CHAPTER I
INTRODUCTION

A. Background

Practical work is an essential feature of science education (Abraham and Millar, 2008). It can not be separated from the learning process of science. The House of Commons Science and Technology Committee (2002); Kurniawan and Aji (2009) stated that practical work is one of the way to enhance students' understanding. In addition, The House of Commons Science and Technology Committee (2002) stated that practical work helps students in appreciating evidence as basic of science and acquiring hands-on skills. Abraham and Millar (2008) stated that practical work can be defined as activities in which the students manipulate and observe real objects and materials. To do this practical work, students have to deal with hands-on activities. It is clearly known that hands-on activity in learning science is usually done in laboratory, although it may be held in the classroom and field as well. In this context, laboratories are essential component of education to make students gain experience (Tuysuz, 2010).

Physical laboratory is very useful to promote the learning process of science, yet provides several problems for both students and teacher. Pyatt and Sims (2012) stated that physical laboratory experiences may not always promote conceptual change. In the real world situation, students have no much experiences in conducting laboratory activity. Based on Tuysuz (2010), there are several problems faced in conducting laboratory activity in physical laboratory such as limitation of facilities, limited time allocation, and insufficient laboratory condition. Those problems sometimes forces the teachers to perform laboratory activities in crowded groups. Moreover, related to safety concern, Tatli and Ayas (2013) stated that perform laboratory activities in the physical laboratory involve risks due to poisonous and unsavory gas releases.

Considering the problem faced by using physical laboratory to conduct laboratory activities, a virtual laboratory may be a preferable alternative to overcome those problems (Tatli and Ayas, 2013). Virtual laboratories simulate a real laboratory environment and processes, and are defined as learning environment in which students convert their theoretical knowledge into practical knowledge by conducting experiments (Woodfield, 2005). Tiwari and Singh (2011) added that it is designed and sequenced in such a manner as to give a real feel of performing the experiment. Based on the researchers, there are the advantages and disadvantages of using Virtual laboratory in the instruction process. The disadvantages including the impossibility to include all environmental parameters into the virtualization, hence a virtual laboratory will react sometimes different from a real one (Online Labs, 2013). Meanwhile the advantages of using virtual laboratory in the instruction process are described below.

1. Conducting experiments as if the users are in real laboratories (Tatli and Ayas, 2011).
2. Enrich learning experiences (Jeschke, Richter, and Zorn, 2005).
3. Providing the students with meaningful virtual experiences and present important concepts, principles, and processes (Tatli and Ayas, 2011).
4. Improving the experiment-related skills such as manipulating materials and equipment, collecting data, completing experiment process in an interactive way (Tatli and Ayas, 2011).
5. Having the opportunity of repeating any incorrect experiment or to deepen the intended experiences (Tatli and Ayas, 2011).
6. Offering a clear and enjoyable learning environment (Jeschke, Richter, and Zorn, 2005).
7. Can be solution for Schools which has no Science Lab, but has a computer lab instead (Tuysuz, 2010).

8. Overcome some problems faced in real laboratory such as safety problem, limitation of facilities, and time allocation (Tuysuz, 2010).

As can be seen from the explanation above, a virtual laboratory may sometimes be a preferable alternative, or simply a supportive learning environment to physical laboratories (Tatli and Ayas, 2011).

According to Jaya (2012), in this era, educators have got the accesses to use various kind of technology to enhance the effectiveness of instruction process. It supports the use of Virtual laboratory in the instruction process. The use of virtual laboratory as an alternative to overcome the problems faced in the physical laboratory is in line with 21st century demands. In the 21st century, technologies have become commonplace in improving and advancing the practice of science education because of its potentials of bringing about change in ways of teaching practice and learning process (Srisawasdi, 2012).

One of examples of virtual laboratory is Physics Education Technology abbreviated as PhET (Finkelstein et al., 2005). PhET is developed by University of Colorado, it is freely available on it's website (www.phet.colorado.edu). This website consists of more than 50 simulations related with physics subject, it can be accessed both offline and online. These simulations are designed to be highly interactive, engaging, and open learning environments that provide animated feedback to the user. The simulations model physically accurate, highly visual, dynamic representations of physics principles (Finkelstein et al., 2005). PhET simulation is equipped with it's student activity, teacher guidance, and worksheet.

Since doing practical work using virtual laboratory has so many advantages and PhET as virtual laboratory is freely provided, hence there is question that comes up, "How if the practical work using Physics Education Technology (PhET) as virtual laboratory applied in one of International School in Bandung?" It strengthen the researcher to conduct this research.

Many researchers in science have determined that carrying out virtual laboratory in the instruction process significantly increase students' achievement (Tuysuz, 2010; Tatli and Ayas, 2011; & Jaya, 2012) and have positive effect on students' attitudes (Tuysuz, 2010; Jaya, 2012; & Pyatt and Sims, 2012). In the process of increasing students' achievement and having positive attitude in learning, students experience an environment which can support them to gain the knowledge and have positive attitude. Luketic et al., (2013) stated that student's perception of their learning environment influence how and to what extent they learn and retain knowledge. Hence, the researcher decided to analyze the students' cognitive and their perception about their science laboratory environment in learning waves and sounds using Physics Education Technology (PhET) as virtual laboratory. The result of this research is expected to be used by the teacher as an information to guide attempts to improve their classroom.

B. Research Problem

The research problem of this study is "How is the use of Physics Education Technology (PhET) as Virtual Laboratory in learning Waves and Sounds?"

C. Research Question

Elaborating the research problem, the research attempts to explore the following questions:

1. How is the implementation of Waves on a String Students Activity as Lesson Plan in learning waves and sounds with Physics Education Technology as Virtual Laboratory?
2. How is the profile of students' cognitive in learning waves and sounds with Physics Education Technology (PhET) as virtual laboratory?
3. How is the profile of science laboratory environment in learning waves and sounds with Physics Education Technology (PhET) as virtual laboratory?

D. Limitation of Problem

In order to make the research become more focused, the problem is limited as follow:

1. The analysis of the use of Physics Education Technology (PhET) as Virtual Laboratory in this study is investigated in terms of the implementation of waves on a string student activity as lesson plan, which the contribution of it can be seen from students' cognitive and science laboratory environment.

E. Research Objective

This research objective is described specifically as follow:

1. To analyze the implementation of using waves on a string students activity as lesson plan in learning waves and sounds with Physics Education Technology (PhET) as virtual laboratory.
2. To analyze the profile of students' cognitive in learning waves and sounds with Physics Education Technology (PhET) as virtual laboratory.
3. To analyze the profile of Science laboratory environment in learning waves and sounds with Physics Education Technology (PhET) as virtual laboratory.

F. Research Benefit

The results of this study are expected to provide the following benefits:

1. For teachers, this study may use as precious knowledge as an evaluation to have better teaching – learning activity.
2. For students, along with the existence of this research, they can feel new experience in constructing laboratory activity. Students may access virtual laboratory without limitation in time and place.

3. For other researchers, this study may use as precious references in analyzing the use of *Physics Education Technology (PhET)* as virtual laboratory in learning waves and sounds.