CHAPTER I
INTRODUCTION

A. Background

The purpose of learning science is to engage students learn to express natural phenomena by following the scientific principles that were conducted by researchers. Learning science should involve elements of processes or students' activities both mentally and physically so that students can gain a real learning experience. Thus, learning science is not just memorizing the concepts but students attempt to discover a concept.

A number of researchers advocate the use of engineering design as a promising context in which to learn science. Using engineering design as a basis for teaching science has a number of potential advantages, such as better connecting to the knowledge students bring to the classroom, while also providing a clearer sense of utility outside of the classroom (Cajas, 2001).

Nowadays many industrialized countries do not emphasize the designation sum education of primary and secondary high school in design and technology. Design and technology education is not required as a subject in school. Even in the middle school level it is typically an elective subject and is not offered in all schools (Dyer, Reed & Berry, 2006). Most science curricula lack engineering background beyond Information Technology (IT) subjects (De Veries, 1997). But on the other hand, schools of engineering that are placed in each country more emphasis on teamwork, design process skills, and hands-on construction. Due to these reasons and the treatment of design and technology education is typically weak. Seen from the fact above, moreover for developed countries basically still backwards in all fields and perhaps the immersion of design and technology particularly in science curricula is kind a new thing in educational system.

The results of research from Trends in International Mathematics and Science Study (TIMSS) research institutions (TIMSS: 2011), for junior high school students in 42 countries, Indonesia ranks third from the bottom in the mastery science content domains and science cognitive domains. It means that students only show some

elementary knowledge of life, physical, and earth sciences. Students demonstrate knowledge of some simple facts, demonstrate some basic knowledge of the concept, interpret simple diagrams, complete simple tables, and provide short written responses to questions requiring factual information.

Based on data above, it can be concluded that the ability of Indonesian students in solving complex problems that involve creative thinking skills are still low. It might because the learning process that is done in the classroom is still conventional. Therefore, improving the quality of learning is needed with improving learning model; by using a design-based learning.

The presence of design concepts and principles in national science standards speaks to the emerging view of experts in the science, technology, and education fields that an understanding of design is complementary to, and supportive of, science literacy (Cajas, 2001). At an even more fundamental level, some of the big ideas that are central to an understanding of design are also central in science, such as an understanding of complex systems (Hmelo, Holton, & Kolodner, 2000) and the use of models (Penner, Lehrer, & Schauble, 1998). Therefore, the fundamental content of design may be mutually reinforcing with that of science, and possibly even shared directly.

In addition to the content, the instructional methods typical in design-based science curricula also have particular appeal to the learning of science. The points of alignment include engaging students as active learners, encouraging students to use metacognitive strategies for self-monitoring and reflection, and supporting classroom communities in which knowledge is distributed such that interaction between members is essential (De Miranda, 2004). By taking a broader view of technology as being *designed*, rather than simply *used*, as it is conventionally taught in schools, design-based science curricula encourage students to solve their own everyday problems in real contexts. In doing so, students may be more likely to question and make sense of the data they collect, rather than distorting data or failing to accept contrary evidence as a result of wanting to confirm their initial beliefs or get the "right" answer (Benenson, 2001). The design artifact is not only the final outcome or product of design-based learning, but also provides opportunities to externalize ideas, having unusual ideas and

innovative thoughts, able to put things together in new ways. We have often said that it is like thinking outside of the box. This kind of skill can be called as creative thinking skill.

Creative thinking will make students move "sideways" to try different perceptions, different concepts, different points of entry. Students can use various methods including provocations to solve the problems. Creative thinking has very much to do with perception to put forward different views. The different views are not derived each from the other but are independently produced. In this sense, creative thinking has to do with exploration just as perception has to do with exploration. (Awang & Ramly, 2008)

Design-Based Learning can best be conceived of as a type of education with an emphasis on products that are created within the framework of education. However, this is not the interpretation that is intended here. In Design-Based Learning, not only the resulting products are important. The underlying process is highly relevant as well.

Design Based Learning is a model of learning that is rarely applied in the science curriculum and not all curriculums are appropriate to use this approach. But the Cambridge IGCSE curriculum that commonly used in international schools is proper to use it. The Cambridge syllabus helps learners to understand the technological world in which they live, and take an informed interest in science and scientific developments. They learn about the basic principles through a mix of theoretical and practical studies. As they progress, learners gain an understanding of how science is studied and practiced, and become aware that the results of scientific research can have both good and bad effects on individuals, communities and the environment.

Typically, as the case in the subject school district, physics subject is taught by using scripted/guided inquiry to learning. Students are given materials and procedural scaffolding depending upon the philosophy of the curriculum designers' views of what they think students need in order to accomplish a learning goal. In this research paper exhibit a performance that is used in gaining students' creative thinking skill for middle school students learning science through design-based learning. Students designed and built electrical alarm systems to learn electricity concepts in science classes of international school. This concept is suitable with the learning model that would be

conducted. By building the electrical alarm system, it much more focusing on the learning process, test the understanding and thinking, and it is related to teamwork and individual's contribution to the team. Infusing creative thinking competence through the design process of authentic projects requires not only changing the teaching methods and learning environment, but also adopting new assessment methods, such as portfolio assessment (Doppelt, 2009).

In this case, portfolio assessment can be used as a developed alternative assessment. It should be emphasized here that portfolio assessment is not intended as a substitute for alternative tests, but as a companion test that is used to complete the test. So, the test would not be the only information in the assessment of learning (Wulan, 2009).

One of the reasons portfolio used in education today is because of dissatisfaction with the use of tests that are considered not able to show the entire students' ability (Marhaeni, 2006). Assessment portfolio shows several advantages that are not possessed by the objective test, such as the ongoing assessment, appreciate students as individuals with uniqueness, and the development of metacognition through reflection and self-evaluation (Supranata, 2006).

Associated with the use of portfolio assessment in student learning activities, particularly in physics subject is identic with calculation and concepts. In fact, this subject is easy due to related with everyday life. The selection of topic is electricity because there are some electrical materials that allow giving assignments to the students, which will be recorded in the portfolio.

The task of project is described as authentic because students followed the same design process that a system designer typically uses to propose, investigate, and construct embodied solutions to meet actual needs. The study took place in the ninth grade students in science class. The implementation and data collection will take over three weeks. The result suggest that a system design approach for teaching science concepts has superior performance in terms of knowledge gain achievements in core science concepts, particularly in creative thinking skill.

Some of the reasons or arguments that have been described above are the reason for doing this research, the impact of design based learning towards secondary students' creative thinking skill in the electricity concept.

B. Research Question

The purpose of this study is to answer the following questions:

1. Whether the implementation of Design-Based Learning model to the electricity concept accordance with the existing theory?
2. What is the creative thinking skill level that could be reached by ninth grade students by using portfolio assessment through Design-Based Learning?
3. How are the profiles of ninth grade students' creative thinking skill to the electricity concept through Design Based Learning?
4. How are the improvements of students' cognitive domain to the concept of electricity through Design Based Learning?

C. Purpose

The purposes of this study are:

1. Investigate the implementation of Design-Based Learning model to the electricity concept accordance with the existing theory or not.
2. Find out levels of creative thinking skill that could be reached by ninth grade students through Design-Based Learning.
3. Investigate the profiles of ninth grade students' creative thinking skill to the electricity concept.
4. Identify the improvements of students' cognitive domain to the concept of electricity

D. Benefit

As the benefits of this research paper are:

1. Teacher
   a. Have greater insight and know all the steps to use the Design-Based Learning (DBL) in the implementation of learning science context.

b. Apply the Design-Based Learning (DBL) in science class.
c. Apply the portfolio assessment as an alternative assessment.
d. For future, hoped that the teacher could develop and refine Design-Based Learning (DBL) to implement it in secondary schools.

2. Students
   a. Students get the opportunities to have a much stronger experience in terms of the ability to design and propose scientific investigations.
   b. Develop student's creative thinking skill.
   c. Get experience involved in evaluation process by using portfolio.
   d. Motivate students to show and display their project result in presentation.

3. Other Researcher

   To know strengthens and weaknesses during implementation of Design Based Learning Model to overcome constrain that were existed as a consideration for the next research.

E. Research Methodology

This study conducted with Qualitative Method by using a treatment towards secondary students in Mutiara Nusantara International School with design based learning model. As for the research steps are follows.

1. Preliminary study to the learning model
2. Preliminary study to the electricity concept
3. Designing Lesson Plan
4. Designing Instruments
5. Validity of Instruments
6. Implementation of Design Based Learning Model
7. Data Analysis

F. Systematic of Writing

Overall, this research paper consists of 5 chapters and several appendices. As each chapter consists of a sub-section. The systematics of this research paper is:

Chapter I – Introduction, In this chapter briefly outlines about background, research question, purpose of study, Benefits of study, and systematic of writing.

Chapter II – Review of Literature, In this chapter will be described in detail the definition and stage of Design-Based Learning model, definition of creative thinking skill, portfolio assessment, Cambridge IGCSE curriculum, electricity concept, and other things that correlated to the science issues under study.

Chapter III – Methodology, This chapter tells about the methodology that will be conducted during the research. It is consists of operational definition, population and sample of research, research method, procedure, data collection, instruments, validity of instruments, and data analysis.

Chapter IV – Result and Discussion, This chapter shows the results that was obtained and discuss the problem regarding to the research question.

Chapter V – Conclusion and Recommendation, in this chapter described about conclusions and recommendations from the research that the author obtained, the use of suggestion and development of the research object made to be useful in the future.