CHAPTER I
INTRODUCTION

1.1. Background

As the demand of 21st century skills students must be prepared with a number of skills, abilities and learning disposition which enable students to compete and success in the information age. The mastery of 21st century skills is essential for students to be successful in work, life, and citizenships. The partnerships for 21st century learning presented the framework of 21st century learning. This frame work describes and expertise students to succeed in work and life. It it is a blend of content knowledge, specific skills, expertise and literacies. The 21st century students' outcomes are expected the students master of the key subjects and 21st century themes, learning and innovation skills, information media and technology skills, life and carrier skills (P21, 2015).

Learning and innovation skills of 21st century are based on 4Cs; critical thinking and problem solving, creativity, communication and collaboration. Kivunja (2014) reveals that learning and innovation skills 4Cs as new learning paradigm, because the skills are expected to assist students to be well preparing to succeed in a rapidly changing and digital society that require the teacher to implement effective teaching that is the teacher who understands the different characteristic of students, utilizing a range of instructional strategies and educational theories.

Donovan, Green, and Mason (2014) suggest teacher teach effective reasoning, the use of system thinking, judgment and decision making and problem-solving to build a learner's ability to think critically and problem solve as a part of the 21st century skills. Students are taught to learn how to make judgments and decisions by learning how to analyze and evaluate evidence, arguments, claims, and beliefs then to reflect critically on learning experiences and processes.

Teacher train students to use a wide range of idea creation techniques, create new and worthwhile ideas, and elaborate, refine, analyze, and evaluate their own ideas in order to improve and maximize creative effort that are examples of

implementation creativity (Donovan et al., 2014). In line with Coxon (2012) suggests practicing creativity in the classroom such as inventing animals to fit in an environment, conducting experiments and reflecting on outcomes.

Students demonstrate communication through articulating thought and ideas effectively, using a variety of communication tools for a range of purposes and in diverse environments. Such as students should be able to listen effectively to decipher meaning and utilize multiple media and technologies as well as know how to judge their effectiveness and assess their impact, while students demonstrate collaboration through working in the diverse team effectively and respectfully. For example, students display flexibility and willingness to be helpful in making compromises necessary to accomplish a common goal, as well as assume shared responsibility for collaborative work and value individual contributions from each team member (Donovan et al., 2014).

To answers the challenges of 21st century skills, Indonesia have been applied Curriculum 2013 which emphasizes on the scientific process and reasoning. It is focused on "scientific approach" model that allows the students to find evidence and to reason (Widodo, Waldrip, & Herawati, 2016). Curriculum 2013 emphasizes on assessment standards that are expected to enhance students' higher order thinking skills (Kemdikbud, 2015). As the demand of 21st century learning and innovation skills curriculum 2013 has been revised. The changes of revised curriculum 2013 focuses on the lessons which should be integrated character building and learning and innovation skills of 21st century that are 4Cs, literacy, and higher order thinking skills (HOTS). In order to deal with the challenges, science learning in 21st century requires students to be able to prove the truth of science knowledge (Osborne, 2010).

Scientific reasoning ability as the core of scientific literacy is required to enhance students' performance in science lesson and as the demand of 21st century skills (Piraksa, Srisawasdi, & Koul, 2014). Scientific reasoning includes the thinking skills involved in inquiry, experimentation, evidence evaluation, inference and argumentation that are done in the service of conceptual change or scientific understanding (Zimmerman, 2007). Critical thinking as part of scientific reasoning must be developed in science learning. Critical thinking skills can be

developed along with building skills of argumentation (Minarti & Hayat, 2015). Argument was processed which used by someone to analyze information on a topic and then results of the analysis were communicated to others (Inch, Warnick, & Endres, 2006).

The practices of argumentation have recently been upheld as an important need to develop students' understanding of scientific concepts (Heng, Surif, & Seng, 2015). While the result of argumentation study in the last few decade show that there is still lack of the quality of scientific argumentation study and only some schools that involve argumentation approach in science learning (Osborne, 2010). Current studies in Indonesian junior high school, students' scientific reasoning through argumentation in science lesson showed that most students' argumentations skills were relatively immature in that most students were at the level 2 (of five levels) while only a small proportion of the students developed coherent arguments (Widodo et al., 2016). In line with the study in senior high school, students' argumentation is still in a simple statement without any support of evidence and reason. The discussion and interaction activities between the students and teachers are less intensive. The results are indicating that the student has not been trained to argue (Pritasari, Dwiastuti, & Probosari, 2015). The students still have difficulties in making scientific arguments, explaining science phenomena of empirical science in class discussion and applying the concept and solve the problems in everyday life (Ryu & Sandoval, 2010). Several factors were influence students' reasoning through argumentation; teachers' question, discussion, practicum, class management, students' conceptual understanding, and school activities program (Herawati, 2015).

According to Acar & Patton (2012) reveal argumentation skills should be taught and incorporated into the course curriculum using instruction or teaching strategy to improve students' scientific reasoning. While, students in developed countries still focus on concept and principle of science rather than expressing the idea based on the experience, as well as knowledge. The students still have difficulties applying the concept and solve the problems in every day life, in making scientific argument, explaining science phenomena of empirical science in class discussion (Ryu & Sandoval, 2010). The teacher has a role to improve

students' scientific reasoning using learning strategy, learning approach, models and methods that allows students to learn actively. According to curriculum 2013 learning should be directed to build awareness and concern for the environmental and required to be active in learning process and the teacher should arrange the learning process to encourage students to develop thinking skills. Active learning refer to the lesson is focuses to students' activity it facilitates students to involve in a process of learning, such as critical inquiry, practice, and problem solving.

Practicum and discussion can facilitate students active to learn and explore students' scientific reasoning. The role of practicum has evolved over time, (Tobin, 1990) argues laboratory or practice work as meaningful learning given student opportunities to manipulate equipment and materials in an environment suitable for them to construct their knowledge of phenomena and related scientific concepts. Practicum encourages the students to have an experience by observing the phenomena and given more times to conceptual understanding. Teaching and learning practicum in 21st century engage inquiry strategy and empowering technologies such as computer technology by using software students can gather and analyze data and more time to observe, to reflect, and to construct conceptual knowledge it can enhance students' understanding they can examine functional relationships and the effects of modifying variables, they can also make and test predictions and explanations. Such experiences also offer opportunities that may help students to perceive a complete inquiry process (Hofstein & Lunetta, 2004).

According to the study conducted by Hogan, Nastasi, & Pressley (2000) reveal that in peer discussion allow students to be more generative and exploratory. Students' discourse was more varied within peer groups, and some peer groups attained higher levels of reasoning on their own. Discussion has role in learning, students have opportunities to exchange viewpoints and hear other students' ideas and students can elaborate on their thinking of issues (Levin, 1995).

Drawing is one of the activities that make students active. According to Ainsworth, Prain, & Tytler (2011) reveal drawing can be used to learn in science, the role of drawing are to enhance engagement, to learn to represent in science, to reason in science, as a learning strategy, and to communicate. Visualization can

help explain findings and excite public interest. To understand the phenomena, we can use models as representations of reality that can engage of theory and evidence, models play an important role in the formation of scientific knowledge (Schouten, 2016). According to Ornek, (2008) models can be actively engaged in understanding and learning phenomena, it can guide teachers and students in their science courses. Modeling as teaching learning process can enhance students' understanding the abstract concept (Acher, Arca`, & Sanmarti`). Modeling-based learning has contribution in science education in cognitive, metacognitive, social, material and epistemological aspects (Louca & Zacharia, 2012). Based on the previous research drawing based modeling can stimulate students' scientific reasoning processes in science lesson (Heijnes, 2015). There is an activity whereas the students draw models of scientific phenomena by themselves then run the models into a simulation.

To understand the concept of ecosystem especially predator – prey system which compose food webs the practicum by using diagram of food webs usually conduct in learning activity. In this research i am going to compare the effect of practicum diagram of food webs and practicum drawing based modeling using Simsketch as tool in modeling activity. This activity involves individual task and group task. In group task allow students to discuss and solve the problem which given in students' worksheet.

To see how drawing based modeling can stimulate students' understanding and argumentation on the ecosystem topic, the computer program is called SimSketch as a modeling tool can be implemented on predator – prey system (Bolen & van Joolingen, 2013). In Simsketch students using their reasoning about animals' behavior, the relation and processes among populations which compose food webs in ecosystem as predator – prey system. In this study involve students work use Simsketch and diagram of food webs by individual task and group task to explore individual argumentation and group argumentation.

1.2. Statements of the problem

The aims of this research are to explore students' understanding and argumentation on the concept of ecosystem using drawing based modeling and

diagram of organisms which compose food webs in Indonesian senior high school. This can be formulated as the following research question:

How can drawing based modeling be used to stimulate students' understanding and students' argumentation on the concepts of Ecosystem?

More specifically, the research questions are:

1. *How does the students' understanding on the concept of ecosystem between the students which implemented drawing based modeling and the students which implemented diagram of food web?*
2. *How does the students' level of arguments and coherency of arguments based on written arguments on worksheet which engaged individual argumentation and group argumentation between the students which implemented drawing based modeling and the students which implemented diagram of food web?*
3. *How does the students' level of arguments and coherency of arguments based on argumentation test between the students which implemented drawing based modeling and the students which implemented diagram of food web?*

1.3. Problem Limitation

Due to the wide range of problem addressed, researcher then set a limitation for this study as follow:

1. The ecosystem topic in this study are four subtopics; The Components of The Ecosystem, Interaction, Energy flows, and Biogeochemical Cycle.
2. The practicum activity in this study focusses on interaction subtopic especially on the concept of predator – prey system which composes food web and diagram of food web.
3. This study covered analysis of students' understanding and argumentation as the effect of two methods in lesson that are practicum and discussion methods.
4. Students' argumentations in this study are focus on written argumentation as the result of students' answer in worksheet and argumentation test.

1.4. Research objectives

The purpose of this study is to explore students' understanding and argumentation between the lesson which use drawing – based modeling and diagram of food web on the concept of ecosystem. Furthermore, this study seeks to attain the following purposes:

1. To analyze students' understanding on the concept of ecosystem.
2. To describe the students' argumentation skills based on the level and coherence of arguments between students engaged in individual argumentation and group argumentation on the concept of ecosystem.
3. To describe the students' argumentation skills based on the level and coherence of arguments on the concept of ecosystem.

1.5. Advantages of Research

The major contribution of this research is drawing based – modeling as an innovative learning approach that can stimulate students' understanding and argumentation ability on the ecosystem topic. The advantages of the research detail were following:

1. Provides an overview of students' understanding on the concept of ecosystem.
2. Provide an overview the the students' level of arguments and the coherence of arguments which engage individual argumentation and group argumentation on the concept of ecosystem.
3. Provides an overview the students' level of arguments and the coherence of arguments on the concept of ecosystem.
4. As an active learning where the students draw the models of scientific phenomena and run into simulation it can explore students' reasoning.
5. The results of the study can be used as a reference for similar studies related to the uses of computer modeling program to enhance students' scientific reasoning.

1.6. Research paper organization Structure

The research paper organization structures in this research consist of five chapters, those are; Chapter I: Introduction. This chapter contains background of the

study, statements of problem, problem limitation, research objectives, and advantages of research.

Chapter II consists of models and modeling in science learning, SimSketch as drawing based modeling tools, students' understanding using drawing – based modeling, students' reasoning using drawing based modeling, students' argumentation as reasoning process, and the ecosystem concept. This chapter contain theory and literature explanations, the research variables in present study, the literature review contains the explanation about students' understanding, students' argumentation, drawing based modeling, and Ecosystem topic.

Chapter III consists of research methodology. This chapter explains the research methodology, population and sample, data gathering, research instruments, data analysis, and the research procedure.

Chapter IV consists of result and discussion. This chapter contains data analysis, interpretation, and also discussion of the findings.

Chapter V consists of conclusion and recommendation. This chapter explains all research questions are concluded based on the findings. The suggestion regarding the difficulties and obstacles are presented on present study.