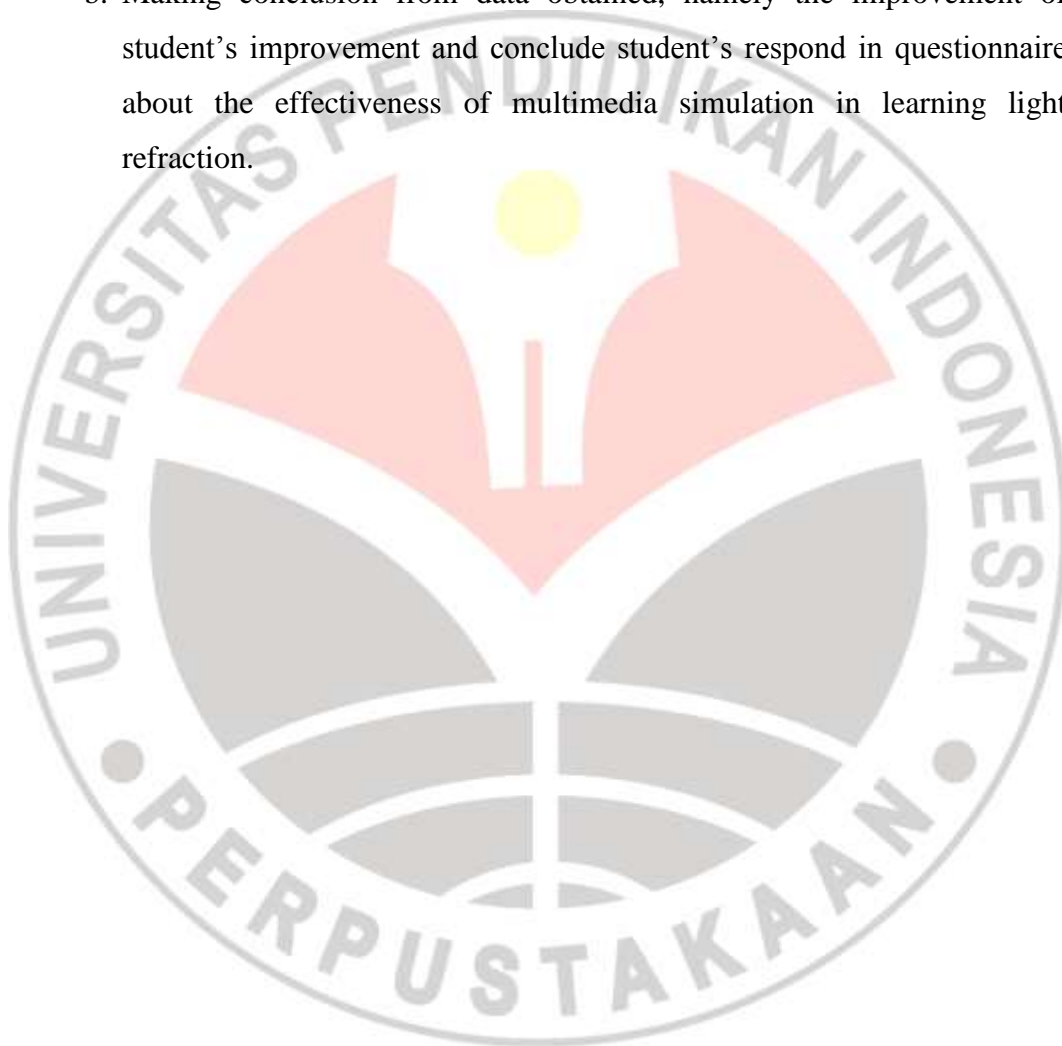
- a. Conducting the pretest with the same question to the experimental group and control group to measure basic knowledge of the students before learning process.
- b. Give the treatment using PhET simulation learning activities in experimental group. Experimental group studies in computer laboratory in the group of two students. Meanwhile the control group using traditional teaching-learning model by PowerPoint Presentation that given by teacher during the lesson activity, but both of group have same the number of hours of the lessons, teachers and subjects. Two observer came to observe the whole process of the implementation occurred in the experimental group with the guidance from the writer and the observational sheet given to check whether the implementation process suit the lesson plan prepared by the writer or not. Students given the treatment for about three meeting.
- c. After third meeting students give posttest with the exactly same questions as pretest question distributed to measure the improvement of student's achievement in both experimental and control group. Distributing questionnaire to students to know students' response about using simulation in the teaching-learning activity is effective or not.

3. Final Stage

In the final stage performed the following steps:

H. Data analysis done to process the data obtained from the whole research pretest and posttest data processing done using SPSS 18.0 .

b. Making conclusion from data obtained, namely the improvement of student's improvement and conclude student's respond in questionnaire about the effectiveness of multimedia simulation in learning light refraction.



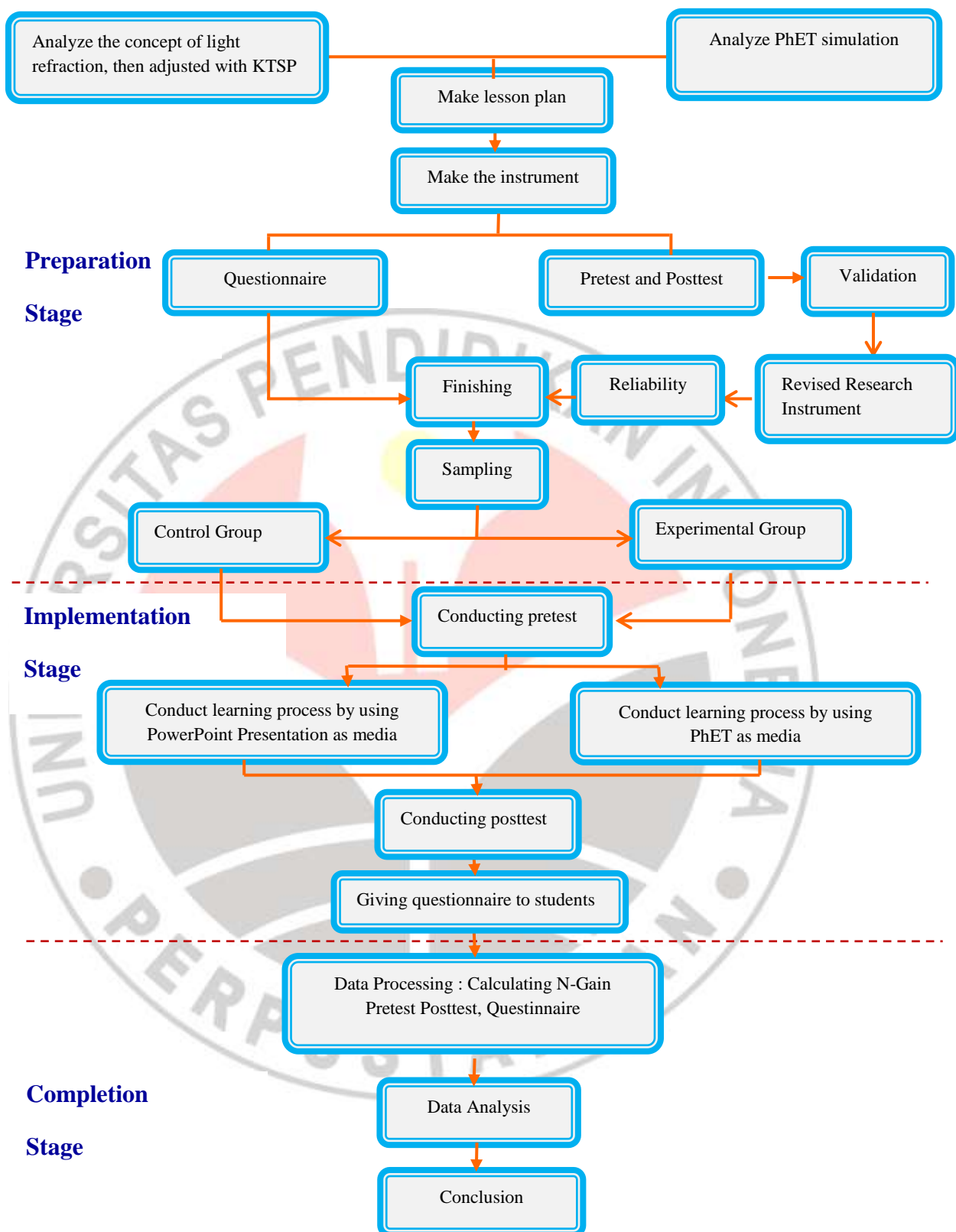


Figure 3.6 Research Procedures

H. Data Analysis

Data that has been obtained from research instrument then will be processed by using statistic. Statistic used to analyze data. For time efficiency of data processing, researcher using SPSS software (Statistic Product and Service Solution) is a statistical computer program that capable to processing statistic data quickly and accurately, as well as serving in a variety of output.

1. Analysis Improvement of Students' Achievement

To simplify the data processing, all statistical tests in this research was performed using SPSS 20.0 for windows. in detail the techniques of data analysis in this research are as follows:

a. Normality Analysis

Normality is identified to search whether gain from control group and experimental group are distributed normally or not. This analysis will be used as the consideration in analysis data whether the analysis use of parametric or non-parametric analysis test. If both data distribute normally, we can continue the data processing to homogeneity test. If the data show that the distribution from one or all the data not normally distribute, the data processing can continue using non-parametric statistic it is using Mann Whitney test.

b. Homogeneity Analysis

When the normality has been identified, the consideration of analysis method is not able to considered yet. Nevertheless, another aspect which needs to be identified is homogeneity. If both data normally distribute and homogenous, the hypothesis test will be use is *t-test* (more than 25 students), meanwhile if the data comes from normal and did not have homogenous variances hypothesis test that will be use is *t'* test.

c. Score of Mean Difference

Score of mean difference is done to determine whether both group (experimental and control group) have the same mean score or not. If the data obtained normally distribute and has homogenous variances the next test will be *t-test* (independent sample *t* test). If the data normally distribute and did not have homogenous variances will be tested using *t'* test. Meanwhile if the data obtained

did not distribute normally and did not have homogenous variances the test will be use is non-parametric test (Mann Whitney test).

d. Significance test

To analyze the correlation of pre-test and post-test result, the determination of normalized gain index is conducted. Normalized gain is calculated by using the formula proposed by Hake (1998):

$$\langle g \rangle = \frac{\% \text{ posttest score} - \% \text{ pretest score}}{100 \% - \% \text{ pretest score}}$$

Table 3.6

Table of N-Gain Criteria

Gain	Interprets
$g > 0,7$	High
$0,3 < g < 0,7$	Medium
$g < 0,3$	Low

2. Analysis Improvement of Students' Achievement in Cognitive Domain

To simplify the data processing, all statistical tests in this research was performed using SPSS 20.0 for windows. in detail the techniques of data analysis in this research are as follows:

a. Normality Analysis

Normality is identified to search whether gain of each cognitive domain from control group and experimental group are distributed normally or not. This analysis will be used as the consideration in analysis data whether the analysis use of parametric or non-parametric analysis test. If both data distribute normally, we can continue the data processing to homogeneity test. If the data show that the distribution from one or all the data not normally distribute, the data processing can continue using non-parametric statistic it is using Mann Whitney test.

b. Homogeneity Analysis

When the normality has been identified, the consideration of analysis method is not able to be considered yet. Nevertheless another aspect which needs to be identified is homogeneity. If both data normally distribute and homogenous, the hypothesis test will be use is *t-test* (more than 25 students), meanwhile if the data comes from normal and did not have homogenous variances hypothesis test that will be use is *t'* test.

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$$\langle g \rangle = \frac{\% \text{ posttest score} - \% \text{ pretest score}}{100 \% - \% \text{ pretest score}}$$

3. Analysis Of Questionnaire

Questionnaire used in this research was a questionnaire with a percentage scale. In this questionnaire, the respondents were asked to provide an assessment of the media associated with the use of PhET simulation. In processing data, using a Likert's scale with the formula used is:

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

Note :

P : Percentage of the students' responses

f : Frequency of the students' responses

n : Number of students

