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"SUSTAINABLE ENVIRONMENT, RESILIENCE AND SOCIAL WELL-BEING"

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Co-organiser :
Faculty of Architecture, Planning and Surveying (FSPU) & Centre for Post Graduate Studies (CGS)

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PSYCHOLOGICAL RESPONSES TOWARD ALLOCATION OF INDOOR PLANTS IN VIRTUAL SETTING AMONG ARCHITECTURE STUDENTS

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Abstract

It is common for architecture students to stay in the studio for a long period of time for their design studio courses. They are psychologically vulnerable to mental stress, downturn learning performance and increasing negative emotions. Several studies have found that visual connection with nature like indoor plants can be used as part of a therapeutic therapy method in addressing stress at the workplace. The objective of this study is to determine the impact of biophilic design on the emotion of the students by placing indoor plants in their studio in a virtual environment. 30 students from the architecture programme in Polytechnic of Sultan Idris Shah (PSIS) were selected as participants. Electroencephalography (EEG) signal is collected for both scenes of virtual studio setting with and without indoor plants. Galvanic Skin Response (GSR) and Heart Rate (HR) signals are used to determine the Emotional Index (EI). Participants also answered self-report assessment to validate the psychophysiological responses. The results show that the participants tend to have positive emotions with the presence of indoor plants.

Keywords: *indoor plant; psychological responses; electroencephalography (eeg); architecture learning space*

1.0 INTRODUCTION

Environmental psychology is an interdisciplinary field to study the interrelationships between human wellbeing and physical surroundings which are closely related to architectural psychology that fulfil the gap between architecture and psychology. Correspondingly, this effort could provide a comprehensive information and understanding about how the physical environment affects the mental, physical and emotions of human wellbeing. However, the establishment of this ideal practice seems far-fetched due to less concern about human psychological feedback in the field of architecture.

The crisis of architectural education in Malaysia is attributed to certain issues related to human capital when the construction industry demand is focusing more on high skills and knowledgeable students. Apparently, architecture studies in Malaysia should be referred to the educational psychologist in order to enhance awareness in producing quality of human capital (Surat, Abdullah, Tahir, Nor, & Utaberta, 2011). Other than the needs to improve the teaching plan for architectural learning with reference to educational psychology, it is also important to study the influences of environmental psychology within the architecture studio. This is because architecture students could be exposed to the mental stress, negative emotion and reduced learning performance due to staying up late nights, extreme dedication on design projects and punishing critiques which are also recognised as studio culture (Abdullah, Beh, Tahir, Che Ani, & Tawil, 2011).Therefore, the idea of bringing nature approach to be applied in architectural studio is highly recommended as it is an attempt to kickstart students' learning by experience in biophilic elements as part of psychological support of human health.

2.0 BACKGROUND

Biophilic design elements is a theoretical hypothesis developed by Stephen Kellert which applies an approach to architecture: that is to incorporate natural elements into the buildings as a solution to create a productive and healthy environment for the occupants. Biophilic design is a supporting tool to reduce stress, increase cognitive performance and enhance emotion-mood in useful ways (Kayıhan, 2018). These are the main factors, along with the need to put people in a closer contact with nature. Besides, the good things about implementing a biophilic design approach is it would motivate people to protect and preserve the environment. It is the time for us to take serious action on bringing nature into a formal education environment such as assess the advantages of green schoolyards and green walls in the classrooms with support from the management board of educational institutions (Kuo, Barnes, Jordan, & Snell, 2019). There are many kinds of research done on the benefits of plants in Europe and North America, but such studies are limited in other countries and this is the reason for this research to be conducted in Malaysia.

The imitation of indoor plants in architecture design studios can bring positive elements to emotional experiences among the architecture students. The presence of indoor plants also supports psychological, physical and emotional wellbeing through the stimulation of human senses that promote a pleasant environment (Abdelaal & Soebarto, 2018). Indoor Plants are considered as a direct experience of nature which has the ability to represent green and living nature into the indoor environment. The small, green and lightly scented plants were the most optimal and selective type of plants for health and wellbeing based on the psychological and physiological assessment (Gillis & Gatersleben, 2015). Current research trends on restorative environments are highly focused on the visual sense rather than auditory and olfactory senses; however, the experience of nature is multisensory. It is unnecessary for some spaces with high-quality restorative value to be filled with plants, since a space with too many plants also may decrease the productivity (Larsen, Adams, Deal, Kweon, & Tyler, 1998). Despite the findings, indoor plants are still the main factors to achieve positive results in optimising the indoor quality of living.

3.0 HYPOTHESIS

3.1 Research question

Is there a difference in psychological responses toward non-plant and plant indoor learning space among architecture students?

3.2 Null hypothesis

There is no difference in psychological responses toward non-plant and plant indoor learning space among architecture students.

3.2 Alternative hypothesis

There is a difference in psychological responses toward non-plant and plant indoor learning space among architecture students.

4.0 METHODOLOGY

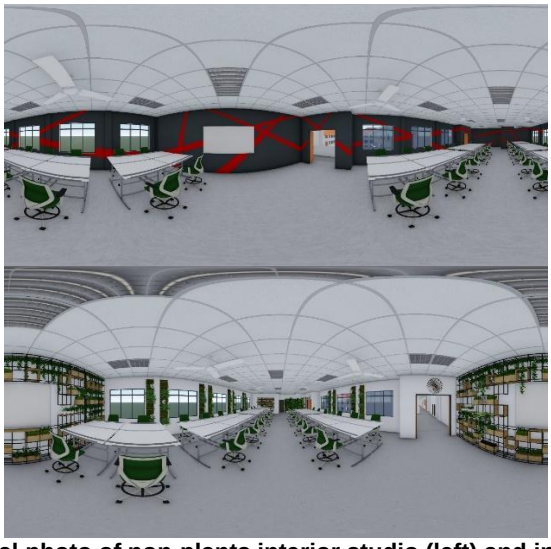

Figure 1: Spherical photo of non-plants interior studio (left) and interior studio with plants (right)

Participants are selected among architectural students of Polytechnic Sultan Idris Shah (PSIS), Sabak Bernam, Selangor. 30 volunteers participated in the research (21 male, 9 female) and they were already in the fourth semester when the experiment was conducted. Participants wore the Oculus Go VR headset to view both virtual environments of their studio, which are non-plants indoor and studio with indoor plants, as shown in Figure 1. Participants spent around 2 minutes for each virtual studio while Emotiv Epoc+ recorded the brain activity and automatically analysed using performance metrics which displayed application on a scaled axis from 0 to 100. Performance metrics consist of 6 metrics which are stress, engagement, interest, excitement, focus and relaxation. After completing the experiment session, participants were asked to answer a self-report questionnaire using the format of a semantic differential scale as shown in the flow, in Figure 2.

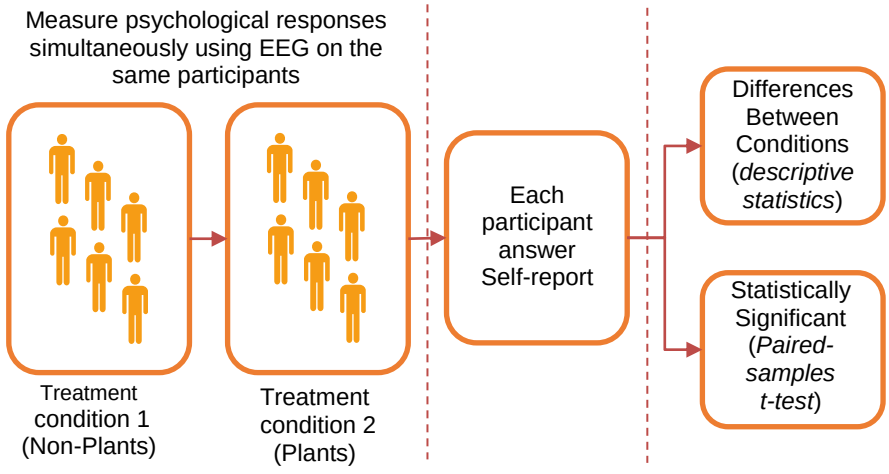

Figure 2: Process flow of study design

5.0 RESULTS

Previous theories have proposed these factors which are related to the effect of exposure to green surrounding on student performance which is: Attention Restoration Theory (ART) (Kaplan, 1995) and Stress Reduction Theory (SRT) (Ulrich et al., 1991). However, the researcher suggests using EEG results from performance metrics analysis as the primary data collection. Self-report assessment was used to measure every single person's report of his or her feelings toward the virtual environment. Both methods of EEG and self-report were conducted to compare both results.

Table 1: Paired samples statistics

		Mean	N	Std. Deviation	Std. Error Mean
Stress EEG	Plants	43.8667	30	11.88373	2.16966
	Non-Plants	45.7333	30	13.21685	2.41306
Excite EEG	Plants	38.9000	30	13.76239	2.51266
	Non-Plants	38.1667	30	12.40713	2.26522
Engage EEG	Plants	65.9333	30	4.41731	.80649
	Non-Plants	63.0333	30	9.69352	1.76979
Focus EEG	Plants	48.9333	30	10.65747	1.94578
	Non-Plants	45.8000	30	10.68483	1.95077
Interest EEG	Plants	57.2667	30	6.04542	1.10374
	Non-Plants	58.8667	30	8.05470	1.47058
Relaxation EEG	Plants	30.6000	30	7.77529	1.41957
	Non-Plants	34.0000	30	10.68676	1.95113
Stress Self-report	Plants	1.8333	30	.91287	.16667
	Non-Plants	2.6333	30	1.56433	.28561
Excite Self-report	Plants	8.3000	30	.65126	.11890
	Non-Plants	7.7333	30	1.41259	.25790
Engage Self-report	Plants	8.3667	30	.85029	.15524
	Non-Plants	7.8333	30	.98553	.17993
Focus Self-report	Plants	8.0333	30	1.21721	.22223
	Non-Plants	7.7667	30	1.38174	.25227
Interest Self-report	Plants	8.5333	30	.62881	.11480
	Non-Plants	8.1667	30	.94989	.17343
Relaxation Self-report	Plants	8.5333	30	.57135	.10431
	Non-Plants	7.8000	30	1.32353	.24164

Data are mean ± standard deviation, unless otherwise stated. Participants' feeling of stress was higher towards non-plants indoor studios (45.733 ± 13.217) as opposed to the studio with indoor plants through EEG measuring (43.867 ± 11.884). They were also supported by the participants self-report on stress (2.633 ± 1.564) which was higher for non-plant indoor compared to studios with indoor plants (1.833 ± 0.913). All means of psychological responses through EEG collecting data show positive emotion with the presence of indoor plants in the studio except for interest and relaxation. While for the self-report, each performance metrics item showed that participants tend to prefer the existence of plants in their studio. However, the difference between the mean score is not too noticeable.

A paired-samples t-test was used to determine whether there was a statistically significant mean difference in participant's focus using EEG between staying in a studio with plants indoor

compared to normal studio without indoor plants. One outlier was detected that was more than 1 box-length from the edge of the box in the boxplot. Inspection of their values did not reveal them to be extreme and they were kept in the analysis. The assumption of normality for participant's focus was not violated and normally distributed, as assessed by Shapiro-Wilk's test ($p = .785$). Participant's focus obtained a mean increase of 3.133 percentage for performance metrics, 95% CI [-1.743, 8.011] in the percentage staying in a studio with indoor plants for 2 minutes compared to a non-plants studio.

According to the paired samples test results for EEG, only participant's relaxation ($p = 0.04$) was statistically significant ($p < 0.05$). However, the result for self-report shows that there are statistically significant mean among participant's stress ($p = 0.009$), excite ($p = 0.022$), engage ($p = 0.018$), interest ($p = 0.039$) and relaxation ($p = 0.005$). Therefore, most self-report results enable the researcher to reject the null hypothesis and accept the alternative hypothesis.

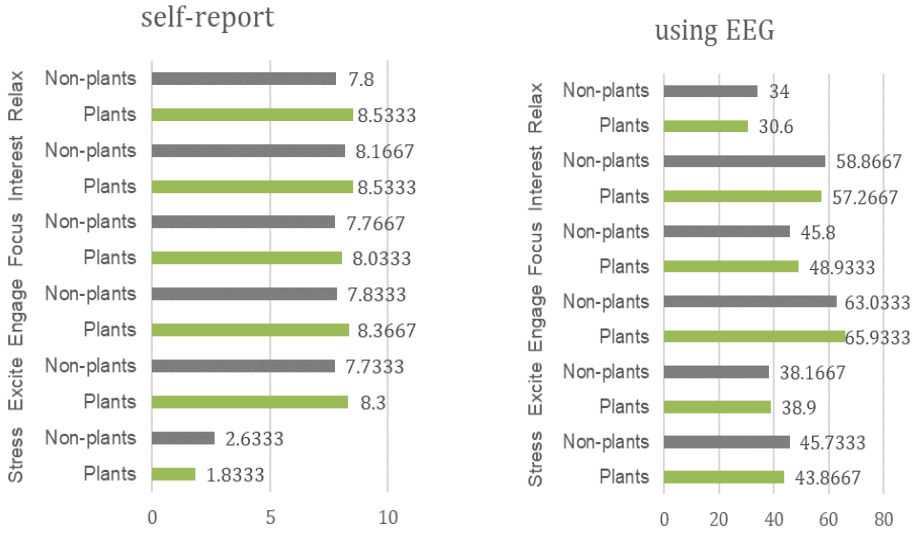

Figure 3: Chart of psychological responses mean score from participants using electroencephalography (EEG) and using self-report (semantic differential scale) towards virtual studio interior with plants and no plants

6.0 DISCUSSION

Out of six (6) basic measures of mental performance data collected using EEG, there are 4 elements based on the analysis of descriptive statistics that positively support the presence of indoor plants rather than studio environments with no plant. Furthermore, all elements of performance metric mean score for studio interior with indoor plants with self-report are higher for indoor plants environment. The lower stress level in a studio with indoor plants is supported with the self-report that shows the same pattern on the graph. This highlights the potential of healing the emotion for architectural students when they stay longer in the studio: as a result, the approach has long term consequences for their health. Participant's excitement is considered as an awareness of feeling of physiological arousal with positive value while staying in the studio with plants. Participants' engagement towards indoor surroundings with plants is higher than non-plants surrounding particularly in the attention and concentration aspects. Moreover, participant's focus level is greater while staying in a studio with indoor plants and this is shown in the depth of attention and frequency of attention to minimize the distraction.

7.0 CONCLUSIONS

The use of EEG signals for capturing biofeedback is not a new invention and it is commonly used in hospital for medical purposes. However, the use of EEG experiment and self-report for this study is a new exploration on psychological responses with a Performance Metrics indicator developed by Emotiv. For future research, it is recommended for the duration of each participant I in the experiment to be prolonged. Comparing the psychological responses of two different conditions with the help of virtual reality can be economically challenging but the method is still efficient. This research could encourage the designer to start thinking and adding suitable plant elements to support biophilic's awareness.

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