CHAPTER I
INTRODUCTION

A. Background

Science is commonly perceived as a difficult subject (Liliasari et al., 2008: 81); despite students’ innate curiosity about the natural world, science classes rarely foster their interest. In most science classes students spend time listening to lectures, carrying out preordained “cookbook” laboratory activities, and memorizing the science facts that are emphasized in current high-stakes tests, this condition eventually made them losing interest in science as they move beyond school level (Honey & Miller, 2010:8). This situation demands an urgent intervention, especially for Indonesian students that were far lag behind their global peer in terms of science achievement (Pearson, 2012:42).

The intervention should put student as the centerfold in which teacher act as a facilitator rather than an instructor, or as the saying goes teacher are no longer “sage of the stage” but should be a “guide by the side” (Manner, 2003:91). In this approach, teachers spark students’ interest by engaging them in investigations, helping them to develop understanding of both science concepts and science processes, while maintaining motivation for science learning (Honey & Miller, 2010:12).

Despite the number of efforts, it seems however that the improvement does not yet meet the expectations of the stakeholders (Liliasari et al., 2008:82). This could be attributed to the fact that most effort only focused on a certain aspect.

“...most of our research studies (in science education red.) are done in simplicity ways, for example the influence of X to students’ achievement, while improvement of students’ achievement is not to be expected from a change in one single variable….unfortunately, the pedagogical issues explored are limited certain issues, such as teaching methods, models, and approaches. In terms of science, most research treated science as a byproduct of the changes in pedagogical aspects. The nature of scientific concepts is rarely studied....”

(Widodo, 2008:8)

Duit (in Widodo, 2008:7) implied that science education research should address issues in a more comprehensive way since science education is multi-discipline.
One of the alternative innovations to promote students' science learning is the utilization of information and computer technologies (ICT) (Liliasari et al., 2008:82). Using technology in the science classroom benefits teachers and students. Generally, teachers who use technology are more motivated, knowledgeable in scientific inquiry and positive about teaching than those who do not. The use of technology enables students to collaborate on meaningful research projects with their classmates and students throughout the world. By working on research projects, students learn to use scientific tools and technologies appropriately (Colley in Manner, 2003:94).

In recent years Multi-User Virtual Environments (MUVEs) that was originally emerged as gaming software, started to gain fame and attention as a learning media. MUVEs incorporate a virtual world in which learners control characters that represent their online personas. Through these so called ‘avatars’, learners can explore the world, interact with objects, communicate with other users, and generate and test hypotheses while they explore (Nelson & Erlandson, 2007:1). That instance made MUVEs a promising platform in improving students’ learning of science. One of the alternative innovations to promote students' learning of science is by utilizing computers and information technologies (ICT) (Liliasari et al., 2008:82). This was made possible as ICT enable learners to see and interact with representations of natural phenomena that would otherwise be impossible to observe (Honey & Miller, 2010:8).

One of the successful cases in the utilization of MUVE to foster learning of causality nature of scientific concept was shown by a research conducted by a group of researcher from Harvard Graduate School of Education (HGSE) (Metcalf et al., 2011:1). They developed a software called EcoMUVE (Ecological Multi-User Virtual Environment) which simulate an ecosystem along with interaction among it’s component that constantly change over a time period, which provide a semi-authentic inquiry experience for student. Through an experiment to a group of secondary school student it is shown that activities with the virtual ecosystem significantly bridge understanding of one out of three complex causality patterns-related concepts in ecosystem.
Understanding causal patterns is important in learning ecosystem, as this understanding is also used by ecologists to reason ecological phenomenon. Grotzer (2011:8) explained that the absence of this understanding cause student to structure information differently and end up distorting them, even when they are taught with the accurate information. Experience alone does not help students understand how to structure the concepts. Students need support to get beyond the cognitive hurdles involved. Students typically reason using simple linear cause and effect, where one thing directly makes another thing happen. Because of that, most students were unable to reason science correctly and end up distorting them, even when they are taught with the accurate information (Metcalf, 2011:8).

Though proven to be effective in fostering learning of complex science topic through immersion of causality nature, learning with EcoMUVE is still risky. Since, students are given access to a wide range of information represented as text, graphics, animation, audio, and video structured in a nonlinear fashion (Jonassen, in Azevedo & Cromley, 2004:524). Learning in such an environment requires a learner to regulate his or her learning, that is, to make decisions about what to learn, how to learn it, how much to learn, how much time to spend on it, how to access other instructional materials, how to determine whether he or she understands the material, when to abandon or modify plans and strategies, and when to increase effort (Williams, in Azevedo & Cromley, 2004:254). Or in other word student need to practice self-regulated learning.

According to one-of cited source self-regulated learning which being referred as an important new construct in education (Boekaerts, 1999:445) defined as “proactive processes that students use to acquire academic skill, such as setting goals, selecting and deploying strategies, and self-monitoring one’s effectiveness, rather than as a reactive event that happens to students due to impersonal forces” (Zimmerman in Rosen, 2010:70). Self-regulated learning is essential to the learning process as it can help students to create better learning habits and strengthen their study skills, apply learning strategies to enhance academic outcomes, monitor their performance and evaluate their academic progress (Zumbrunn et al., 2011:4). According to Zimmerman (2002:69) although
highly personalized, Self-Regulated Learning is not asocial in nature and origin. Student can learn how to self-regulate their learning through instruction and modeling from teachers, parents or colleagues. Teacher could utilize a variety of effective instructional strategies for encouraging self-regulation in the classroom (Zumbrunn et al., 2011:13).

Given those arguments a study was then important to be conducted. This study follows the suggestion by Widodo (2008:8) in which several multi-disciplinary issues: self-regulated learning (educational psychology), nature of scientific concepts (life science) and multi-user virtual environment (educational technology). This study is not only to point out the effectiveness of MUVE as a learning media that foster understanding of scientific concepts and self-regulated learning but also to highlight as well to present a different perspective about research in science education. The perspective was expected to eventually help community of science educators to understand the dynamics in learning.

This study was conducted in the middle-upper educational level, involving high school students within ecosystem learning. Knowledge about ecosystems and populations is an important strand of the life science, besides that, content standards and the processes underlying ecosystems exemplify sophisticated causal features inherent to ecosystem processes and relationships make it difficult to understand the dynamics involved in concepts such as energy transfer, matter recycling, decomposition, and interaction between biotic and abiotic factors (Grotzer, in Metcalf, 2011:1). The ecosystem learning with this study was conducted using the MUVE software, called Ecological Multi-User Virtual Environment (EcoMUVE) as suggested by previous research (Metcalf, 2011). EcoMUVE immersing the features of causal complexity, such as action at a distance, time delays, and non-obvious causes in the virtual ecosystem facilitate construction of the conceptual understanding of the complex causality patterns (Grotzer, 2011:1).

The biggest challenge of this study is to present a deep and comprehensive analysis about the problems of students’ understanding of causality and self-regulated learning. Because of that, researcher then incorporated a mixed-method
study. Both methods were combined to present “...a more complete picture of the phenomenon under study than either method could produce on its own...” (Fraenkel et al., 2011:584). This study combined a quantitative, pre-experimental method with qualitative methods include interview, observation and content analysis.

B. Statements of the Problem

The problem that will be focused in this research is as follow “How is the dynamics of students’ self-regulated learning on understanding causal patterns in ecosystem via Multi-User Virtual Environment?”, the problem was then expanded into several research questions as follow:

1. How is the students’ self-regulated learning behavior before and after the intervention?
2. How is the students’ self-regulated learning behavior before and after the intervention?
3. How is the students’ understanding of causal patterns before and after the intervention?
4. How is the correlation between self-regulated learning and students’ understanding of causal pattern after the intervention?
5. How is the effect of self-regulated learning to students’ understanding of causal pattern after the intervention?
6. How do the qualitative results explain and expand the experimental outcomes?

C. Purpose of the Study

The main purpose of this study was to examine the dynamics of students’ self-regulated learning on understanding causal patterns in ecosystem, via learning with the Multi-User Virtual environment.

D. Problem Limitation

Due to the wide range of problems addressed, researcher then set a limitation for this study as follow:
1. Dynamics of students’ self-regulated learning is represented by the change of students’ self-regulated learning and understanding of causal patterns in ecosystem after the given intervention: Multi-User Virtual Environment.

2. The ecosystem concepts that were addressed in this study are energy flow, matter cycle and balance of the ecosystem.

3. This study covered analysis of four out of five causal patterns: domino causality, mutual causality, cyclic causality and dynamic stability.

E. Assumptions of the Study

Multi-User Virtual Environment (MUVE) offers an immersion of scientific concepts which accommodate the perspective of causality through 3-D visualization. The open-ended nature of MUVE on the other hand require student to self-regulate their learning in order to obtain optimal experience which in turn foster understanding of complex ecology concept, by reasoning the causal patterns.

F. Hypotheses of the Study

The quantitative part of this study tested these hypotheses:

$H_{1-1}$: There is a significant difference of self-regulated learning before and after the intervention.

$H_{1-2}$: There is a significant difference of understanding of the causal patterns in ecosystem before and after the intervention.

$H_{0-3}$: There is no significant correlation between self-regulated learning and students’ understanding of the causal patterns in ecosystem after the intervention.

$H_{1-3}$: There is a significant correlation between self-regulated learning and students’ understanding of the causal patterns in ecosystem after the intervention.

$H_{0-4}$: There is no significant effect of self-regulated learning to students’ understanding of the causal patterns in ecosystem after the intervention.

$H_{1-4}$: There is a significant effect of self-regulated learning to students’ understanding of the causal patterns in ecosystem after the intervention.
G. Significance of the Study

1. Theoretical Significance

As a reference to encourage the use of Educational MUVE as an alternative learning media that foster understanding of scientific concepts as well as self-regulated learning.

2. For researcher

Obtain experiences on how to conduct a computer assisted-learning with the use of Educational MUVE, in order to encourage self-regulated learning on understanding scientific concepts.

3. For other researchers

As a reference on how to conduct a mixed method study in science education research and to introduce the urgently resolved but rarely studied issue within science education research in Indonesia.

4. For teachers

To encourage the practice of promoting student’s self-regulated learning in everyday teaching, via educational Media such as MUVEs.

5. For students

Facilitate the construction of self-regulated learning behaviors and skills, as well as understanding of scientific concepts for student participating in this research.

H. Organization of the Writing

Chapter 1 gives introduction of the research, and it consists of seven subchapters which are background of the study (A), statements of problems (B), purpose of the study (C), problem limitation (D), assumption of the study (E), hypotheses of the study (F), significance of the study (G) and organization of the writing (H). Chapter 2 comprehensively discusses theories used in this research, which include self-regulated learning (A), nature of the scientific concepts (B),
ecosystem learning (C) and multi-user virtual environment (D), the chapter also include related works (E) and theoretical framework of this study (F). Chapter 3 presents the operational definition (A), research design (B), data source (C), instrumentation (D), data processing (D), data analysis (E) and the summary of the previous subchapter (of Chapter 3) in the procedure of the study (F).

Chapter 4 include the findings and discussion of the study which organized into several subchapter based on the design of the study into: pre-intervention qualitative phase (A), experimental outcomes (B) and post-intervention qualitative phase (C), that chapter also include the general discussion (D) that sums the idea of the previous subchapter and closed with the implication of the study (E). Finally in chapter 5 conclusion (A) and recommendation (B) of the study complete this paper.