Measurement of Concentration Duration on Reading Activity: EEG Analysis with OpenBCI Ganglion Board

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Abstract:

The brain's electrical signal activity can be measured by electroencephalograph (EEG) recording. The electrical signals represent the conditions of recorded brainwaves (oscillations), such as delta, theta, alpha, beta, and gamma waves. Each of the resulting waves will vary depending on the activity of the brain in progress. This EEG recording can be done to measure the condition of one's concentration. Someone who is concentrating will be at a frequency of 15-18Hz. One activity that requires concentration is reading activity. For maximum mastery of reading results, one must concentrate optimally. EEG recording of reading activity may indicate a person's concentration power while reading is indicated through the duration of concentration when reading activity is performed. The method used in this research is qualitative method. EEG data were taken from 16 respondents (18-22 years old) consisting of 8 males and 8 females. EEG recording was performed for 15 minutes with Open Brain Computer Interface assisted with a sampling rate of 200Hz with a maximum impedance of 15Ω. EEG data recording results are processed using EEGLab and EDF Browser. The results of this treatment will be analyzed to show the duration based on optimal concentration conditions, low concentrations, and non-concentrations, as well as differences in these conditions in males and females. It is expected that the results of this measurement can be used to determine the appropriate reading strategy so that reading activity more effective and efficient (brain friendly).

Keywords: reading concentration power, open brain computer interface, EEG

INTRODUCTION

It is generally known that concentration is an important factor affecting the effectiveness of reading. In some cases, the reader often complains about the difficulty of reading the reading material because of the decreased concentration power during the reading process. The decrease in concentration will certainly affect the reader in understanding the reading material so that the reading process becomes ineffective. This condition of course affects the absorption capacity both in quality and quantity of information captured from reading material. In other words, concentration has an important role to the whole in the process of reading itself. Not only that, the concentration also plays a role against the absorption of information received by readers from the reading.

Because concentration is an important factor that should be involved in reading activities, measurements related to the condition of one's concentration at the time of reading activity become important to know. Through the measurement of the concentration of reading, can measure the duration of a person's concentration when reading involved. Information from these measurement activities can certainly be used as an evaluation material related strategy and reading techniques that can be used by someone at the time of reading so as to remain in optimal condition while reading.

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One way that can be done to measure the power of concentration is to look at patterns of changes in brainwaves that are monitored through electroencephalograph (EEG) sensors. (Tatum et al., 2008) suggest that EEG is a unique and valuable measurement of brain electrical function that displays graphics of voltage differences from within two brain function locations recorded over time. EEG involves the study of recording these electrical signals generated by the brain.

EEG recording of reading activity is expected to identify one's power of concentration while performing this activity. This concentration power is determined based on the condition of brainwaves (oscillations) recorded, such as delta waves, theta, alpha, beta, and gamma. The concentration is at a frequency of 15-18Hz which is in the beta1 range. By knowing the condition of the brainwave, one's concentration power can be described based on the duration of concentration. In addition, the recording data can also be analyzed to show the duration based on optimal concentration conditions, low concentrations, and nonconcentrations, as well as differences in these conditions in males and females.

THEORY AND RESEARCH METHOD

This study uses case studies focused on a single phenomenon selected and studied in depth. The method used is descriptive. The elements described include interpretation of the results of EEG recording, especially brain wave through neurolinguistic analysis performed on reading activity for 15 minutes. Recording uses Open Brain Computer Interface devices and applications. In addition, this research utilizes RAW Data EEG processing applications, namely EEGLab and EDFBrowser. To describe and interpret the results of EEG recording and measurement of reading power, two main theories are used: neurolinguistic theory and brain wave theory. Neurolinguistic theory adapted from Caplan (1987) and Ingram (2007). The brain wave theory is adapted from (Stern and Engel (2005), Quigg (2006), and Tatum et al. (2008).

FINDINGS AND DISCUSSIONS

Data analysis of students' concentration power on reading activity was done through observation and interpretation of EEG recording and measurement results. After the recording process is done, EEG data is then interpreted based on mental conditions (delta, theta, alfa, beta and gamma). Then the EEG with the brain wave range at 13-40Hz (Beta Rhythm) is characterized as the optimal concentration condition, especially at 15-18 Hz. If it is above 22 Hz even up to 40 Hz (Gamma Rhythms), EEG data is characterized as high concentration (focus), but can have anxiety / anxiety impact. Meanwhile, if under 13 Hz it shows diminished concentration and towards a relaxed state and toward a reduction of awareness conditions. The tagging results were then calculated the average duration of a person able to survive in optimum concentration conditions. The results from EEG data were then differentiated by gender, to see the possibility of differences in concentration levels between male respondents and female respondents. The following is a sample image of male and female subject EEG´s data.

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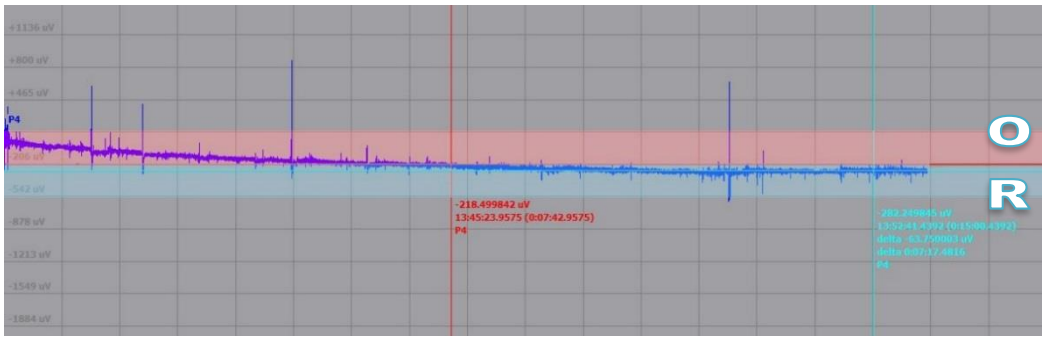


Figure 1. Sample of male EEG´s data (L6)

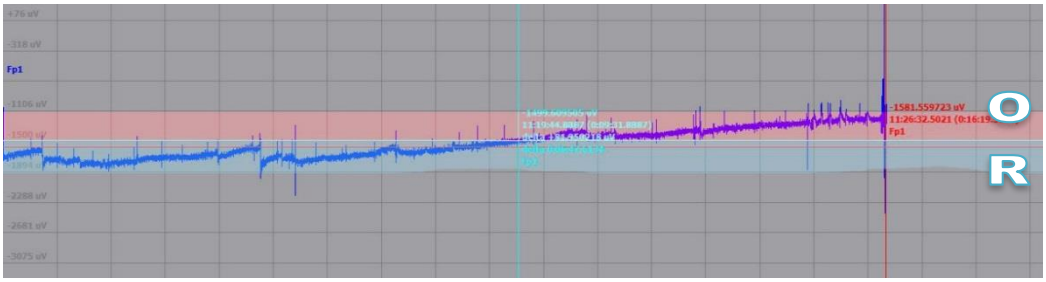


Figure 2. Sample of female EEG´s data (P4)

Based on the analysis results can be known the duration of the concentration of respondents on reading activities conducted for 15 minutes recapitulated into the form of table 1 as follows.

Table 1 Recapitulation of Length Condition Concentration and Nonconcentration Student on Reading Activity

Subjek	Concentration´s Duration			Nonconcentration´s Duration
	Optimal Concentrations	Low Concentrations	Total Duration	
L1	03.36	03.26	07.02	07.58
L2	02.01	02.03	04.04	10.56
L3	03.15	10.45	14.00	01.00
L4	06.51	08.09	15.00	00.00
L5	03.31	03.22	06.53	08.07
L6	07.42	07.18	15.00	00.00
L7	04.00	11.00	15.00	00.00
L8	00.00	10.00	10.00	05.00
P1	00.00	02.23	02.23	12.37
P2	00.00	12.02	12.02	02.58
P3	00.00	12.00	12.00	03.00
P4	05.29	09.31	15.00	00.00
P5	05.13	09.47	15.00	00.00
P6	00.16	03.10	03.26	11.34
P7	09.58	05.02	15.00	00.00
P8	08.05	06.55	15.00	00.00
Averages	**03.19**	**06.59**	**11.03**	**03.57**

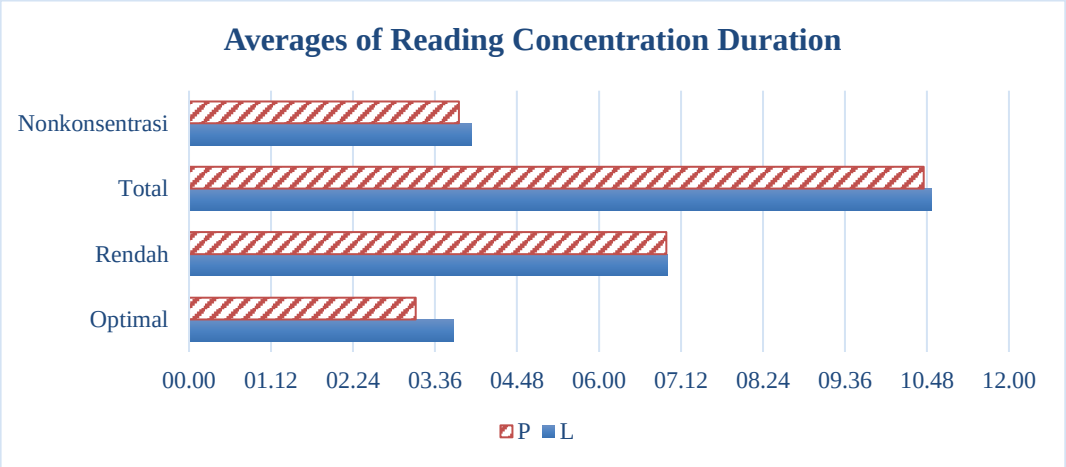
Based on table 1 above it can be described that the average duration of student concentration on reading activity for 15 minutes is 11 minutes 03 seconds, consisting of the average duration of optimal concentration for 3 minutes 19 seconds and average duration of low concentration 6 minutes 59 seconds. Meanwhile, the average duration of the non-concentrated condition during reading lasts for 3 minutes 57 seconds.

In addition, the highest optimum concentration duration was obtained, ie in subjects P7 for 09 minutes 58 seconds, while the lowest optimum concentration duration, for 0 seconds on the subject of L8, P1, P2, and P3. The highest duration of concentration was obtained, ie in P2 subject with 12.02 minutes duration, while the lowest low concentration duration was on L2 subject with duration of 2 minutes 3 seconds. It can also be described that the highest nonconcentration duration is found in the subject of P1, ie for 12 minutes 37 seconds, while the lowest nonconcentration duration for 0 seconds exists on the subject, L4, L6, L7, P4, P5, P7, and P8.

Based on table 1 it can also be described that the highest optimum concentration duration in men marked with code L is 07.42 minutes, whereas in women is 09.58. Meanwhile, the lowest optimal concentration, both in men and women is 00.00 minutes. Then the highest low concentration in men was 11.00 minutes, while in women was 12.02 minutes.

Table 1 shows the highest total concentrations, both in men and women for 15.00 minutes. Meanwhile, in men the total duration of the lowest concentration was 04.04 minutes, whereas in women was 02.23 minutes. Can also be described, the highest non-concentration duration in men is 10.56 minutes, whereas in women 02.23 minutes. When compared to the average duration of concentration and duration of non-concentration, men had a mean duration of optimal concentration higher than women, which amounted to 3.52 minutes. Meanwhile, women are 03.19 or there is a difference of 33 seconds. At low concentration, the average duration of men and women is only 1 second difference. In men, the duration of concentration of 07.00 minutes, while women 06:59 minutes. Thus, it can be described that men are still larger than women, men have an average total duration of concentration of 10.52, whereas women have an average total duration of lower concentrations, which is 10.45 so there is a difference of about 7 seconds.

However, it turns out that men have an average duration of non-concentration greater than women. Nonconcentration duration in men is 04.08 minutes. Meanwhile, in women by 03.57 minutes, equivalent to a difference of 11 seconds. Here is a comparison of concentration duration between men and women.



Graph 1 Comparison of Averages of Reading Concentration Duration between Men and Women

CONCLUSION

Based on the description in the previous section, some conclusions can be drawn as follows. First, the average duration of student concentration on reading activity for 15 minutes was 11 minutes 3 seconds, which consisted of the average duration of optimal concentration for 3 minutes 19 seconds and the average duration of low concentration of 6 minutes 59 seconds. Second, the average ratio of concentration duration between men and women shows that men have average duration of optimum concentration higher than women, which is 3.52 minutes. Meanwhile, women are 03.19 or there is a difference of 33 seconds. Thus, it can be said that in the sample of this research data men have a higher concentration compared with women.

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