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運用腦波研究法探討自然環境對大學生科學創造力之影響

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摘要

本研究主要目的為運用腦波研究探討自然環境對創造力的影響，本研究之研究對象為 30 名大學生(平均年齡=19.6 ± 0.8 歲；男性=17 人，女性=13 人)。所有研究對象均為自願受試者，且均完成自願受試同意書之填寫。本研究之研究對象分別於不同環境中(戶外自然環境/教室環境)散步 5 分鐘，並於散步後坐著休息 10 分鐘，散步前、後均須填寫科學創造力量表，填寫量表的過程中配戴腦波儀器同步收集腦波資訊。研究結果顯示，本研究對象不論在戶外自然環境或一般教室環境中散步，其後測的科學創造力表現均高於前測，而腦波的資料分析則顯示，研究對象在戶外自然環境中散步後，其科學創造力表現比在教室內散步的腦波更為活化；本研究將根據上述研究發現進行深度探討與提供研究建議。

關鍵字：自然環境、腦波、科學創造力

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Exploring the influence of natural environment on university students' scientific creativity through neuroscience research

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Abstract

This study aims to explore the influence of natural environment on creativity through brainwave research. There are 30 university students participated in this study (Mean ± S.D. = 19.6 ± 0.8 years old; male=17, female=13). All participants were volunteers and signing the volunteer consents. In this study, the participants were asked to complete the parallel Scientific Creativity Tests (5 minutes) and detecting the neuroscience data before and after walking around in different places. All the participants walked for 5 minutes and took a rest for 10 minutes. The results from tests and neuroscience data showed that the participants showed significantly higher scientific creativity after walking in the natural environment/ classroom building than pre-test. Further, the neuroscience data show the participants performed significantly higher scientific creativity after walking in the natural environment than in the classroom building. The further implication will be showed in the presentation.

Keywords: Natural Environment, Neuroscience, Scientific Creativity

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1. Introduction

The contemporary world is changing rapidly and information explosion, the static knowledge could not reflect the world changing and most of the questions could be answered through internet, what people need to learn? What will be the core value of human kind's knowledge? Sun, Wang, Wegerif and Peng (2022) mentioned that creativity might be the most important skill in 21st Century. Previous studies also indicated that the creativity ability is a high level cognition ability to appropriate ideas to solve problems (Ma, 2009; Sun et al., 2022). In other words, in the future, how to improve students' creativity will be more and more important.

Although creativity is very important, Kozhevnikov, Ho and Koh (2021) mentioned that scientific creativity, which is a kind of specific domain creativity, could reflect students' social representation. That is to say, scientific creativity could more accurately reflect students' ability to face real-life problems. Based on these background information, this study focused on exploring students' scientific creativity.

In recent years, there are a lot of researches investigated students' scientific creativity (Dogan & Kahraman, 2021; Atesgoz & Sak, 2021), but, most of these studies focused on the children, elementary school students or high school students. There are less research focused on university students' scientific creativity. However, think carefully, university students will connect to work immediately after graduation, they should be the group that need creativity most to solve problems. For this reason, this study aims to explore university students' scientific creativity.

Furthermore, past studies indicated that creativity will be shown in relax emotion, and someone who reached in more information will produce more creativity. This study hypothesized that the natural environment which involved in huge information and making people relax will be the best material to induce creativity. For proving this hypothesis, the purpose of this study is to explore the influence of natural environment on university students' scientific creativity through neuroscience.

Farrugia, Lamouroux, Rocher, Bouvet and Lioi (2021) indicated that neuroscience data could provide a further evidence to explain the performance of creativity ability. Previous studies mentioned that alpha band activity is correlated with creative performances, and the higher alpha power indicated the greater creativity performance (Fink & Benedek, 2014; Stevens & Zablina, 2019). This study referred the definition and criteria of previous studies, to explain the participants' scientific creativity ability by collecting and analyzing the alpha power of the participants' neuroscience data.

2. Materials and Methods

2.1 Participants

This study was conducted at an university of the south of Taiwan. Thirty university students participated in this study (Mean ± S.D. = 19.6 ± 0.8 years old; male=17, female=13). All participants were asked to complete the experimental task by wearing the brainwave cap to collect the neuroscience data. All participants were confirmed to be mentally healthy without a history of neurological or psychiatric disorders, and all gave voluntary consent to participate in the neuroscience experiments.

2.2 Procedure and Instrument

In this study, the participants were asked to complete the parallel Scientific Creativity Tests (5 minutes) and detecting the neuroscience data before and after walking around in different places.

There are three parallel Scientific Creativity Test (Hu & Adey, 2002) which included in Test A, Test B and Test C. The results from pilot study with 50 university students' data showed that the "Degree of Difficulty" and the main findings did not reach in significant differences between these three Tests. That means the three Tests could reflect the similar results, therefore, these three Tests could be the parallel test.

The participants were divided into two groups which is group A and group B. Group A is walking in the classroom building for 5 minutes in the first step and walking in a natural garden of the campus for 5 minutes in the second step, while the group B is opposite. After walking for 5 minutes, all the participants would take a rest for 10 minutes. (Figure 1).

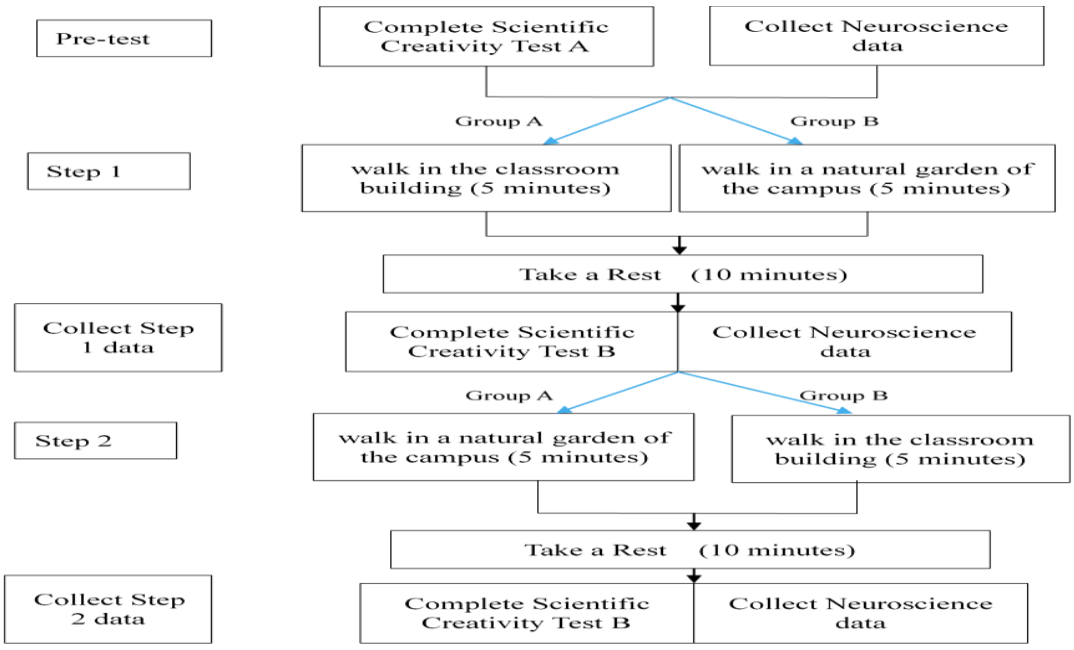

Figure1 procedure and instrument of this research

2.3 Data Collection and Analysis

This study adopted the neuroscience technology (see in figure 2) to collect the data of the participants' brain wave reactions.

(a) (b)

Figure2 (a) the simulation example of the participants' experiment situation (b) the neuroscience technology (The pictures (a) and (b) were provided from Sheng Hong Precision Technology Co.)(http://www.brain-sh.tw/product_content.php?p_id=134)

This study adopted the EEG signal combinations reflection system which was developed by Sheng Hong Precision Technology Co. Ltd. In this system, the raw neuroscience signals will be collected 512 data per second. The raw data can be translated into 8 FFT frequency bands of neuroscience data which included in delta wave (1-4 Hz), theta wave (4-7 Hz), alpha wave (8-14 Hz), beta wave (15-30 Hz), low gamma wave (30-50 Hz) and high gamma wave (> 50 Hz).

All of the participants' raw neuroscience signals data were collected while they were participating in the experiments. Then, these data would be translated in statistical data through the neuroscience technology system automatically. This study focused on alpha wave more, the higher alpha power indicated the greater creativity.

In this study, the average alpha power data of neuroscience research from experiments were been compared by paired *t* test. In this study, the statistical analysis was been analyzed by SPSS 27 software.

3. Result and Discussion

Based on the research procedure, this study compared each 2 variables by using paired *t* test (table 1). In table 1, the variable "pre-test alpha" means the alpha power value of neuroscience data before the participants joining this study. The identifications about "step 1 alpha" and "step2 alpha" refers to the alpha power values which collected by the participants at different stages. In table 1, the higher scores of neuroscience data indicated that the participants showed greater scientific creativity (Farrugi et al., 2021).

Otherwise, the variable “pre-test Test” means the participants’ scores of Scientific Creativity Test before the participants joining this study. The identifications about “step 1 Test” and “step2 Test” refers to the participants’ scores of Scientific Creativity Test which collected by the participants at different stages. In table 1, the higher scores of n Scientific Creativity Test indicated that the participants showed greater scientific creativity.

Table1 The paired *t* test analysis of each 2 variables of neuroscience and Test data (N=30)

Pair	Source	Mean	S. D.	*t*	*p*
1	pre-test alpha	3014.63μV	1825.85μV	-4.13***	<.001
	step 1 alpha	17629.57μV	18888.19μV		
2	pre-test alpha	3014.63μV	1825.85μV	-4.75***	<.001
	step2 alpha	16512.87μV	15341.19μV		
3	step 1 alpha	17629.57μV	18888.19μV	.31	.761
	step2 alpha	16512.87μV	15341.19μV		
4	pre-test Test	29.90 points	9.25 points	-7.42***	.<.001
	step 1 Test	41.23 points	12.96 points		
5	pre-test Test	29.90 points	9.25 points	-4.46***	<.001
	step2 Test	41.23 points	9.68 points		
6	step 1 Test	41.23 points	12.96 points	.00	1.00
	step2 Test	41.23 points	9.68 points		

Note: * $p<.05$; ** $p<.01$; *** $p<.001$

The results from table 1 show no matter which steps, the participants show higher alpha power value and higher test scores than pre-test. The findings indicate that the participants show greater scientific creativity than pretest, and both the neuroscience data and Scientific Creativity Test show the same findings. However, since the group A and group B walked in different places, the results from step 1 and step 2 might cannot show the differences. The results are supported by Sun et al. (2022), their research findings show that the multiple stimuli could improve students’ creativity.

For clarifying if the natural environment could improve students’ scientific creativity, this study reprocessing data allocation. In table 2, the variable “pre-test alpha” means the alpha power value of neuroscience data before the participants joining this study. The identifications about “natural alpha” and “classroom alpha” refers to the alpha power values which collected by the participants at different places. In other words, this study chose group A students’ step 2 alpha power data and group B students’ step 1 alpha power data to be the “natural alpha”. Similar, the “classroom alpha” was collected by group A students’ step 1 alpha power data and group B students’ step 2 alpha power data. In table 2, the higher scores of neuroscience data indicated that the participants showed greater scientific creativity.

In the same way, the variable “pre-test Test” means the participants’ scores of Scientific Creativity Test before the participants joining this study. The identifications about “nature Test” and “classroom Test” refers to the participants’ scores of Scientific Creativity Test which collected by the participants at different places. In table 2, the higher scores of n Scientific Creativity Test indicated that the participants showed greater scientific creativity.

Table2 The paired *t* test analysis of each 2 variables of neuroscience and Test data (N=30)

Pair	Source	Mean	S. D.	*t*	*p*
1	pre-test alpha	3014.63μV	1825.85μV	-5.28***	<.001
	natural alpha	23302.40μV	20449.30μV		
2	pre-test alpha	3014.63μV	1825.85μV	-4.33***	<.001
	classroom alpha	10903.03μV	9753.91μV		
3	natural alpha	23302.40μV	20449.30μV	4.03	<.001
	classroom alpha	10903.03μV	9753.91μV		
4	pre-test Test	29.90 points	9.25 points	-5.94***	.<.001
	natural Test	42.00 points	11.80 points		
5	pre-test Test	29.90 points	9.25 points	-4.93***	<.001
	classroom Test	40.47 points	11.01 points		
6	natural Test	42.00 points	11.80 points	.49	.628
	classroom Test	40.47 points	11.01 points		

Note: * $p<.05$; ** $p<.01$; *** $p<.001$

The results from table 2 show that both neuroscience data and Scientific Creativity Test data referred the similar findings, that is no matter walking in natural environment or in classroom building, the participants’ scientific creativity performances are better than pre-test. Furthermore, the neuroscience data also indicate that walk in natural environment places could improve university students’ alpha power value in their brain wave. However, in Scientific Creativity Test, although the natural Test scores are higher than classroom Test, there is no significant differences between these two scores.

This finding in table 2 indicate that the neuroscience data could provide more detailed analysis results to make the overall interpretation more objective and meticulous. This claim supported by Farrugi et al. (2021).

4. Conclusion

The purpose of this study is to explore the influence of natural environment on creativity through brainwave research. There are 30 university students participated in this study. The participants were asked to complete the parallel Scientific Creativity Tests (5 minutes) and detecting the neuroscience data before and after walking around in different places, one place is classroom building and the other place is the natural garden in the university campus. All the participants walked for 5 minutes and took a rest for 10 minutes in each step.

The results from tests and neuroscience data showed that the participants showed significantly higher scientific creativity after walking in the natural environment and classroom building both than pre-test. Further, the neuroscience data show the participants performed significantly higher scientific creativity after walking in the natural environment than in the classroom building. However, although the Scientific Creativity Test scores of walking in the natural environment are higher than walking in the classroom building, there is no significant differences between these two scores. The finding indicate that the neuroscience data could provide more detailed analysis results to make the overall interpretation more objective and meticulous

There are two main implications of this study. First, to provide multiple stimuli could improve university students' scientific creativity even just push them to walk outside. Second, neuroscience research might could provide more detail information to explain the cognitive performance, this study suggests further researchers to consider neuroscience research orientation in educational researches.

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