Chapter III
RESEARCH METHODOLOGY

A. Location, Population and Sample

1. Research location

The research was held in Mutiara Nusantara International School (MNIS). This research was involved 9 students from 9th grade students of MNIS. The research was conducted in the physics laboratory for 3 meetings.

2. Population

According to Sarwono (2006), population is defined as set of complete analysis unit which is investigated. Population in this research is all Middle school students in Mutiara Nusantara International School that have the same level of understanding.

3. Sampling

Sample according to Sarwono (2009) is sub from set of element that is chosen for being observed. The sampling is taken based on purpose (purposive sampling) due to in Mutiara Nusantara International School there is only one class in each grade. 1 class is chosen with population is 9 students of 9th grade of Mutiara Nusantara International School, students will be divided into 2 groups. The division of the group was using convenience technique. The classes will be taught by the same teacher. The classes were assigned to two condition in which first group complete the virtual experiment followed by the physical experiment (Virtual-Physical condition), the second group complete the physical experiment followed by the virtual experiment (Physical-Virtual condition).

B. Research Design

Qualitative descriptive was used in this research. The data gained from research instruments in this research will be explained descriptively. According to Sarwono (2006) qualitative design is flexible and can be changed based on the condition of the research field, the role of research design is to help researcher in guiding in doing research process in line with research problems and run systematically

C. Research Method

1. Triangulation Method

Triangulation method was used in order to find the answer of research problems. According to Rahardjo (2010) Triangulation is multi-methods or multi-sources approach conducted by researcher to collect and analyzing the data. Data triangulation could be using different sources of information in order to increase the validity of a study. Thus in this research different kind of instruments were used to answer research questions. The instruments used were teaching-learning observation, students' worksheet, and narrative of teaching-learning activity. Although the method used was qualitative but the experiments remained to be done. Pre-test and post-test were used just as additional information in discussion.
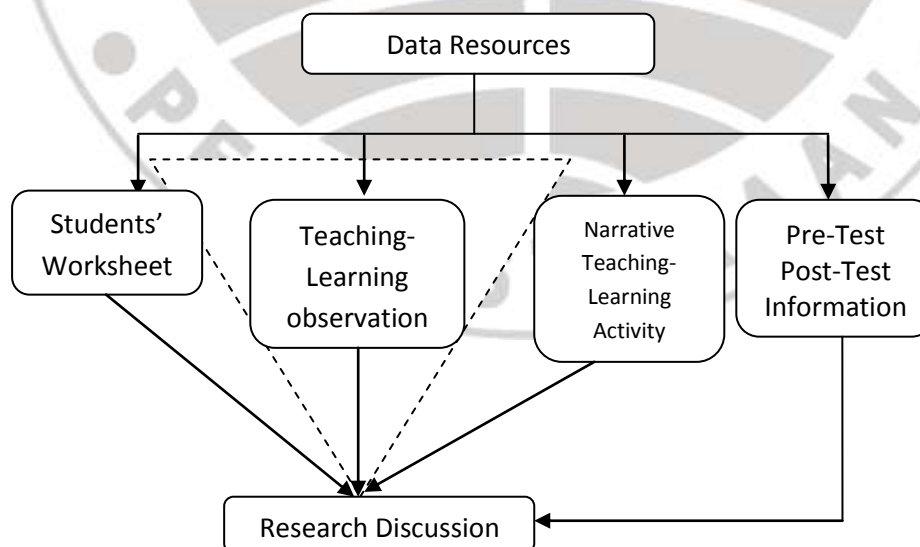

Figure 3.1: Triangulation of Research Data Resources

2. The Plot of the Research

Research Background

↓

Problem Identification

↓

Research Instrument

Teaching-Learning Instrument

Pre-Test

Judgment Validation

Teaching-Learning Activity

Post-Test

P-V   V-P

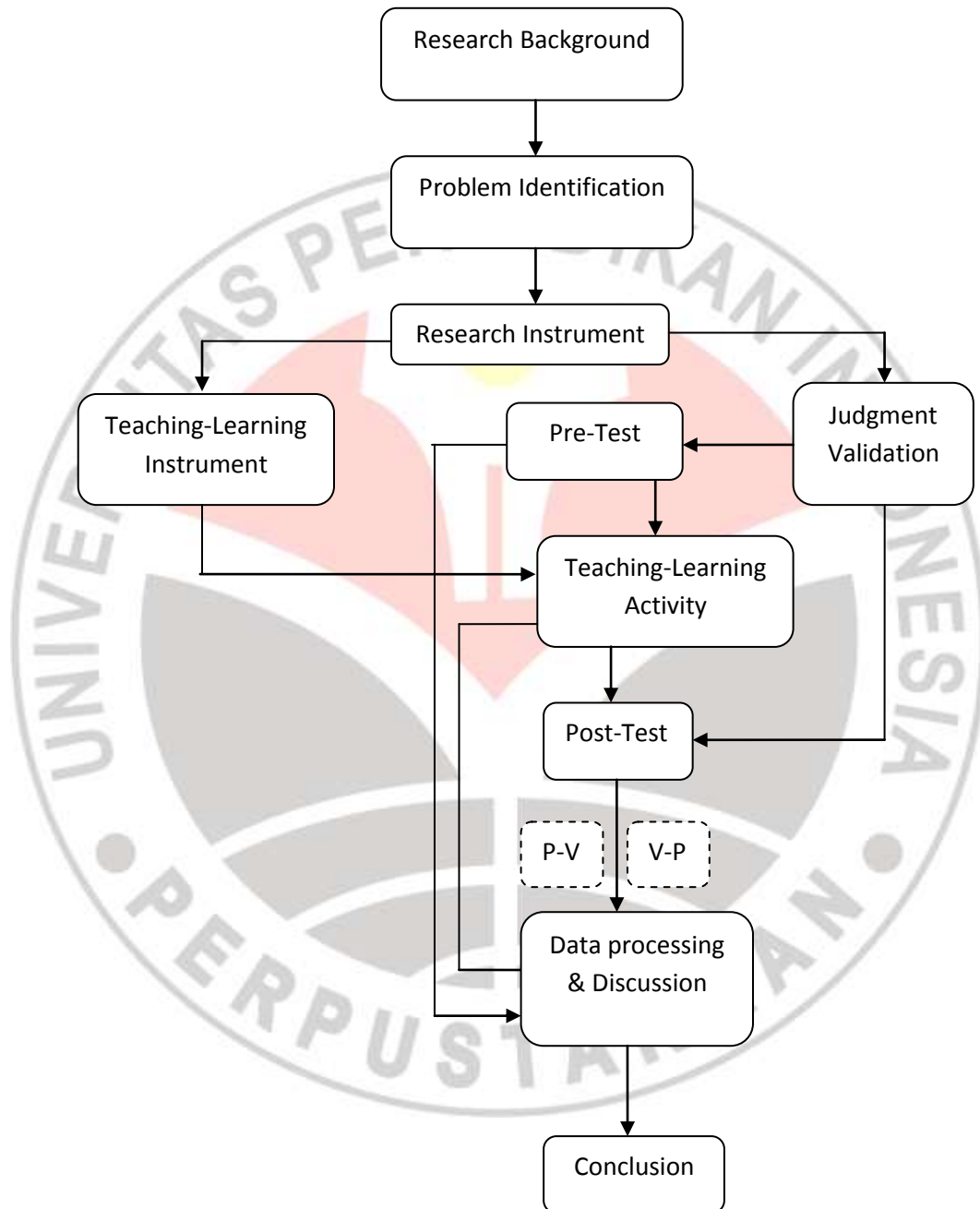Data processing & Discussion

Conclusion

Figure 3.2: Flowchart of Implemented Research Procedure

3. Component of Research Procedure

The research procedure components includes research background, problem identification, determining research instrument, Implementation of teaching learning activity, data processing and discussion, and making conclusion.

a. Research Background

Research background was taken from study literature and direct interview towards 9th grade physics teacher in MNIS.

b. Problem Identification

The problems were identified based on study literature and interview findings. The problem was specified into research questions. The research was conducted in order to answer the research questions.

c. Research Instrument

Research instruments were designed to give information for investigation to be analyzed and used to answer the research problems, research instruments were in a form of teaching-learning observation sheet, students' worksheet, pre-test and post-test. Pre-test and post-test could be used in teaching learning activity after validated by expert.

d. Teaching-Learning Activity

The class was divided into two groups. The two groups were conducted different sequences of experiment. The Pre-Test was given before teaching-learning activity began. Problem and Prediction were given to both physical-virtual and virtual-physical group at the beginning of teaching-learning activity. After that virtual-physical (V-P) group conducted virtual experiment first by using computer and followed by physical or real experiment by using real apparatus, meanwhile physical-virtual (P-V) group conducted physical experiment first by using real apparatus, after that students conducted the same experiment by using computer (virtual experiment).

Drawing conclusion of the experiment was conducted after two groups finished with both physical and virtual experiment. Post-Test was given after teaching-learning activity finished. The experiments that conducted were static

electricity and dynamic electricity experiment. The experiment objectives for both virtual and physical experiment were same.
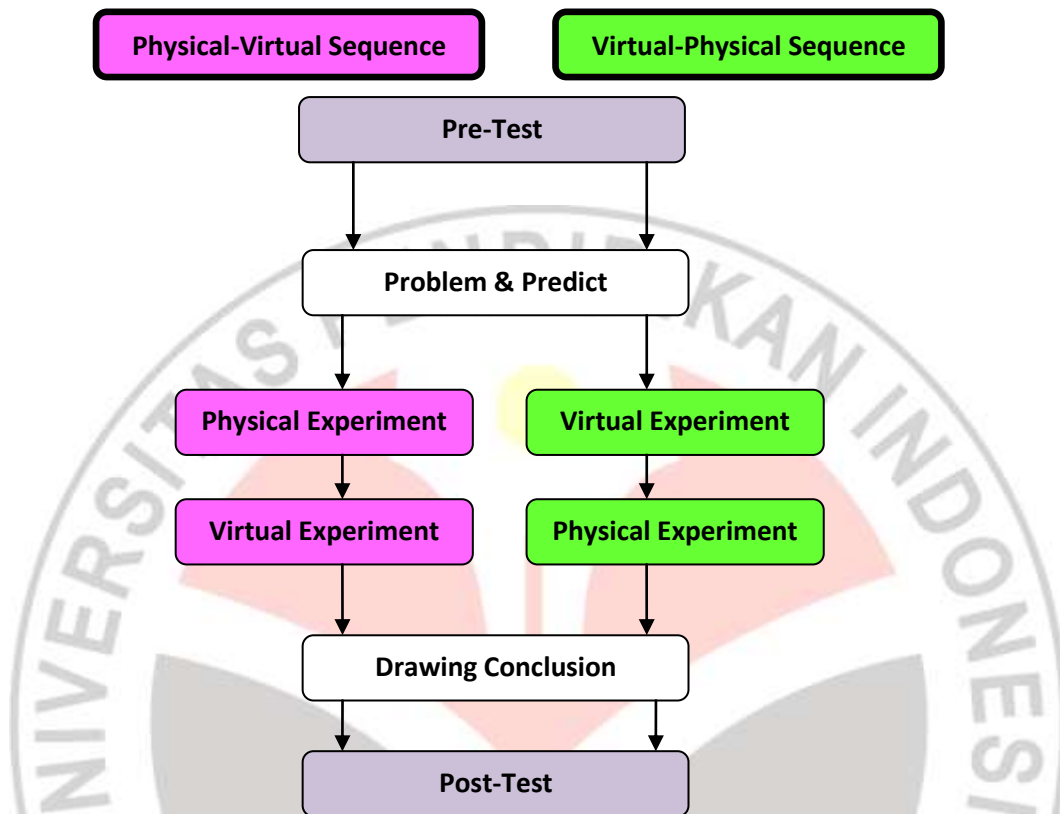

Figure 3.3: Adaptation of Experimental Design (Jaquelin et al., 2010)

e. Data processing and Discussion

The data were proceed and discussed to give mean towards relations among variables of the research, so that the data can be used to answer research questions.

f. Conclusion

Conclusion was constructed based on findings, discussion and the answer of the research questions.

D. Operational Definition.

1. Combining Physical and Virtual Experiment

According to Jaakola (2012) the principle of the way in combining virtual and physical experiment is divided into two, they are sequential combination and parallel combination. Sequential combination is used when the virtual and physical experiment is conducted separately in different phase, meanwhile parallel combination is used when the virtual and physical experiment are used alternately. In this research, the sequential combination of virtual and physical experiment was used by the students. Physical-virtual sequence means the students conducted real experiment first, after the students finished the real experiment they continue did simulation on the computer from *PhET* by using the same experiment objectives as the real experiments. Virtual-physical sequence means they did simulation on the computer first and followed by real experiment by using the same objectives.

2. Understand Cognitive Process of Revised Bloom Taxonomy

According to Anderson (2001) understand is the ability to construct the meaning of information gained in a form of oral, written and graphic. According to him, there are seven categories in the domain of understanding, the categories include in interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining. In this research, students' achievement that is going to be investigated is interpreting, inferring and explaining based on physics Cambridge curriculum objectives that was used in MNIS for junior high school. The tendency of students' answers was measured by using students' worksheet and students' achievement on each understanding category was measured by using test items on the pre-test and post-test.

a. Interpreting

Interpreting is the ability to change one representation to another form of representation, the activity or problem that is used to interpret is drawing scheme, demonstrate, illustrate or simulate (Anderson, 2001). In this research, interpreting is used to interpret factual and abstract concept into form of explanation and

Dea Saskia FH, 2013
The Framework of Sequence in Combining Virtual and Physical Experiment Based on the Profile of Students Understanding in Physics
Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

picture, change abstract explanation into picture, and change the picture into explanation.

b. Inferring

Inferring is ability to arrange ideas from the subject into a form of summary or conclusion by finding the pattern of the presented material. In this research, the inferring used to find the relation among experiment variables such as the relation among resistance, current and voltage in the form of numbers, explanation or table.

c. Explaining

According to Anderson (2001) explaining is the ability to construct the cause and effect of the phenomena or theory. The explaining used in this research is students' ability in explain the visible and invisible phenomena based on factual or abstract theory according to the results that got from both physical and virtual experiment.

E. Instructional Tools and Research Instrument

1. Instructional Tools

In order to find the research questions, several instructional tools were used in this research, such as:

a. Lesson plan

Lesson plan was made based on Cambridge curriculum in physics for 9th grade of students in electricity topic. The lesson plan referred to objectives as well as adjusted with physical experiment and virtual experiment activities. The indicators of experiments were made to know the achievement of the students. The activities on the lesson plan were made based on the stages of the experiment. There were 3 main stages that were arranged on the lesson plan; (1) Problem and prediction, (2) experiment sequences (P-V experiment and P-V experiment) (3) drawing conclusion. Lesson plan was arranged for three meetings that included static electricity topic and dynamic electricity topic. The lesson plans then were implemented by researcher as a teacher.

Dea Saskia FH, 2013
The Framework of Sequence in Combining Virtual and Physical Experiment Based on the Profile of Students Understanding in Physics
Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

b. Students' worksheet

According to Sudjana and Rivai (2001) the instrument for evaluating students' achievement should include test and non-test so that the description of learning outcomes could be appeared. Students' worksheet that used were different in each meeting, it depend on the topic and objectives from Cambridge curriculum that used in each experiment. Both physical-virtual group and virtual-physical group has identical module in each meeting. Instead of contains exact procedures from teacher, students' worksheet contains some questions to be answered by students through conducting either virtual or physical experiment. Students were asked to build their own procedure by answer the experiment questions. And the blank papers were provided to be filled by the students. The experiment's question could be answered by the students in a form of all representation such as narrative explanation, picture, table or diagram.

c. Laboratory Tools and Apparatus

The tools and apparatus that were used in this research included laboratory apparatus and another apparatus. Laboratory apparatus that used were apparatus that were available in school laboratory of MNIS. Real laboratory apparatus were used to conduct real or physical electricity experiment in Junior high school students in grade 9. Wires, switch, batteries, bulbs, ammeter, voltmeter, and resistor were used in conducting physical experiment of dynamic electricity. Meanwhile for another apparatus such as balloon and sweater were used to conduct physical experiment of static electricity.

d. Laptop and Virtual laboratory application

Virtual laboratory was prepared based on activity on the lesson plan. Two kinds of virtual laboratory software from PhET were downloaded and installed on the laptop that was used by the teacher before the class began. The virtual laboratories that used were virtual laboratory about static electricity and virtual laboratory about dynamic electricity. There were 2 groups of students, and one laptop was used for each group.

Dea Saskia FH, 2013
The Framework of Sequence in Combining Virtual and Physical Experiment Based on the Profile of Students Understanding in Physics
Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

2. Research Instrument

a. Test Instruments (Pretest and Post-Test)

Test instruments are used to analyze the result of students' understanding before and after the treatments were conducted. Pretest and post-test were consisted the same questions in a form of multiple choices that reflects students' understanding of explaining, interpreting and inferring. There were 18 items of multiple choice questions that were included in static electricity topic and dynamic electricity topic; 3 explaining questions for static electricity, 3 interpreting questions for static electricity, 3 inferring questions for static electricity, 3 explaining questions for dynamic electricity, 3 interpreting questions for dynamic electricity, and 3 inferring questions for dynamic electricity .

F. The Process of Instrument Validation

1. Pretest and Post-Test validation

In order to validate the test instruments, rubric of question validation was used. The rubric was given to 3 experts; 2 experts were physics lecturers and another expert was physics teacher of MNIS. The experts decided the validity for each question. If there were 2 or more experts give their validation for the question, then the question considered as valid and used as pre-test or post-test question items. Vice versa, if there was only one expert or no expert that is considered the question was valid, then the questions were revised and repeated the validation process until the questions items became valid.

G. Data Collection Techniques

1. Pre-Test and Post Test

Pre-Test was given before the treatments whereas post test was given after treatment. There will be 2 different treatments, one group conducted virtual-physical experiment sequence meanwhile another group conducted physical-virtual experiment sequence , thus this test instrument was used to measure, describe, and compare the result of different sequences descriptively.

Dea Saskia FH, 2013
The Framework of Sequence in Combining Virtual and Physical Experiment Based on the Profile of Students Understanding in Physics
Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

2. Observation of Teaching-Learning Activity

In order to observe teaching-learning activity, observational sheet was designed to be filled by observer in each group during treatment was giving to the students. There was one observer in each group. This observational sheet instrument contains several aspects and indicators that were filled by observer in each group.

3. Narrative of Teaching-Learning Activity

The narrative of teaching-learning activity is used to describe and analyze students' action that showed tendency of actions that were done in different sequences of physical and virtual experiment that at least could influenced students' understanding in explaining, interpreting and inferring that showed in pretest and posttest results.

4. Students' worksheet

Student worksheet is students' written communication which was elaborated descriptively in this research. The students' worksheet was used to find the differences of tendency of students in explaining, interpreting, and inferring in each experiment sequence.

H. Data Analysis

1. Pretest and Post-Test Processing

After pre-test and post-test were collected, the data then proceed by finding normal gain. Normal gain was used to know the increasing score from both groups (V-P group and P-V group), and also it was used to know the increasing score from all categories of understanding (explaining, interpreting and inferring). Then the results were shown as graphs for further analysis. Normal gain could be found by using formula of:

$$\text{Normal Gain} = \frac{\text{PostTest score} - \text{PreTest score}}{\text{Maximum score} - \text{Score pretest}} \times 100\%$$

Table 3.1: Category of Normal Gain

No	Category of Normal Gain	Gain Value
1	High gain	Gain value $\geq$ 70%
2	Medium gain	30% $\leq$ gain value < 70%
3	Low gain	gain < 30%

2. Teaching-Learning Observation Sheet

The percentage of activities done by each sequence was calculated based on how many scores of indicators that are done by both teacher and students. The lowest score of each indicator was 1 and the highest score is 4.

The total percentage of teaching-learning activities in each meeting was used as information in discussion to find the research questions.

3. Students' worksheet

The answers of students' worksheet were classified in to explaining, interpreting, and inferring categories in the form of table. Then the findings of students' worksheet were used as additional information in answering research question in discussion.

Dea Saskia FH, 2013
The Framework of Sequence in Combining Virtual and Physical Experiment Based on the Profile of Students Understanding in Physics
Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu