CHAPTER I

INTRODUCTION

A. Background

Students are viewed as goal-directed agents who actively seek information as it is stated based on Piaget (1978) that they come to formal education with prior knowledge, skills, beliefs and concepts that significantly influence what they notice about the environment and how to organize and interpret it in order to develop their thinking process. The process of transferring knowledge especially during teaching and learning science is focused on the completion of thinking pattern as stated on Educational Ministry Regulation No.68 year 2013 that involves nine main aspects such based on student-centred approach, interactive learning, network based learning, active learning, team-based learning, multimedia based learning,independent learning based on students' needs, multidiscipline that integrate essentials knowledge and critical learning.

It is distinctly seen that the basic competence in the science content at secondary level deals with mastering scientific concept through describing, explaining, classifying, applying concepts and formulas, investigating through experiment based on students' inquiry by using scientific method and communicating the results (Basic Framework and Curriculum Structure for Secondary Level, 2013). The basic competence is not only emphasizes on cognitive and psychomotor, but also affective domain such as showing scientific attitude that covers several aspects such as sceptical, objective, responsibility, creativity, critical, and openness in order to construct an individual with precious behaviour in real society. Basic competence as the minimum requirement must be achieved by each participants of education therefore mastering science concept at secondary level is one of the standard competences which are very essential to be developed and implemented as well as constructing good behaviour and implementing scientific methods. As a good teacher in the future, pre-service science teachers have to mastering scientific concept as the most fundamental aspect in transferring the knowledge to students.

In the implementation of science teaching and learning, those expectations are not promising. According to preliminary study that is conducted by the researcher that aims to figure out students' problem in learning Physics, it is obtained that most of students find several obstacles and difficulties that describes by these statements:

1. Based on the average of mid-term Physics exam results, it is obtained that only three students or 13.64% pass the criterion standard at 80 whereas the rest of them or 86.36% have score below.
2. Majority of Students state that physics lesson is extremely difficult that covers 86.36% from total twenty two respondents whereas 13.64% feel also that physics lesson is difficult.
3. Several factors that underlineddifficulties in learning Physics such as low motivation in learning is stated by 9.09% of students as well as high achievement standards, inclusion of complicated formulas is stated by 18.18% of students, and mostly students thinkthat lack of learning media involvement is considered as main factor that covers 63.64% of total respondents.
4. Students cannot be independent to construct their own idea because they prefer to learn in group based learning as stated on questionnaire result that covers 59.09%.
5. Students' motivation in learning is low that is indicated by their response of 72.73% that states willingness to review Physics material only while exam is announced as well as 22.73% of students review only if there is homework or group assignment.
6. The learning environment is not supported as stated by 77.23% students that feel boring to conduct the lesson.

Teacher interview is also conducted in order to figure out the reliability of students' answer. Teacher realizes that insufficient time for students to construct their own concept is considered as main factor. The statement is align with students' response because 63.64% respondents recognize that teacher never use

specific software in order to visualize concept. The role of teacher during instructional process is also dominant because teacher often uses speech with the lack of discussion process that is stated by 59.09% students. After doing self-reflection as stated on interview result, teacher thinks that inappropriate teaching method and media is considered as main factor of lower cognitive outcomes although remedial program is already conducted.

Two main problems underline students' low achievement results based on preliminary study through questionnaire and teacher interview. These problems are classified into two; the inappropriate method and time for students to construct their own concept and the lack use of learning media in science teaching and learning process. In order to overcome those problems; method based on constructivism is essential in order to improve students' independence in learning as well as thinking process. Students actively construct new information by making use of their prior knowledge and experience; therefore they construct their own understanding through the interaction with the physical and social environment (Liang and Gabel, 2005). Therefore, learning processdevelops students strongly held assumptions or ideas that are not consistent with accepted scientific understanding (Posner et.al, 1982). As a result, science teaching and learning must address these ideas.

Science teachers need to help students identify their prior ideas and modify them based on scientific knowledge. This process is called as conceptual change (Aydin and Balim, 2011). One of essential tools to analyse students' conceptual change is by using concept map. Concept maps are graphical tools for organizing and representing relationships between concepts that is indicated by a connecting line through linking words (Novak and Canas, 2007). Concept map aims to answer focus question related with particular inquiry that the arranger seek to answer. Concepts and propositions are usually arranged in hierarchical structure; from most inclusive to exclusive concepts that represents knowledge organization (Canas, 2003). In particular period, teacher can analyse the existence of conceptual change by viewing prior knowledge, misconception, also the

acquisition and accommodation of new knowledge as maps are modified over time (Kern and Crippen, 2008).

Constructing concept map can be implemented by adapting the role of technological information and communication, as it is suitable with Educational Ministry Regulation No.68 year 2013 that stated the aids of multimedia to support learning process.Bennett, 2003 (in Qarerah, 2010) explains that as technology has become ever central to schooling, assessing students via technology-based methods will be increasingly required.With the help of ICT tools such as computer and software, complex Physics concepts can be visualized statically or dynamically i.e, graphic animation (Utari*et al*, 2013).

Institute for Human and Machine Cognition (IHMC) has developed*CmapTools,* softwarethat provide many capabilities for the creation of concept maps including highly intuitive, modeless editor and the ability to connect links into several trusted resources through serves (Canas*etal*. 2003). This software is designed based on client-server architecture that allows users to browse and share concept map that is stored in *CmapServers* distributed throughout the network by supporting synchronous and asynchronouscollaboration (Granados, 2003). Synchronous collaboration through *CmapTools* allows two users to construct concept maps simultaneously in spite of at different place, meanwhile asynchronous collaboration through *CmapTools*is existed by the role of *Concept Map sharing* and *Knowledge Soups* that allow users to add or modify annotations and discussion threads (Canas*et al*. 2003).The knowledge soups that is stored in *CmapServer* allows students from distant schools to share claims (propositions) derived from their concept maps regarding with any domain of knowledge being studied (Canas*et al*. 2003).

*CmapTools*has been used as effective tool to construct concept maps. A recent study by Carvhalho*etal*. (2001) states that this software allows user to locate resources and web pages that are related to a concept, facilitating the addition of explanatory resources (pictures, videos, interactive flash) through the *CmapServers*. This software facilitates users by linking concept propositions through automatic linking words and enabling the navigation from one concept

map to another (Canas*et al.* 2003). *CmapTools* also provide beneficial features that allows user to easily construct *knowledge model*; a set of concept maps and associated resources about a particular domain of knowledge (Canas*et al.* 2003). Users can create concept map based on their conceptual understanding by establishing informative linking words and cross links, therefore publish and share them through *CmapServers*, social media or personal websites.

Based on the statement above, it is essential to implement research that able to investigate students' conceptual change by optimizing the role of technology through *CmapTools* utilization. Conceptual change can be investigated under conceptual teaching strategy that involves concept acquisition process by modifying students' prior conception. Therefore, the researcher has intention to conduct research entitles, ***"Application of Five-Stage Conceptual Teaching Model by Utilizing CmapToolsto AnalyzeConceptual Change and Cognitive Learning Outcomes on Light and Optics Topic."***

B. Research Problem

According to the background which has already stated, the problem of this research is formulated into: "How is secondary student's conceptual change and cognitive learning outcomes after experiencing five-stage conceptual teaching model by utilizing *CmapTools*in learning Light and Optics?"

C. Research Questions

Based on the research problem that has been stated before, there are several specific questions that come up to be answered by the results of this study, as follow:

1. How is the significance of secondary students' conceptual change in learning Light and Optics after utilizing*CmapTools*under five-stage conceptual teaching model?

2. How is the improvement of secondary students' cognitive learning outcomes in learning Light and Optics after utilizing *CmapTools*under five-stage conceptual teaching model?
3. How is the correlation of secondary students' conceptual change by utilizing *CmapTools* towards cognitive learning outcomes in learning Light and Optics?
4. How is student's response towards *CmapTools* utilization in learning Light and Optics?

D. Limitation of Problem

The problem stated is limited to the aspects as follow:

1. Conceptual change based on students' preliminary and post concept map is limited on quantitative and qualitative domain. Quantitative domain deals with concept map validity that covers four main aspects; relationship, hierarchy level, cross link, and examples (Novak, 1984 in Karakuyu, 2010) based on scoring rubric that is developed by researcher together with experts, whereas qualitative aspect deals with form of concept map into spoke, chain or net (Kinchin et. al., 2000) as well as indication of misconception including the acquisition and accommodation of new knowledge (Kern and Crippen, 2008).
2. Cognitive learning outcomes that is measured in this research is limited into C1 level (remembering), C2 level (understanding), C3 level (applying), and C4 level (analyzing) based on Anderson's and Krathwohl'sTaxonomy.
3. Students' response towards *CmapTools* utilization is limited into four indicators that is arranged based on students' internal factors towards Physics lesson.
4. Light and Optics content is limited into Light properties that classified as electromagnetic wave and propagates in straight line, law of light reflection including reflection in plane and curved mirror, Snell's law of

refraction including refraction in lenses as well as nature of image formation in various distance using geometrical optic formula in curved mirror and lenses, also the application of mirror and lenses in daily life. Deeper comprehension of interference, diffraction pattern andpolarization of light waves will not be investigated since those are classified into advance concepts that might produce confusion and further misconception for secondary level.

E. Research Objectives

According to research problems and questions that are stated above, this research aims to investigate several aspects as follow:

1. Investigate significance of secondary student's conceptual change in Learning Light and Opticsby comparing preliminary and post concept map construction through quantitative and qualitative analysis.
2. Investigate secondary students' improvement of cognitive learning outcomes in learning Light and Optics by comparing pretest and posttest results through quantitative analysis.
3. Analyze the correlation between secondary students' conceptual change and cognitive learning outcomes.
4. Investigate secondary students' response towards *CmapTools* utilization in facilitating concept map construction.

F. Research Benefits

It is expected that the results of this study ableto conquer these following benefit aspects:

1. For science teachers, this study may use as precious knowledge how to utilize the aids of supporting software to create innovative ideas during instructional process. *CmapTools*is considered as one of brilliant prototyped media to help secondary students in enhancing their concept

comprehension by constructing concept maps with great validity. The role of *CmapTools* is possible to improve their interest while learning physics' concept that deals with daily life phenomena, so that they are able to achieve better result of cognitive outcomescompared to traditional teaching method.

2. For students, along with the existence of this research, they can feel new experience in constructing concept map using *CmapTools* for making interconnection and interrelation within one concept and another. Students will experience deeper concept mastery that prevents memorizing; because *CmapTools*provides constructive idea for students to dig scientific concepts as well as benefits in visualizing concepts.
3. For other researchers, this study may use as precious references in analyzing how *CmapTools*affectsthe significance of students' conceptual change and cognitive learning outcomes as well as response towards physics lesson by understanding research treatment and essential instruments in supporting better results such as concept map scoring rubric and physics pretest and posttest questions with good discrimination power, difficulty level, validity and reliability based on Anderson's Taxonomy.
4. For further research, it is expected to analyze *CmapTools* utilization for achieving higher cognitive development; C5 (evaluating) and C6 (creating) so that students' performance under PISA will be better. It is also expected that further research can optimally use *CmapTools* for creating collaborative learning atmosphere using networking and global data storage feature through *CmapServers*.