CHAPTER 1

INTRODUCTION

A. Background

The scenario of the world in the 21st century saw rapid progress in science and technology. Knowledge is increasing rapidly as the effects of testing new ideas in the world either by research institutions or others. In today's information age, the main goal of the educational system should be to provide students with information acquisition skills instead of directly providing them with the information they need. As it is known education desires to change the behavior that aims to acquire individuals the ability to define problems around them, to observe, to analyze, to hypothesize, to experiment, to conclude, to generalize, to solve their existing problems and living in accord with their environment (Karsli, Yaman & Ayas, 2010). Science subjects are crucial to accomplish these aims. Mastery of relevant concepts and phenomena generates a necessary base for the acquisition of knowledge and understanding in science subject.

One of the important findings of science education research is that students come to science classes with a wide range of preconceptions. Students come into classroom with their own knowledge and they reformulate their existing knowledge, either valid or invalid or incomplete, only if new information is connected to knowledge in their mind. The experiences gained by the individual form the basis of these self constructed conceptions (Baser, 2006). The persistence of preconceptions, preformed ideas and theories about how the natural world works, theories that students bring with them to the science class and stand as an obstacle to what students are expected to learn becomes a difficulties for students to construct conceptual understanding of science concept (Kapartzianis, 2012). Thus, teaching students can not be understood as merely providing new material to mix with what students already know.

Science may require a challenging process of dealing with the prior concepts that guide students' thinking. Students who are exposed to scientific concepts would hardly give up their prior understanding completely. They will try to change their previous conception when they are confronted with the new idea but still they might integrate both to build a new framework. Simply presenting a new concept or telling the students that their views are inaccurate will not result in conceptual change, because students have relied on their preconceptions to understand and function in their world (Kapartzianis, 2012). Instructional process with an exposing event is needed to elicit students' conception. Students can use a variety of ways to expose their ideas, it can be through discussion, small group work, journal writing, and pencil and paper quizzes. Regardless of the method, the goal of this step is to help students recognize and begin to clarify their own ideas and understandings. Once students' conceptions are made explicit, teachers can use them as the basis for further instruction (Kapartzianis, 2012). There is also an argument about constructivist view on learning in which students' alternative conceptions derived from their everyday-life experiences before the formal instructions has been seen as a starting point in teaching (Baser, 2006).

One basic constructivist principle of learning is that learners build connections between their existing knowledge and new experiences. From the perspective of conceptual change, teaching requires an active approach in which children must be engaged in building explanations that challenge concepts and beliefs that they previously held (Thagard, 2003). Students should be given opportunity to be actively involved in the learning process. This has therefore, created room for further search for other instructional strategies that could possess enough cure and appeal to the learners and that would help to achieve the objectives of science education. All these call for constructivist-based teaching strategy in science. Students are able to learn and retain knowledge better by actively participating rather than learning passively. Science instruction that emphasizes science process skills *(SPS)* will be able to help students acquire and understand information, as well as improve skills in critical

thinking and decision making. Science process skills include observing qualities, measuring quantities, classifying, inferring, predicting, experimenting, and communicating. Hence, it is necessary to teach students how to acquire this knowledge and not just teach all the knowledge. In the science education system, science process skills are competencies that enable students to acquire knowledge as well as understand the knowledge obtained (Harlen, 1999; Karsli, Yaman, & Ayas, 2010).

Science process skills are beneficial in that students can realize by participating in instructional activity. Science process skills are special skills that simplify learning science, activate students, develop students' sense of responsibility in their own learning, increase the permanency of learning, as well as teach them the research methods (Karamustafaoğlu, 2011). Besides, they are the thinking skills that we use to get information, think on the problems and formulate the results. They are also the skills that scientists use in their studies. Science process skills are not inseparable in practice from the conceptual understanding that is involved in learning and applying science. Classroom studies have centered on the basic and integrated science process skills over the past three decades, many researchers have focused their attention on these skills (Harlen, 1999). Basic science process skills are (BSPS): Observing, classifying, measuring, and predicting. These skills provide the intellectual groundwork in science, such as the ability to order and describe natural objects and events. Integrated Science Process Skills (ISPS): identifying and defining variables, collecting and transforming data, constructing tables of data and graphs, describing relationships between variables, interpreting data, manipulating materials, and recording data, formulating hypotheses, designing investigations, drawing conclusions and generalizing.

Improve students' achievement in science courses has always been targeted as the goal of science education. Along with this aim, it is desired to let them gain some specific characteristics of the age to understand scientific information who

investigate, interrogate, experience, discover and solve, who adapt their prior understanding into new conditions, improving their skills, who have the ability to come up with creative ideas and to develop integration activities with other sciences. Among the science concepts, separation of mixture concept is one of the topics that can promote the acquisition of students' science process skill and conceptual change.

Separation of mixture concept is explicitly addressed in assessed curriculum of TIMSS (Trends in International Mathematics and Science Study) in chemistry domain of eight grades. Test items that addressed separation of mixture topic are test item in TIMSS 1999 with ID S02219, TIMSS 2003 with ID S032562 and TIMSS 2007 with ID S042083. The context of question is attributed to reasoning and analysis about separation of salt, sand and iron fillings mixture. At the eighth grade, students should be able to classify substances on the basis of characteristic physical properties and recognize that substances can be grouped according to similar chemical and physical properties (Yung, 2006). Rustaman *et al.* (2009) found that the result of Indonesia students' achievement on test item that covered separation of mixture topic in TIMSS 1999, TIMSS 2003 and TIMSS 2007 are below the international average. Indonesia students are not used to response the form of TIMSS test items, most of test items on separation of mixture topic which are applied on general examination and national examination in Indonesia are still knowledge oriented and not applicable for junior high school students, meanwhile TIMSS test items have essay and multiple choice form which tend to provide data or information in table-graph-diagram, examine students' ability to analyze based on observation or experiment and problem solving which is provided hierarchically.

The use of Predict-Discuss-Explain-Observe-Discuss-Explain (PDEODE) method is introduced in which the activity consists of focusing on peer interaction, having the students take responsibility for making their own research plans, doing hands on activity and analysis, producing a report and presenting the results in a class, were all tools for motivating, engaging students to take responsibility for their learning and

aimed to understand how conceptual change of students is generated and how science process skill of junior high school students can be improved through PDEODE method in separation of mixture lesson.

B. Statement of Problems

How can PDEODE method help students to generate conceptual change and science process skills' acquisition?

1.2.1 Research questions

In the light of the problem above, this study will be guided and structured around the following research questions:

1. Are there any effects of PDEODE method on students' conceptual change on the degree to which students generate conceptual change on separation of mixture concept?
2. How does students' acquisition of science process skills on separation of mixture concept through PDEODE method?

C. Limitations of the Study

Limitations of the study are examined in order to define the research. This study will be defined based on the following limitation:

1. Students' conceptual change which is examine in this research is limited on the change of students' conception code from first session until third session during instruction process through PDEODE (*Predict-Discuss-Explain-Observe-Discuss-Explain*) method by considering the result of students' conception sheet
2. Students' acquisition of science process skills is examined through SPS (*Science Process Skills*) observation sheet, students can be said acquire science process skills aspect if students conduct learning activity based on indicator of scence process skills.
3. The concept which is examined in this study is separation of mixture. The concept is limited into magnetic attraction, decantation, filtration, and evaporation for 8th grader of secondary school students.

D. Assumption of the Study

Students often express a wish to have theoretical and practical issues well integrated in the other hand, students who are exposed to scientific concepts would hardly give up their prior understanding completely. Using pre-lecture assignments, focusing on peer interaction and cooperating in small groups, having the students take responsibility for making their own research plans, taking advantage of the PDEODE method, doing fieldwork and laboratory analysis, and summing up results in a report and presenting them in a class discussion, were all tools which help to achieve an excellent learning outcome (Kolari, 2005).

E. Aim of the Study

In view of the above, the aim of this study are to examine the effectiveness of PDEODE method benefits students learning on the degree to which students accept scientific concepts and use them to generate conceptual change and improve their science process skills, to improve learning results in science education by pedagogical means and to suggest approach of teaching that may promote conceptual change.

F. Benefits of the Study

This study is expected to give contributions for researcher, teachers, students and readers as follow:

1. This research is expected to give information about the implementation of PDEODE method on separation of mixture concept in secondary school
2. This research is expected to give information about the effectiveness of PDEODE method to help secondary school students to generate conceptual change and improve science process skills
3. Through the implementation of PDEODE method, it is expected that student will be able to improve their science process skill and be able to generate conceptual change.

4. This research can be an alternative method to conduct instructional process in a classroom
5. As the reference for the other researcher in doing research with same focus of study

G. Organizational Structure

This research paper comprises five chapters that is started with introductory chapter which describes the background and statement of the problem, limitation of the study, assumption of the study, aims of the study and finally the benefits of the study. It starts by focusing on students' preconceptions which although they have proven by a series of observations and empirical research to stand as an obstacle to what students are expected to learn and the importance of science process skills that enable students to acquire knowledge, develop sense of responsibility in their own learning and increase the permanency of learning. The researcher in order to help students overcome this obstacle, determined the objectives of the study, and subsequently formulated the research questions. The second chapter provides literature review of the study, the chapter started by focusing on theory of conceptual change and science process skills. Finally the PDEODE method used in this study for the teaching and learning of chemistry more specifically separation of mixture concept was discussed along with an attempt by the researcher to justify the research. The third chapter examines research methodology. The chapter begun by detailing the participant of the study and the time and location under which the various stages of research were carried out. Next, it dealt with the method and design of research, operational definition and data collection instruments. The fourth chapter presented data analysis and interpretation. Descriptive and inferential statistics such as frequencies, tables and percentages were used in the data analysis and summaries. The results of both qualitative and quantitative data were presented by using tables and graph. The last chapter presented conclusion that was taken from the research and suggestion for further research.