

## CHAPTER I INTRODUCTION

### A. Research Background

Science consists of many abstract topic that is difficult to be understood by the students, therefore the constructivist based student centered instructional methods is necessary to be used, In this context, laboratories are important components of education to make students to gain experience and construct the knowledge that infuse constructivist principles where learners are expected to function as self-motivated, self-directed, interactive, collaborative participants in their learning experiences by virtual of their physical learning process (Tam, 2000).In experiment, students are guided to find the answer and underlying the principal behind it (Chan et al., 2009).

Experiment is starting point of all approaches in natural science concept that is assumed as a method that can enhance students learning in science to develop students' skill in using tools (Zacharia et al., 2008).. The students that used physical experiment have opportunity to improve their skill in using real apparatus to investigate and observe the real phenomena, test their hypothesis and apply their understanding in a physical form.

But students are hard to understand the concept of material through physical experiment, students often confused about their purpose of their work in their experiment because they focus on the procedure of the experiment (Hofstein, A., & Lunetta, 2003).

Virtual experiment provides quick feedback for the students, students can explore the ways and action more than physical experiment, and allows student to focus on the theoretical principles in the concept because of the absence of measurement errors (Jacquelyn et al., 2010). Thus virtual experiment gives good understanding of material concept and students can see the relation among the concepts as well.

But, using virtual laboratory only in all topic, it can reduce communication in team work and discourage students from becoming familiar with physical instruments and real devices (Chan et al., 2009). Also in using virtual laboratory only the students do not have opportunity to conduct the experiment with the real tools, so it can reduce students' skill in using real apparatus.

Due to the differences of advantages and disadvantages between physical and virtual experiment, many researchers combine the physical and virtual experiment together rather than use them separately and proved the using the combination of physical and virtual experiment give more benefits than use virtual and physical experiment alone (e.g., Jaakkola, 2012; Zacharia et al., 2008). For example, one of characteristics of virtual laboratory and real experiment, the source of virtual experiment is limited on the varied sources and multimedia whereas the source of real experiment is the teacher itself, (babateen, 2011). But using virtual laboratory we can see the abstract things that happen theoretically in real experiment, such as the movement of electron. Teacher can use the virtual experiment to design model in virtual experiment and see what is really happen, if the tool in virtual experiment is limited or cannot modified freely, teacher can continue with the real experiment.

In addition, based on the research, by using combination of virtual and physical experiment, students can understand the concept more than conducted simulation and real experiment alone, the students that used physical experiment is good in relate topics with real tools, the students that used virtual experiment tend to strong in understanding concept, but the students that used both physical and virtual experiment are can strengthen the concepts of the students (Jaakkola, 2012).

Then, the researchers investigated the sequence of combination of physical and virtual experiment in learning science, especially in physics subject, figured out which one is better physical-virtual experiment or virtual-physical experiment (e.g., Puntambekar et al., 2010). In fact the sequence of combine physical-virtual experiment or virtual-physical experiment gives significant effect for students in learning science (Jaakola, 2012; Puntambekar et al., 2010). In Puntambekar(2010)

research, the sequence of physical-virtual experiment give more advantages in conceptual understanding than virtual-physical experiment in secondary high school level in condition that teacher provides important grounded, physical experience with the phenomena of interest to students. Thus, the giving problem is used as prior knowledge for students. Virtual experiment then can provide and enhance students' concept from action that is impossible or impractical in physical experiment. In the other hand, the students who conducted virtual experiment first seemed to have blocked information in the conducted physical experiment, the students that conducted virtual experiment first not showing the improvement of score in physical experiment (Jacquelyn et al., 2010).

In another hand, Jaackola (2012) criticize previous research "However, the study had one considerable limitation: the comparison between the conditions was unfair, as the groups were different already at the baseline. The group that used the laboratory first had scored significantly better in the pretest than the students who used the simulation first, meaning that the results cannot be attributed solely to the condition, as the level of prior knowledge likely affected the outcome as well". The prior knowledge of the students, conceptions, age, and developmental level can influence the sequence in combining virtual and physical experiment, so these factors should be explore more in the future (Jacquelyn et al., 2010).

In addition, based on research of Chan & Fok (2009), virtual experiment is better for familiarization to the topic, enhancing students' enthusiasm, and offering safe equipment. Therefore, the virtual experiment is better to be conducted first to gather students' motivation to learn and also to increase students' engagement to the topic, also it is said that virtual experiment is offering safe environment which means virtual experiment can be used to design the real experiment model without worrying about the safety, then students can test their design with real experiment. Therefore, seeing some researches of virtual-physical and physical-virtual sequences, they have different conditions and objective in order to give benefit to the learning process. All science topics can have different best sequence based on the purpose and the condition, not always virtual-physical sequence give more advantage in giving understanding to students and vice versa.

The electricity concept was chosen because electricity concept for junior high school can be conducted both physically and virtually, electricity concept need model to be designed by using virtual experiment and need virtual experiment to enhance the concept such as the electron flow in the circuit, so virtual-physical and physical-virtual experiment's sequence is tested in this research. In addition it is common that the tools of electricity experiment can be found in school laboratory or in the market, such as resistor and wires can be found at the market, and also there are so many virtual laboratory software related to electricity concept can be downloaded freely on the Internet.

And also from direct interview from teacher that teach in MNIS, whostated that most of 9<sup>th</sup> grade students have difficulty in understanding electricity concept because some of them contain abstract things. In addition the teacher is not from physics department and he admitted that electricity experiment is never conducted in grade 9<sup>th</sup> due to the complication in using electricity tools, whereas the curriculum that used is from IGSCCE physics that needs experiment activity in order to reach the objectives of the lesson, such as “use an describe of an ammeter”. Virtual experiment can enhance students' concept when it explained the abstract things (Puntambekar et al., 2010) and physical experiment can give advantages that cannot be got from conducting virtual laboratory only. Besides, some of the aims to combine characteristic of virtual and physical experiment is to create safe practical works, teacher could designed the model of electricity using virtual laboratory and test the design of experiment from virtual laboratory by using real tools before the teacher implement electricity to the students. Besidethe combination of virtual and physical experiment can enhance students' concept by seeing phenomena virtually that cannot be seen by conducting real experiment alone. These aims are perpendicular with objectives that written in Cambridge curriculum. Cambridge curriculum assessment objective states about the objective of knowledge with understanding and the third objective is safety techniques in handling instruments and apparatus.



## **B. Problem Identification and Research Questions**

After all, combining physical and virtual experiment give better influence compare with using physical and virtual experiment alone, and both of virtual-physical and physical-virtual sequences give benefits in different condition ,Therefore the problem can be generalized.

How does the framework of sequence in combining virtual and physical experiment based on the profile of students' understanding in physics?

Furthermore, there are 3 questions are raised in further research:

1. How does the sequence of Virtual and Physical experiment to be implemented in 9<sup>th</sup> grade of students thus can be compatible for all topics?
2. How does the profile of students' understanding in using different sequence of Virtual and Physical experiment in electricity topic ?
3. What are the advantages and disadvantages of physical-virtual and virtual-physical experiment sequence?

## **C. Purpose of the Research**

Hence, the main purpose of this study is to find the framework how to choose the sequence in combining virtual and physical experiment so that the experiment could give maximum benefits towards the improvement of students understanding.

## **D. Significance and Benefits of the Research**

### **1. Significance of the Research**

- a. This research investigates which experiment sequences (physical-virtual or virtual-physical) that give better benefit in enhance understanding in explaining, interpreting, and inferring.
- b. This research investigates how both physical-virtual and physical-virtual experiment sequence influence students' ability in explaining, interpreting and inferring.
- c. This research investigates the advantages of disadvantages of physical-virtual and physical-virtual experiment sequence, the advantages and disadvantages

of each sequence could be used as consideration of teacher that want to combine both physical and virtual experiments in order to choose experiment sequence that have highest possibility in giving the best benefit in enhance students' understanding, or it can be used as another reference for another investigation as well.

- d. This research results the framework of using combination of physical and virtual experiment based on the objective that focus on explaining, interpreting and inferring that can be used by teacher and researchers for further investigation.

## **2. Benefits of The Research**

### **a. For Teachers**

- 1) Teacher could give experiment activity to students without losing chance to give real concept related to the experiment through virtual lab.
- 2) Teacher can enhance ability to conduct real experiment and virtual experiment.
- 3) Teacher can assess students' ability in conducting real experiment and also can assess students' ability in design the circuit through virtual experiment.
- 4) Teacher can use the framework of combining physical and virtual experiment in order to achieve learning objective.

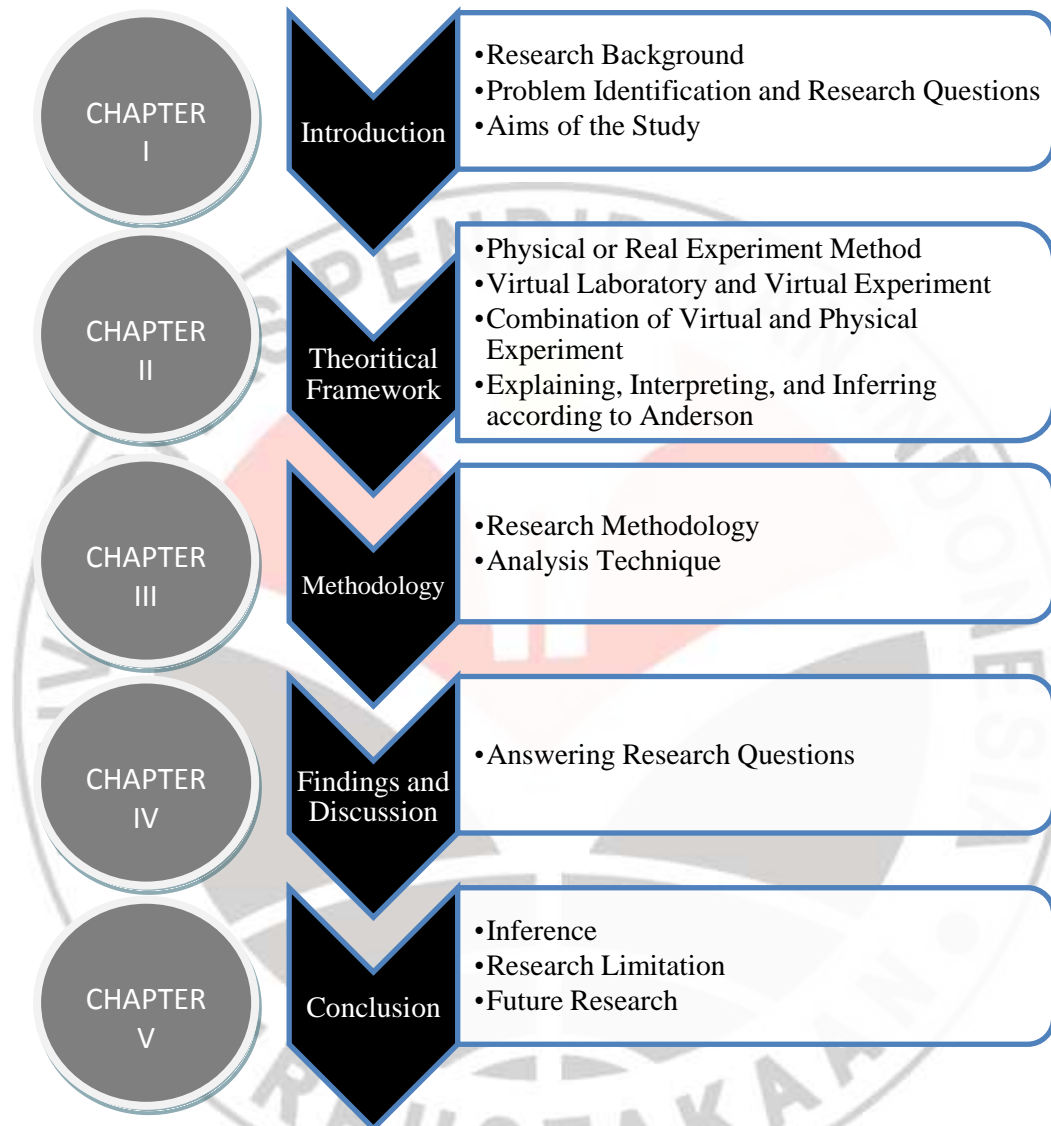
### **b. For Students:**

- 1) Students can enhance their ability in conducting real experiment with real apparatus, and can test their design virtually without worrying any mistake.
- 2) Students can compare the result of the real experiment with the real condition with the result of virtual experiment with ideal condition.

### **c. For Researcher**

- 1) As references of the same study that is investigate the sequence of combination of virtual and physical experiment either in the same topic or different topics or grades.

## E. The Outline of the Research Paper



**Figure 1.1: The Outline of the Research Paper**