

# A Study Of Non Dyslexia Person EEG Pattern For Cognitive Activities Due To Different Gender.

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**Abstract:** The purpose of this study is to identify the electroencephalogram (EEG) pattern of male and female engineering student during the cognitive activity. EEG is a method to monitoring electrical activity in the brain and has four main brainwave; Delta, Theta, Alpha and Beta. Delta wave is slow wave generated in deepest meditation, Theta Wave usually occurs in sleep, Alpha Wave dominant in calming, relaxing condition and Beta wave dominant in wakeful condition. The raw data collected analysis using SPSS and Microsoft Excel to analysis the accuracy and the brainwave pattern between male and female. The average, standard derivation and correlation are used to analysis the EEG pattern between male and female during cognitive activity. Cognitive one of the bloom taxonomy formulate for education activities. The process involved in decision making, understanding of information, attitudes and solving. Subjects are given a set of question to answer. Total 24 students, 12 male and 12 female involve to recorded their EEG signal during answered the cognitive question by wearing the Emotive Insight device. All subjects are from UTHM engineering students. Data collected are focused in Alpha and Beta which exist in when someone wake condition. From the discussion and analysis there have the different between male and female brainwave during the cognitive activity.

**Index Terms:** Electroencephalogram (EEG), Alpha Wave, Beta Wave, Cognitive, Male, Female.

## 1 INTRODUCTION

Brain is most complex organ in the human body. It is made up of more than 100 billion nerves that communicate in trillions of connections called synapses [1]. It is an organ which is located in the skull of a head at the top of a body and brain constitutes only about two per cent of the human body, yet it is responsible for all of the body's functions [2]. Brain receives information through our five senses sight, smell, touch, taste, and hearing often many at one time. It assembles the messages in a way that has meaning for us, and can store that information in our memory [3]. Its composed of three parts the brainstem It performs many automatic functions such as breathing, heart rate, body temperature, wake and sleep cycles, cerebellum function is to coordinate muscle movements, maintain posture, and balance, and cerebrum is the largest part of the brain and is composed of right and left hemispheres. It performs higher functions like interpreting touch, vision and hearing, as well as speech, reasoning, emotions, learning, and fine control of movement [4]. Electroencephalography (EEG) is a method for monitoring electrical activity in the brain. It uses electrodes placed on or below the scalp to record activity with coarse spatial but high temporal resolution. EEG can be used in cognitive research or to diagnose conditions such sleep disorders [5] [11]. Cells that formed in brain uses electricity to communicate with each other are call neurons. It can be detected using sensitive medical equipment, measuring electricity levels over areas of the scalp. This activity is called brainwave pattern [5] EEG measures voltage fluctuations resulting from ionic current within the neurons of the brain. It has several strong points as a tool for exploring brain activity. EEGs can detect changes over milliseconds, which is excellent considering an action potential takes approximately 0.5–130 milliseconds to propagate across a single neuron, depending on the type of neuron [6]. Most of the cerebral signal observed in the scalp EEG falls in the range of 1–20 Hz. The EEG signal are separated and divided into four main types of brainwave consist of Beta, Alpha, Theta and Delta wave [7]. Beta wave range is 12 Hz to 40 Hz (high) these are known as high frequency low amplitude brain waves that are commonly observed while we are awake. Alpha wave range is 8 Hz to 12 Hz (moderate) it is the frequency range between beta

and theta. Theta wave range is 4 Hz to 8 Hz (slow) involved in daydreaming and sleep. Delta wave range is 0 Hz to 4 Hz (slowest) they are found most often in infants as well as young children [7] [13].

## 2. MOTIVATION

Bloom's Taxonomy to promote higher forms of thinking in education, such as analysing and evaluating concepts, processes, procedures, and principles, rather than just remembering facts (rote learning) [8]. It is most often used when designing educational, training, and learning processes. The three domains of educational activities is cognitive mental skills (knowledge), affective growth in feelings or emotional areas (attitude or self), psychomotor manual or physical skills (skills). Cognitive domain is when a student is learning using mental skill, there are gender differences in cognitive abilities [12], [9], [15]. Psychologists have gathered solid evidence that when it comes to how and how well to think, males and females differ in very few but in significant ways. Brain show anatomical, functional and biochemical differences throughout life [10], [11], [14]. Many factors are involved in this differentiation physiological factors along with social norms, is another factor that brings changes [16].

## 3. METHODOLOGY

There are four stages to be conduct so that this research can be completed. Figure 1 shows flow chart of the process and method that implement in this research. The first stage is the literature review of the previous researches that related. The second stage is finding more than 20 subjects, which consists from females and males. Each of the subjects needs to do the cognitive question that prepared to implement this research. Subject for the research is from the engineering student and the condition of subject need to be good to avoid the nose when the raw data recording. Next, third stage is raw data collection using an Emotiv Insight device. Emotiv Insight is a user-friendly and wireless device used to Collect and record the raw of EEG signals. This device must be handle with the correct way to get the good signal when the experiment conducted. The fourth stage to analyse, test and classify.

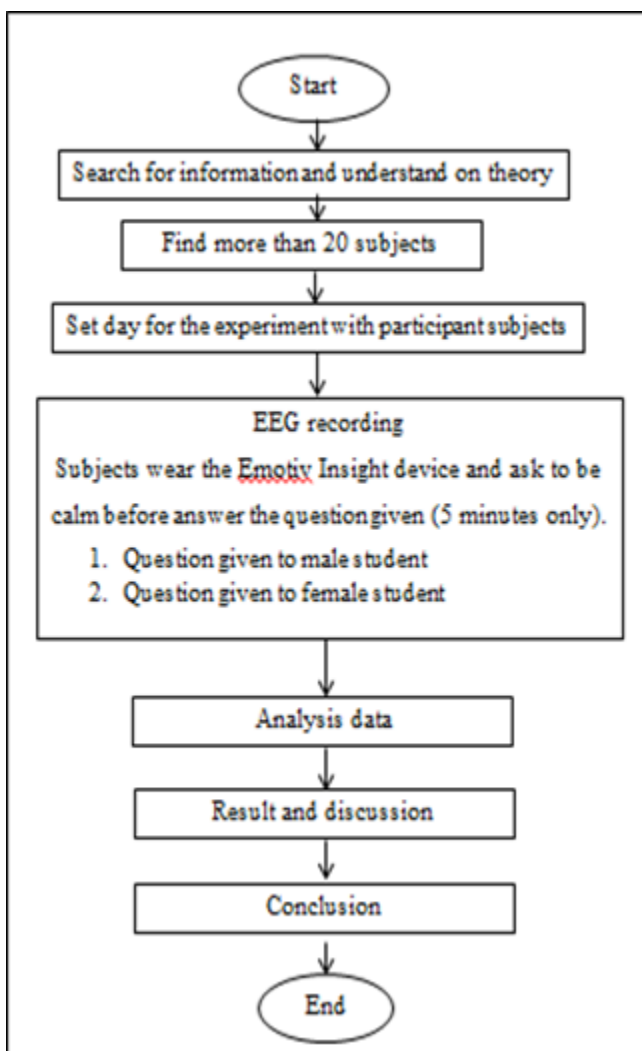


Figure 1. Flow chart of methodology

### 3.1 Subjects

There are 24 subjects of engineering student, which consist females and males. It divided by two group male student and female students. All subjects must answer the prepared question within the time given. The subjects involve in this experiment need to be in a healthy condition and are not on medication to avoid noise on the brainwaves recorded during the experiment is conducted. The chosen subject will be among engineering student from university Tun Hussein Onn's student within the group age of 19 until 30 years old.

### 3.2 Data Collection

The subject is given a set of cognitive question that consists three sections of question total 15 questions and needed to answer it within 5 minutes only. Firstly, the subject must in relaxing condition and wear the Emotive Insight. Once the quality contact is good the record button will be clicked. Questions are varieties of mathematics, general knowledge, visualization and knowledge as well in English language. Figure 2 shows the experimental session the emotive must be wearing before taking the cognitive activity.



Figure 2: The view of subject wearing Emotive from sides, back and front view.

TABLE 1: COMPARISON FOR ALPHA WAVE DURING COGNITIVE ACTIVITY OF MALE AND FEMALE.

Comparison for Alpha Wave during Cognitive activity of male and female		
Subject	Male	Female
S1	Low	Low
S2	Low	Low
S3	High	Low
S4	Low	Low
S5	Low	High
S6	Low	Low
S7	Low	Low
S8	Low	Low
S9	Low	Low
S10	Low	Low
S11	Low	High
S12	Low	Low

## 4. Analysis of Data

The raw data has been recorded using Emotive Insight Equipment. All the data related to this research will be process by using Statistical Package for the Social Sciences (SPSS) software and Microsoft Excel software. This task is the most important part to generate the result and outcome from this research. Descriptive statistics are specific methods are used to calculate, describe, and summarize collected research data such as in a logical, meaningful, and efficient way [17]. Descriptive statistics are numbers that summarize the data with the purpose of describing what occurred in the sample [18]. Descriptive analysis help user to calculate many data automatically and prevent from the error or wrong when the analysis do manually. The standard deviation,  $\sigma$  and variance,  $\sigma^2$  can be calculated by using the formula shows in equation 3.1 and 3.2 [17].

$$\sigma = \frac{\sqrt{\Sigma(x-\bar{x})^2}}{n-1} \quad (3.1)$$

$$\sigma^2 = \frac{\Sigma(x-\bar{x})^2}{n-1} \quad (3.2)$$

## I. RESULTS AND DISCUSSION

### 4.1 Distribution Result.

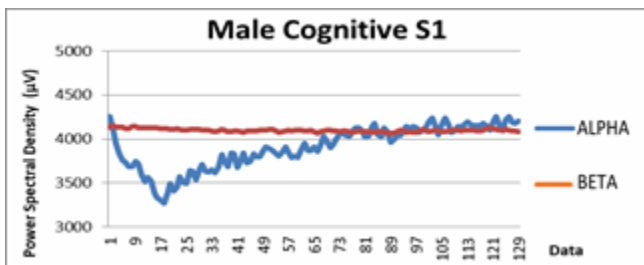
Table 1 shows comparison for Alpha wave during cognitive activity of male and female and Table 2 shows comparison for Beta wave during Cognitive activity of male and female.

**TABLE 2: COMPARISON FOR BETA WAVE DURING COGNITIVE ACTIVITY OF MALE AND FEMALE**

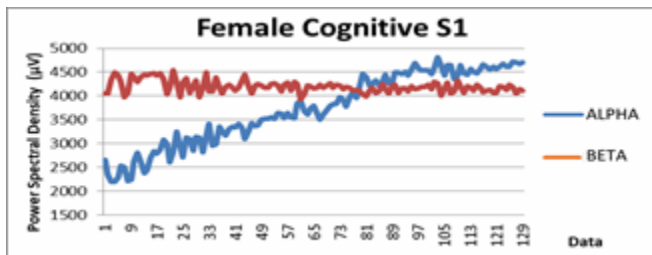
Comparison for Beta Wave during Cognitive activity of male and female		
Subject	Male	Female
S1	High	High
S2	High	High
S3	Low	High
S4	High	High
S5	High	Low
S6	High	High
S7	High	High
S8	High	High
S9	High	High
S10	High	High
S11	High	Low
S12	High	High

**A. Distribution Graph.**

Figure 3 (a) shows distribution graph of male subject 1 as example when conducted the cognitive activity. Beta Wave is remained consisted from the start compare to the Alpha Wave to drop from the beginning and then to go up but Beta Wave remains as the highest. Figure 3 (b) distribution of graph of female subject 1 as example shows the Beta Wave is higher than Alpha Wave even though the Alpha Wave to go up steadily. The graph has been showed 2 subject male and female are dominant in cognitive



(a)



(b)

**Figure 3: Distribution Graph for Cognitive Activity (a) Male subject 1(b) Female subject 1**

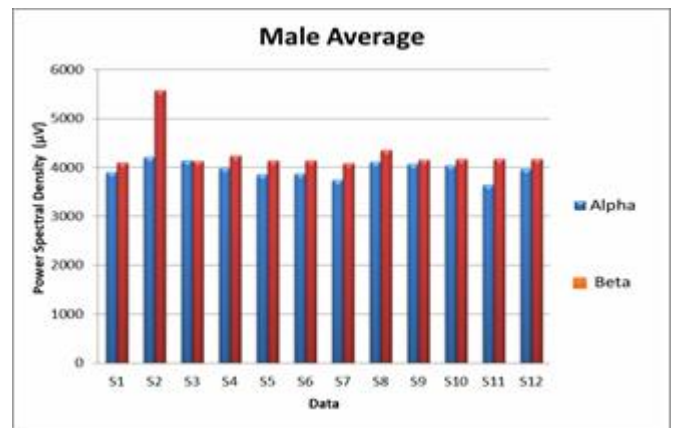
**4.2 Result of Average.**

Table 3 shows the average Alpha wave and Beta wave of male subject during the cognitive activity. A cycle of EEG signal are 0 until 128 reading that totally 129 signal data. From the Table 3 shows Beta Wave has high average than Alpha wave. The smallest value is 3651.727 (S11) and highest value is 4207.152 (S2) of Alpha wave from all 12 subjects. Beta wave smallest value average is 4083.653 (S7) and highest value is 5582.385 (S2). The range can be

seen clearly in Figure 15 shows the bar graph for male average of alpha wave and Beta wave.

**TABLE 3: AVERAGE VALUE FOR ALPHA WAVE AND BETA WAVE (MALE)**

Average Value For Alpha wave And Beta Wave (Male)		
Subjects	Alpha Wave	Beta Wave
S1	3907.398	4098.45
S2	4207.152	5582.385
S3	4141.01	4124.285
S4	3988.042	4236.895
S5	3853.19	4137.77
S6	3874.653	4139.71
S7	3747.716	4083.653
S8	4116.422	4355.514
S9	4076.728	4154.729
S10	4042.604	4175.078
S11	3651.727	4172.351
S12	3967.951	4167.474

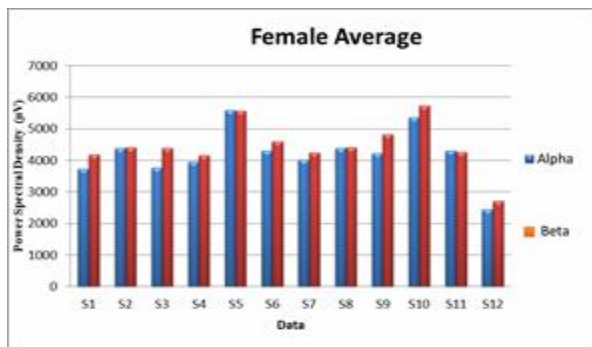


**Figure 15: Male average of Alpha Wave and Beta Wave**

Table 4 shows the average Alpha wave and Beta wave for female subject during the cognitive activity. From Table 4.4 shows Beta wave has high average than Alpha wave. 1 cycle of EEG is 0 until 128 reading that totally 129 signal data. The smallest is 2454.713 (S12) and highest is 5588.293 (S5) of Alpha wave from all 12 subjects. Beta wave smallest average is 2714.045 (S12) and highest is 5744.854 (S10). It can be seen obviously in Figure 16 the bar graph female average of Alpha wave and Beta wave.

**TABLE 4: AVERAGE VALUE FOR ALPHA WAVE AND BETA WAVE (FEMALE)**

Average Value For Alpha Wave And Beta Wave (Female)		
Subjects	Alpha Wave	Beta Wave
S1	3727.223	4197.841
S2	4389.68	4416.959
S3	3777.221	4389.143
S4	3964.258	4164.619
S5	5588.293	5574.291
S6	4316.832	4601.153
S7	4024.77	4260.64
S8	4389.68	4416.959
S9	4236.426	4835.337
S10	5366.19	5744.854
S11	4312.264	4261.177
S12	2454.713	2714.045

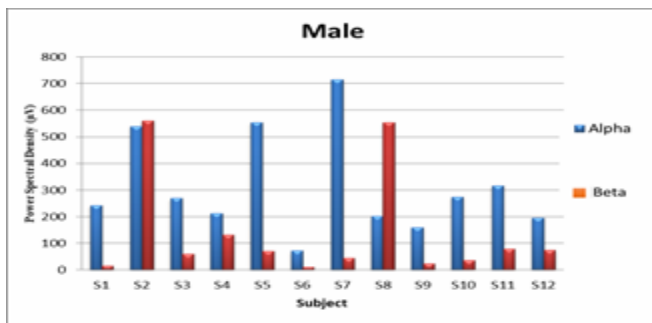


**Figure 16: Male average of Alpha Wave and Beta Wave**

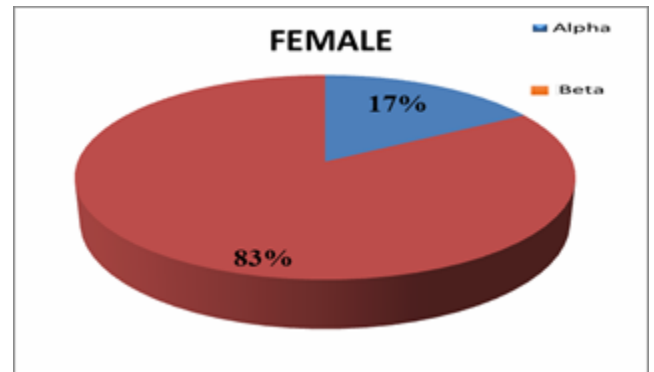
The percentage for average value are shown in Figure 17 and Figure 18 the number of subject who has high Alpha wave or high Beta wave can be total up out of 12 subject between male and female during the Cognitive activity. Table 5 shows the total high Alpha wave, high Beta wave male and female. For dominant in cognitive Beta wave must be higher than Alpha wave.

**TABLE 5: TOTAL HIGH ALPHA WAVE AND BETA WAVE FOR MALE AND FEMALE**

Genders	Alpha	Beta Wave
Male	1	11
Female	2	10



**Figure 17: Percentage High Alpha Wave and Beta Wave male**



**Figure 18: Percentage High Alpha Wave and Beta Wave female**

**4.3 Result of Standard Derivation.**

Standard derivation measure how the data concentrated with the average. The smaller standard derivation means the value of data are close to average (good). The larger standard derivation means the value data are further to average (poor). There have 129 data recording for the experiment. Table 6 shows the value of standard derivation male during the cognitive activity. Figure 19 illustrated the higher value for Alpha wave is 714.8998 subjects 7 and only subject 6 is fewer than 100. For Beta wave there have 2 subjects are the value high than 100, subject 2 (561.0946) and subject 8 (555.2923). The percentage standard derivation Alpha wave fewer than 100 is 8.3 % and percentage of Beta wave fewer than 100 are 75%. These shows the Beta wave of male subject have good standard derivation compare to Alpha wave during the cognitive activity.

**TABLE 6: VALUE OF STANDARD DERIVATION FOR MALE.**

Subjects	Alpha	Beta Wave
S1	243.628	16.7997
S2	540.5214	561.0946
S3	269.5379	61.21825
S4	212.053	132.1257
S5	555.0745	71.2959
S6	72.73152	11.02282
S7	714.8998	44.65906
S8	202.9628	555.2923
S9	159.2619	25.23902
S10	274.7604	36.28503
S11	316.9828	79.33868
S12	196.5554	74.26905

Figure.19: Standard derivation of male.

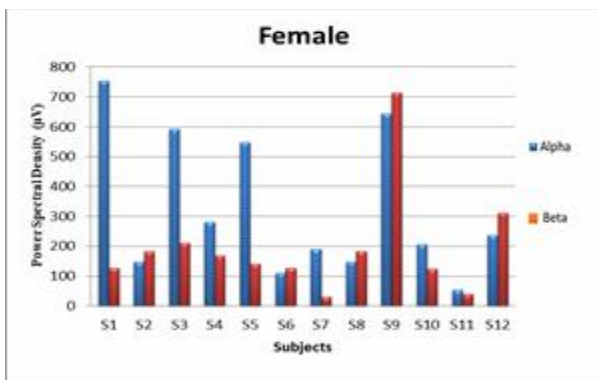
Table 7 shows the value of standard derivation during the cognitive activity for female. Figure 20 indicate the higher Alpha Wave is subject 1 (754.3705) and only subject 11 has value lower than 100 (54.93388). For Beta wave there have two subjects are fewer than 100, subject 7 (30.85971) and subject 11 (41.21505). The percentage of Alpha wave under the 100 is 8.3% and Beta wave is 16.6%. This can be concluded that standard derivations for female subject are



huge and further from the average.

**TABLE 7: VALUE OF STANDARD DERIVATION FOR FFMAI F.**

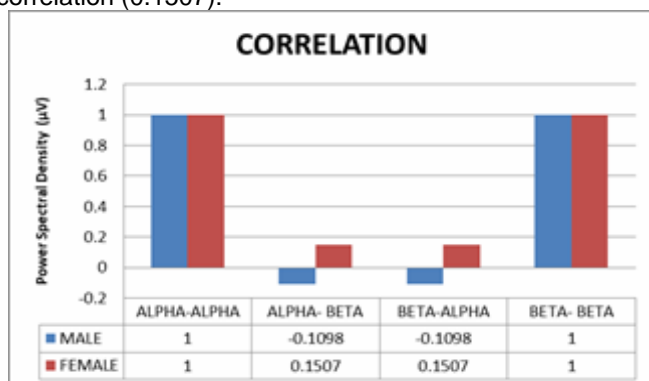
Subject	Alpha	Beta Wave
S1	754.3705	126.22268
S2	147.4588	182.22728
S3	593.3689	211.03892
S4	280.6346	169.51289
S5	548.5033	141.58593
S6	110.2456	126.47213
S7	191.3623	30.85971
S8	147.4588	182.22728
S9	644.2753	713.42018
S10	206.4435	123.80234
S11	54.93388	41.21505
S12	238.0995	310.75441



**Figure 20: Standard derivation of Female.**

**4.4 Correlation.**

Correlation is the method of statistical to measure the strong of relation between 2 variables. 0 value means no correlation, above value 0.5 strong correlations and below value 0.5 weak correlations. Figure 21 shows the correlation between the Wave. For male and female have same correlation of Alpha-Alpha that shows the strong correlation each other (r=1). Similar also for Beta- Beta have strong correlation (r=1). Correlation Alpha-Beta wave of male below 0.5 (-0.1098) this means between this 2 wave have negative weak correlation each other. Female correlation Alpha-Beta also shows the positive weak correlation (0.1507).



**Figure 21: Correlations Alpha Wave and Beta Wave of male and female.**

**5. CONCLUSION**

From this research shows that there have different of the brainwave pattern between male and female. Male subject show the higher level of Beta wave and female subjects shows the higher level of Alpha wave during answered the cognitive question. It can be conclude that male subject show more dominant in cognitive. This result is based on the analysis of the data between male and female signal emitted by the subject's brain during the cognitive activity. In addition, from the observation male subjects show the concentration and focusing when answered the question.

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