CHAPTER I
INTRODUCTION

1.1. Background of the Study

Education is the process of developing the capacities and potentials of the individual so as to prepare that individual to be successful in a specific society or culture. The world is becoming more and more competitive, quality of performance has been the key factor for personal progress. Parents desire that their children climb the ladder of performance to as high a level as possible. This desire for a high level of achievement puts a lot of pressure on students, teachers, schools and in general education system itself. School achievement may be affected by various factors like intelligence, study habits, and attitude of people towards school, different aspects of their personality, and socio-economic status.

An emphasis on understanding leads to one of the primary characteristics of the new science of learning: its focus on the processes of knowing (*e.g.*, Piaget, 1978; Vygotsky, 1978). Humans are viewed as goal-directed agents who actively seek information. They come to formal education with a range of prior knowledge, skills, beliefs, and concepts that significantly influence what they notice about the environment and how they organize and interpret it. This, in turn, affects their abilities to remember, reason, solve problems, and acquire new knowledge.

There is widespread acceptance of the idea that critical thinking should be an important dimension of science education. Thus, for example, the *National Science Education Standards* (1996) as one of its goals has the promotion of science as inquiry. The work in the science education literature devoted to the

fostering of critical thinking takes a number of different forms. Some of it focuses on particular aspects of critical thinking, for example identifying logical fallacies (Dreyfus *et al*., 1980; Jungwirth *et al*., 1990); formal reasoning (Garnett *et al*., 1984; Lawson, 1982, 1985; Obed, 1997); and scientific reasoning more broadly (Friedler *et al*., 1990). Most often it is directed to either the description and evaluation of projects and programmes aimed at fostering critical thinking (Moll *et al*., 1982; Novak *et al*., 1989; Statkiewicz *et al*, 1983; Zohar *et al*., 1993; Zoller, 1999) or the assessment of students' abilities to think critically (Dreyfus *et al*., 1980; Garnett *et al*., 1984).

For much of the 20th century, educators have devoted their attention to trying to define and teach problem solving skills. In the early 1900s, problem solving was viewed as a mechanical, systematic, and often abstract set of skills, such as those used to solve riddles or biological problems. These problems often have correct answers that are based on logical solutions with a single correct answer. Under the influence of cognitive learning theories, problem solving shifted to represent a complex mental activity consisting of a variety of cognitive skills and actions. Problem solving included higher order thinking skills such as "visualization, association, abstraction, comprehension, manipulation, reasoning, analysis, synthesis, generalization, each needing to be managed and coordinated (Garofalo *et al.*, 1985). Problem solving also includes attitudinal as well as cognitive components. Motivation and attitudinal aspects such as effort, confidence, anxiety, persistence and knowledge about self on science are important to the problem solving process (Jonassen *et al.*, 1996).

Science-related attitude is the most important outcome of science teaching. Though some people view the science-related attitude as the by-product of teaching science, yet a majority of the people consider it equally important as knowledge aspect. Science-related attitude is a very significant concern of the process of science education. To develop science-related attitude, the teachers should always remember that without a questioning mind and a spirit of enquiry, studies in science will only mean acceptance of dogma and will never lead to development of attitude towards science in the learner. The students should be made to practice and observe science so that they get the opportunity to feel and develop the components of science-related attitude in their minds.

The means of representing ideas in diagrams with node-link assemblies has been termed concept mapping (Novak *et al.*, 1984), mind mapping (Buzan *et al.*, 1993) and argument mapping (van Gelder, 2013). All of these mapping techniques are called visual mapping (Davies, 2010). When used as a part of instruction, these types of mapping techniques have been shown to increase students' achievement scores (Horton *et al*., 1993), enhance knowledge retention (Nesbit *et al.*, 2006), develop critical thinking skills (Able *et al.*, 2006; Briscoe *et al.*, 1991; Kinchin, 2001), support problem solving abilities (Fiol *et al.*, 1992) and increase students' attitude towards science (Akay *et al*., 2012).

Educators are looking for new ways to make their teaching engaging, active, and student-centered can use visual mapping tools to achieve their teaching and learning goals. Teachers can visually engage students by making maps that complement or take the place of written information. They can also have their students participate in the tactile activity of making maps. Active learning occurs

when “students are doing things and thinking about what they are doing” and meaningful learning happens when students integrate new information into what they already know (Stalheim-Smith, 1998; Novak, 2007). Visual mapping, which requires students to express their understanding of concepts in words and images and then draw and label links between those ideas, facilitates both learning processes.

In our society academic achievement is considered as a key criterion to judge one’s total potentialities and capacities. Hence, academic achievement has the same thing like critical thinking skill, problem solving ability and science-related attitude occupies a very important place in education as well as in the learning process. So in view of this a study was conducted to find out students’ critical thinking skills, problem solving abilities and science-related attitudes in Biology, particularly for the topic of human locomotor system on the basis of constructive teaching method of visual mapping, such as concept mapping, mind mapping and argument mapping, respectively.

The human locomotor system has been also known as the musculoskeletal system is an organ system that gives humans the ability to move using their muscular and skeletal systems. The human locomotor system provides form, support, stability, and movement of the body. It is made up of the bones of the skeleton, muscles, cartilage, tendons, ligaments, joints, and other connective tissues and organs together. The locomotor system’s primary functions include supporting the body, allowing motion, and protecting vital organs. These topics also tell about the diseases or disorders of bones and muscles from another body

system can bring about irregularities and some modern technology which are able to help maintain human's mobility.

The researcher has conducted the preliminary studies and initial observation about the mean score that students have achieved for the topic of human locomotor sysem at MAN 1 Tanjung Pura. Most of the mean score that students have obtained were quite low. The school has applied the minimum accomplishment standard of 83.0 in the eleventh grade, in fact the students just obtained the score below 83.0 (see Table 1.1.).

Table 1.1. The Mean Score of Students' Learning Accomplishment of the 11th Graders of Science Program at MAN 1 Tanjung Pura

No.	Grade	KKM	Mean Score
1.	XI-IPA 1	≥ 83	79.64
2.	XI-IPA 2	≥ 83	78.56
3.	XI-IPA 3	≥ 83	78.81
4.	XI-IPA 4	≥ 83	78.92
	Average		78.98

(Source: 11th Grade Students' Archives at MAN 1 Tanjung Pura, 2016)

In fact, students' critical thinking skills, problem solving abilities and science-related attitudes were also declined because of students were not actively involved in learning activity (Liu, *et al.*, 2010). The learning processes occured in schools were mostly based on a teacher-centered instruction. It was also stated that science education has, in many cases, become teacher centered, based on rote memorization, and focused on test scores (Heinze-Fry *et al.*, 1990; Huai, 1997; Kinchin, 2001; Mason, 1992). Most students considered science to be boring, a list of big words and facts, intimidating, and not relevant to their lives (Mason, 1992). Negative attitudes towards the study of science are also fostered as

students experience no connection between their study and their real lives (Roth, 1994).

Miller, *et al.* (2010) stated that students should assume the role of a scientist by developing concepts and gathering knowledge to support those concepts. According to Drake *et al.* (2009), suggested that in many classrooms, science instruction does not support the need for developing student to inquiry scientific investigations. What students gain as a result of the study of science through real life critical thinking and problem solving skills and understanding the world need to increase as well as their scores in the end of the year tests. Varma, *et al.* (2009) observed that science should be taught and learned through visualization. Activities in science classroom should involve the critical thinking and problem solving aspects. Visual mapping is seen as a system of learning that supports the development of students' critical thinking and problem solving skills.

Based on the interviews conducted with a biology teacher, Mrs. Umi Kalsum Pelawi, S.Pd of the eleventh grade at MAN 1 Tanjung Pura have been known that the topic of human locomotor system was considered to be one of the most difficult matters that students have faced, particularly bone tissue, skeletal system, muscular system and muscular tissue due to the unclear concepts. This case was in line with the conditions in other schools across Tanjung Pura suggested that human locomotor system was quite difficult to be understood well. Although traditional methods of lecturing and experimenting have not proven effective, additional visual mapping learning techniques were implemented to provide students with the opportunity to engage and discover concepts, draw conclusions and report findings with supporting information (van Gelder, 2013).

This study will be expected to be able to provide information about the effects of visual mapping and science-related attitude on students' critical thinking and problem solving skills, particularly for the topic of human locomotor system. The results of this study are expected to help educators making a right decision in teaching a meaningful and effective biology topics in the near future. Based on the information above, the researcher conducted a study about "*The Effects of Visual Mapping and Science-Related Attitudes On Students' Critical Thinking and Problem Solving Skills at MAN 1 Tanjung Pura*".

1.2. Problem Statement

Based on the background of the study aforementioned, here were the problem statements presented as follows:

1. The students' critical thinking skills, problem solving abilities and science-related attitudes for the topic of human locomotor system were quite low, proved by the mean score that students have already achieved.
2. Teachers have been using the traditional lecture or teacher-centered instruction, and based on rote memorization, so that students were not actively involved and engaged in a meaningful learning process in the classroom.
3. Teachers rarely gave the students some instruction with visual mapping aids, such as concept mapping, mind mapping and argument mapping as well.
4. The processes of skeletal and muscular formation and other relatable things were the most difficult matters among others.
5. Efforts to find out the effects of visual mapping and science-related attitudes on students' critical thinking and problem solving skills and also their

interactions for the topic of human locomotor system have not been conducted in other previous studies yet.

1.3. Research Scope

The scopes of this study were limited to the visual mapping and science-related attitudes on students' critical thinking and problem solving skills. The visual mapping tools that have been used to support the research about students' critical thinking and problem solving skills were limited to concept mapping, mind mapping and argument mapping. This study has also attempted to find out the effects of visual mapping on students' critical thinking and problem solving skills, the effects of science-related attitudes on students' critical thinking and problem solving skills, and the interactions between visual mapping and science-related attitudes on students' critical thinking and problem solving skills as well. Other details were mentioned as follows:

a. The study has been conducted at MAN 1 Tanjung Pura.
b. The study has been employed to the eleventh grade (XI) students of Science Program for the topic of human locomotor system.
c. Visual mapping tools that have been used in this research were concept mapping, mind mapping and argument mapping, respectively.
d. Visual mapping (concept mapping, mind mapping and argument mapping) have been treated as the experimental groups and direct instruction has been treated as the control one.

1.4. Research Questions

This study answered three research questions as follows:

1. Are there any effects of learning techniques on students' critical thinking skills for the topic of human locomotor system at MAN 1 Tanjung Pura?
2. Are there any effects of science-related attitudes on students' critical thinking skills for the topic of human locomotor system at MAN 1 Tanjung Pura?
3. Are there any interactions between learning techniques and science-related attitudes on students' critical thinking skills for the topic of human locomotor system at MAN 1 Tanjung Pura?
4. Are there any effects of learning techniques on students' problem solving skills for the topic of human locomotor system at MAN 1 Tanjung Pura?
5. Are there any effects of science-related attitudes on students' problem solving skills for the topic of human locomotor system at MAN 1 Tanjung Pura?
6. Are there any interactions between learning techniques and science-related attitudes on students' problem solving skills for the topic of human locomotor system at MAN 1 Tanjung Pura?

1.5. Objectives of the Study

The objectives of the research were:

1. To find out the effects of learning techniques on students' critical thinking skills for the topic of human locomotor system at MAN 1 Tanjung Pura.
2. To find out the effects of science-related attitudes on students' critical thinking skills for the topic of human locomotor system at MAN 1 Tanjung Pura.
3. To find out the interactions between learning techniques and science-related attitudes on students' critical thinking skills for the topic of human locomotor system at MAN 1 Tanjung Pura.

4. To find out the effects of learning techniques on students' problem solving skills for the topic of human locomotor system at MAN 1 Tanjung Pura.
5. To find out the effects of science-related attitudes on students' problem solving skills for the topic of human locomotor system at MAN 1 Tanjung Pura.
6. To find out the interactions between learning techniques and science-related attitudes on students' problem solving skills for the topic of human locomotor system at MAN 1 Tanjung Pura.

1.6. Significance of the Study

The research findings are very important for researcher, to provide significant information about students' critical thinking skills, problem solving abilities and science-related attitudes through visual mapping. For teachers and educators, this main study is very important to: (1) to provide information about the utilization of visual mapping that need to be carried out to improve and enhance students' critical thinking and problem solving skills, (2) to provide information about a better understanding in how visual mapping help students improve their recall and better achievement, (3) to provide new information about visual mapping and its possible impact to help students' learning, (4) to provide some feedback for teachers, educators and policy makers in term of enlarging knowledge and improvement on students' critical thinking and problem solving skills through visual mapping, and (5) to provide information about the importance of visual mapping for more effective and meaningful way of learning.