

CHAPTER I

INTRODUCTION

1.1 BACKGROUND

Education is a responsibility for people, which all people have a right to get and hope for always developing in their knowledge. Based on Aristoteles cited by Sutrisno (2012), in order to get a good life, human needs to get education. Education is an intentional lesson activity in order to get virtuous personality both in spiritual and physical (Sutrisno, 2012). Family is a first place where human get education called informal education. Informal education is an education that is exposed to a human from daily experience. Besides, there is also non-formal education which is education coming from society, and formal education which is education gotten from school. Formal education is an education that is received by human generally from 9 to 12 years old in elementary school, 13 to 15 years old in junior high school, 16 to 18 years old in senior high school, and the older years in university (Kurniawati, 2013).

For elementary school, junior high school, and senior high school, it is stipulated in government regulation number 19 of 2005 paragraph 63:1, kind of education assessment for student is based on 3 kinds of assessment, which are learning outcomes by educators, by educational units, and by the government (*Peraturan Pemerintah Republik Indonesia*, 2005). Assessment of learning outcomes by government is defined in regulation number 19 of 2005 paragraph 66:1, it is aimed to assess the competence achievement nationally on certain subjects that conducted in the form of national examinations (*Peraturan Pemerintah*

Republik Indonesia, 2005). Based on the regulation, it is indicated that national examination is one of education measurement that has to be achieved by student.

In senior high school, the students need to choose between science and social major. In science major, the subjects that included in national examination is Bahasa, English, Mathematics, Physic, Chemistry, and Biology. Based on record of Ministry of Education and Culture (2017), the result of national examination in Indonesia has been fluctuating for the last 3 years especially in D.I. Yogyakarta. At public senior high school in Yogyakarta, the region that had the highest score of national examination in D.I.Y, the score for English, Chemistry, and Biology subject decreased in 2016 and increased in 2017. For Mathematics subject, the score was significantly increased in 2016 and decreased in 2017. Physics is the only subject that has experienced the decreasing in each year for last 3 years, whereas 12% decreasing in 2016, and 2% decreasing in 2017. The score for each subject can be seen in Table 1.1 below.

Table 1.1 Result of National Examination in Yogyakarta for Science Class
(Source: <https://puspendik.kemdikbud.go.id/hasil-un/>)

Subjects	Score		
	2015	2016	2017
Indonesian	86.38	77.87	84.83
English	75.11	70.41	78.13
Mathematics	66.28	68.13	68.04
Physics	75.69	66.98	65.40
Chemistry	73.54	66.99	74.49
Biology	75.02	70.58	74.61

If it is compared with Bantul, as a region that had the second highest score of national examination in D.I.Y, the score for Physics subject in public senior high school are decreased in 2016 as much as 25% but able to increase in 2017 as much as 3%. However, even the score for Physics subject in Bantul was increased in 2017 and the score for Physics in Yogyakarta was decreased in last 3 years, the average score for Physics in Yogyakarta is still higher than Bantul in each year.

Suswanto (2017), a counselling teacher in SMA N 6 Yogyakarta, said that there are several factors influencing the score of students based on learning process in class, which are subject, teacher, and students (personal communication, August 8, 2017). Hartanti, a physics teacher in SMA N 1 Kasihan, added other factor, which is environmental (personal communication, August 28, 2017). It can be concluded by combining both experts and stated by Slameto (2013) that the factors influencing the result score of students based on learning process in class are environment, subject, teacher, and student. Environment's factor includes noisy, lighting, temperature, and others. Subject's factor covers the difficultness of the subject. Teacher's factor covers on how the teacher explaining the subject. Student's factor covers the motivation and concentration that follows the learning process in class.

Environmental factor can be measured by the condition of the class and facilities provided by the school. The number of students in each class in SMA N 6 Yogyakarta are \pm 28 students, while in SMA N 1 Kasihan are \pm 23 students. The number of student in SMA N 6 Yogyakarta is fewer than in SMA N 1 Kasihan. The smaller group of learning process in class is able to make the students more concentrate with the lesson. Thus, the condition of the class in SMA N 1 Kasihan is more conducive. Besides, the classes' facilities in SMA N 6 Yogyakarta is similar with facilities in SMA N 1 Kasihan. The difference is SMA N 1 Kasihan provides class with 1 fan and 2 AC in each class while SMA N 6 Yogyakarta provides class only with 1 fan. The ACs in SMA N 1 Kasihan are able to maintain the temperature in good condition. As the object of comparison, noisy level in-class room of SMAN 6 Yogyakarta is 69.77 dBa and out-class room is 72.21 dBa, while noise level in-class room of SMAN 1 Kasihan is 72.21 dBa and out-class room is 72.16 dBa. The temperature in-class room of SMAN 6 Yogyakarta is 30.2 °C and SMAN 1 Kasihan is 25.9 °C. The lighting level in-class room of SMAN 6 Yogyakarta is 87 Lux and SMAN 1 Kasihan is 79 Lux. Overall, based on noise level, temperature, and lighting level SMAN 6 Yogyakarta and SMAN 1 Kasihan is almost same. Nevertheless, SMAN 1 Kasihan facility is slightly better than SMAN 6 Yogyakarta.

Subject's factor covers difficultness of the matter. Since the focus of this research is Physics, then there is no difference in both high school. The syllabus of physics is the same

in both schools since it has been arranged in curriculum. Besides, *Dinas Pendidikan* has set the rule in which all of teachers should arrange and attend MGMP (*Musyawarah Guru Mata Pelajaran*). MGMP is an organization that was formed by teachers for communication forum in order to solve any problems faced by each teacher and to provide good coordination among the teachers in the same subject.

Teacher's factor covers on how the teacher explaining the matter. Physics teachers in both school basically have same method in teaching process. When teachers explain the lesson, teachers use LCD and several physics animation in order to attract the attention of the student. When teachers give the homework, teachers would ask several students to go before the class and write answer down on the white board in the next day.

Based on Kinantie et al., (2012), students in senior high school especially in 3rd grade are experiencing the stress in upcoming of national examination. Based on the result of research, 4.15% of students categorized as normal, 15.2% of students categorized as light stress, 49.74% of students categorized as medium stress, 30.05% of students categorized as heavy stress, and 0.52% of students categorized as very strong in stress.

Based on Djemari & Kartowagiran (2009), national examination gives impact to students. National examination will lead to students to add more time for studying. It was recorded that 81% of students in school that categorized as good school and 65% students in school that categorized as low school were added with more time for studying. Unfortunately, 41% students were experiencing fatigue in the upcoming of national examination.

In fact, students of SMA N 1 Kasihan are offered to learn the Physics for 2 x 45 minutes in a day which is repeated for 3 times in a week. The physics are scheduled randomly between school hours where students are asked to go to school 5 days in a week (Saturday-Sunday are free). School hours for 3rd grade student on Monday to Thursday is set from 07:15 until 15:30 WIB while on Friday is set from 07:15 until 13:25 WIB.

According to those facts, students at SMA N 1 Kasihan are asked to study the Physics for 90 minutes continuously, whereas Wascher et al (2014) stated that prolonged periods of cognitive activity lead to mental fatigue. Mental fatigue is a decline of cognitive performance that is able to reduce working memory performance and decrease the ability to focus attention. Mental fatigue is included as a physiological state that arises when someone do a continuous task for a long time or when someone do a task requiring focus and attention. Charbonnier et al., (2016) explained the consequence of someone reaches mental fatigue state is a difficulty to get and process the information in a fast and efficient way.

Mental fatigue is able to be analysed by observing the electric activity in brain by using Electroencephalograph (EEG). Spectral EEG measurement had been proposed to be valid and reliable indicators of mental fatigue. A shift of EEG power toward Delta, Theta, Alpha, and Beta might be related to a decrease in the level of arousal one core aspect of mental fatigue (Wascher et al., 2014).

Consequently, the objective of this study is to investigate the mental fatigue of science students that will face national examination in taking a part of teaching-learning process of Physics by analyzing the brain activity at cognitive system. Brain activity is recorded by using EEG and the experiment will be carried out at Laboratory of Computer Science and Electronics, Universitas Gadjah Mada. The temperature and lighting will be set to be similar as classroom in SMA N 1 Kasihan. In addition, mental fatigue investigation will be performed by combining four different variables which are learning methods (autodidact and non-autodidact) and conditions (late morning and afternoon) to find the best learning method and condition for learning the Physics.

1.2 PROBLEM FORMULATION

The problem formulations of this research are:

1. How are the changes of Theta, Alpha, and Beta waves in brain activity on students while studying the Physics by using book and video in the late morning and afternoon based on Electroencephalograph (EEG) analysis?
2. How much of mental fatigue level on students while studying the Physics by autodidact and non-autodidact in the late morning and afternoon?

1.3 RESEARCH OBJECTIVES

The objectives of this research are:

1. Identifying the changes of Theta, Alpha, and Beta waves in brain activity on EEG while studying the Physics using book and video in the late morning and afternoon.
2. Analysing the mental fatigue level of students while studying the Physics using book and video in the late morning and afternoon.

1.4 LIMITATION AND ASSUMPTION OF RESEARCH

Limitations in this study are determined in order to make the research conducted not too broad and limp from existing research topics. The boundaries of that problem are:

- a. Objectively measured by using EEG assessment based on RMS (Root Mean Square) of amplitude.
- b. Focused on the mental fatigue aspect of learning the Physics by Senior High School's student.
- c. Focused on autodidact and non-autodidact learning method in the late morning and afternoon as the comparison.

Assumption in this study is determined in order to make research conducted not too broad from existing research topics and research conducted naturally without any experimental setting. In this study, although the experiment non-autodidact learning process is done without teacher due to difficultness for having a teacher, it is assumed same as non-autodidact learning process in class. The laboratory for experiment's place is assumed same as class condition.

1.5 BENEFIT OF RESEARCH

The researcher is expected this research is able to give some benefits, which are:

1. This research is expected to be an input and evaluation for school and teachers to manage teaching method in order to make mental fatigue of students is not on the maximum state. Therefore, the students can get full attention in class and accept all information given.
2. This research is expected to be used as a reading reference to increase knowledge of the readers. Then, the analysis of research can be used by society to prevent and control the factors that influence mental fatigue. Moreover, this research also can be seen as a reference for the next research since the scope still needs to be developed.

1.6 SYSTEMATICAL WRITING

Systematic of thesis writing is written in order to make this research more structured and easy to be read. Therefore, systematically the research has six chapters as follows:

First, chapter one is introduction that contains of problem statement, problem background, problem formulation, research objective, scope of problem, research benefit, and systematical writing.

Then, chapter two is literature review written about inductive and deductive study. Inductive study is primarily important to determine the literature study of the previous research. Deductive study suggests the basic supporting theories. Literature review contains both concept and basic principles that needed to solve research problems. It also includes studies result that have been done before by other researchers that related with the research undertaken.

Next, chapter three is research methodology that explains the steps for conducting the research in order to keep researcher focused on the objective of this research. This chapter explains the detailed object and focus of research also the conceptual model of the research.

Chapter four is data collecting and processing described the data collection and processing, analysis and results, including images and graphics obtained. This chapter is a reference for the discussion of the results that will be written in Chapter five.

Moreover, fifth chapter explains the discussion about the result of the previous chapter. In this chapter, there will be the core discussion in order to get a comprehensive understanding about the whole research.

Finally, chapter six is conclusion and recommendation that concludes the overall result of the research and show the suggestion. Suggestion related to the current study in purpose of the advancement in the future research is given based on the limitations of the current research. After the research summarized and recommendation provided, the next part will contain References and appendices.