The Educational Games Panacea: Measuring Engagement Levels for Educational Games vs. Traditional Literature using a Wireless EEG Headset

Marvin Andujar

ABSTRACT

This paper examines the correlation of engagement measurements with knowledge increment of the two different modalities: gaming and the text learning styles. The studies were performed using the non-invasive (EEG) brain-computer interface Emotiv EPOC device. The Emotiv headset, despite its limitations is widely used in consumer BCI applications nowadays, which hopes improvement in the near future. The correlations are broken down into genders and ethnicities demonstrating how each population performed in their perspective tasks. Furthermore, this discusses the analysis of the device and how it helps us to distinguish the learning performance between users.

INTRODUCTION

Hypothesis:
Educational video games claim to be better at attracting students attention and keeping them engaged in the learning process than the traditional text learning styles [1].

Investigation Performed:
This paper investigates the engagement levels produced by educational video games and their effect on the retained information using Brain-Computer Interface tools.

Brain-Computer Interface (BCI):
BCI is a neuroscience paradigm that helps us to understand the functionality of the human and how it is able to communicate with machines through neuroheadsets [3].

CLEMSON
School of Computing

EMOTIV EPOC

The Emotiv EPOC used in the studies is a wireless EEG data acquisition and processing device. The device uses 14 electrodes to obtain the EEG signal and these channels are based on the international 10-20 locations which are: AF3, F7, F3, FC5, T7, P7, O1, O2, P8, T8, FC6, F4, F8, AF4. It also has 2 reference electrodes in the P3 and P4 locations [2].

EXPERIMENT DESIGN

The experimenter made sure the device was able to acquire signal from the participant's scalp, before the participants start the given task.

The sample size of the experiment is 26 participants, ranging from 19 - 25 from Clemson University, and surrounding area. The participants were divided into two different groups: the game (experimental) and the handout (control).

While the participants were performing the given task, the Emotiv device was recording the engagement levels. The engagement was recorded depending on the scalp connectivity with the device, their reaction to the reading, and their physical movement such as: scratching their head, raising their eyebrows, falling sleep, or laughing.

RESULTS

	Engagement Levels	Test Scores	Pre-Knowledge (avg)	Post-Knowledge (avg)
Game	0.566890	58.46	2.00	5.85
Handout	0.572727	66.92	2.08	6.08

Game vs. Handout: Correlations between engagement and knowledge

Game Task				
Gender	Engagement Levels	Test Scores	Pre-Knowledge (avg)	Post-Knowledge (avg)
Female	0.551710	63.33	0.67	6.17
Male	0.579900	54.29	3.14	5.57

Gender Performance: Game Task

Handout Task				
Gender	Engagement Levels	Test Scores	Pre-Knowledge (avg)	Post-Knowledge (avg)
Female	0.552359	66.00	2.6	6.8
Male	0.585620	67.50	1.75	5.63

Gender Performance: Handout Task

REFERENCES

[1] G.Sindre, L. Natvig, and M. Jahre. Experimental Validation of the Learning Effect for a Pedagogical Game on Computer Fundamentals. IEEE Transactions on Education. Vol. 52, No.1. Pg. 10-18. February, 2009.

[2] Emotiv Systems. Emotiv – brain computer interface technology. http://www.emotiv.com.

[3] A. Cichocki, Y. Washizawa, T. Rutkowski, H. Bakardjian, A. Phan, S. Choi, H. Lee, Q. Zhao, L. Zhang, and Y. Li. Non-invasive BCIs: Multiway Signal-Processing Array Decompositions. IEEE Computer Society. Pg. 37- 42. October, 2008.

Human Centered Computing

My Information
Computer Science Department
Kean University, Union, NJ
andujarm@kean.edu

Josh Ekandem, Ignacio Alvarez, Melva James, Dr. Juan Gilbert
School of Computing
Division of Human-Centered Computing
{jekande, ignm, melvaj, juan} @clemson.edu