

The Influence of Timing Reconstruction Curriculum of Physical Education and Mathematics on the Brain Activation in Children

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Abstract

The purpose of this study was to provide objective data renewal recognition of timing reconstruction curriculum by investigating the effect of physical education before mathematics on the brain activation in elementary school students. For this purpose, subjects were selected total 33 student among 4th grade elementary students. The experimental group(Male:10, Female:10) was conducted physical education class followed by mathematics class, and the comparison group(Male:7, Female:6) was conducted non-physical education class followed by mathematics class for 8 weeks. The electroencephalogram was measured at resting state and during the math problem solving, and the brain current density was analyzed by sLORETA software. The results are as follows. In the experimental group, there were showed negative activity in the alpha-2 and beta-2 waves of left hemisphere whereas activity increased superiorly in the gamma waves of right hemisphere. The comparison group appeared to have a higher gamma sensitivity around the left hemisphere.

Keywords: Physical education, Mathematics, timing reconstruction curriculum, Brain activation

1. Introduction

The recent curriculum is diversifying into a curriculum that pursues the diversity of regions, schools, and individual levels as well as the commonality of national curriculum at national level. It aims to lead students to holistic human growth and development through creative curriculum. Brain science and neuroscience approaches are taking place in order to enable the best learning in the most natural state. Designing a learning environment based on how the brain can learn naturally can provide the simplest and new educational paradigm.

Human biorhythm affects sleep and awareness, food intake, work efficiency and so on, because it is adjusted to day and night cycle and seasonal changes [1]. For the best learning that utilizes biorhythm effectively, it should be established the necessary strategies in classrooms and schools where students spend the most time.

If the curriculum time operation in the school takes into account the students' brain rhythm, it will improve the better learning memory and increase the interest and achievement motivation in the learning of the students.

Regular exercise can not only improve mental and physical health, but can also help improve brain function [2]. This is supported by empirical research, [3][4][5][6][7] etc.

Article history:

Received (January 18, 2017), Review Result (March 21, 2017), Accepted (April 16, 2017)

research demonstrates that physical education and physical activity help learners to learn actively, efficiently and interestingly by helping the learning mechanism.

The purpose of this study was to provide basic data that can help to enhance the effectiveness of education through efficient and flexible curriculum instruction and operation by systematically and scientifically analyze the effects and specific causes and processes at the brain area of improved concentration and cognitive ability through physical education class, which is the favorite subject of elementary students on the concentration and problem solving ability in the mathematics class, which is the unfavorable subject of elementary students.

2. Methods

2.1. Participants

The participants of this study were students who are in 4th grade in G elementary school in G City, Gyeonggi Province, with a total of 33 subjects were included in the experimental group 20(Male: 10, Female: 10) and the comparison group 13(Male: 7, Female: 6).

Table 1. Characteristics of participants

Items	Experimental group(20)		Comparison group(13)	
	Gender	F(10)	M(10)	F(6)
Age	11	11	11	11

2.2 The tool of study

Table 2. Development and design of EEG measurement

Items	Detailed steps
Development of subject for EEG measurement	① Background EEG measurement ② Solving math problems ③ Voice reply ※ Amendment and supplementation through pilot test
EEG measurement design	① Subject description, Explanation of measurement cautions and sticking EEG electrodes ② Measuring at steady state ③ Measuring during solving mathematical problems ④ Electrode removal and scalp washing ⑤ EEG analysis



Figure 1. EEG measurement scene

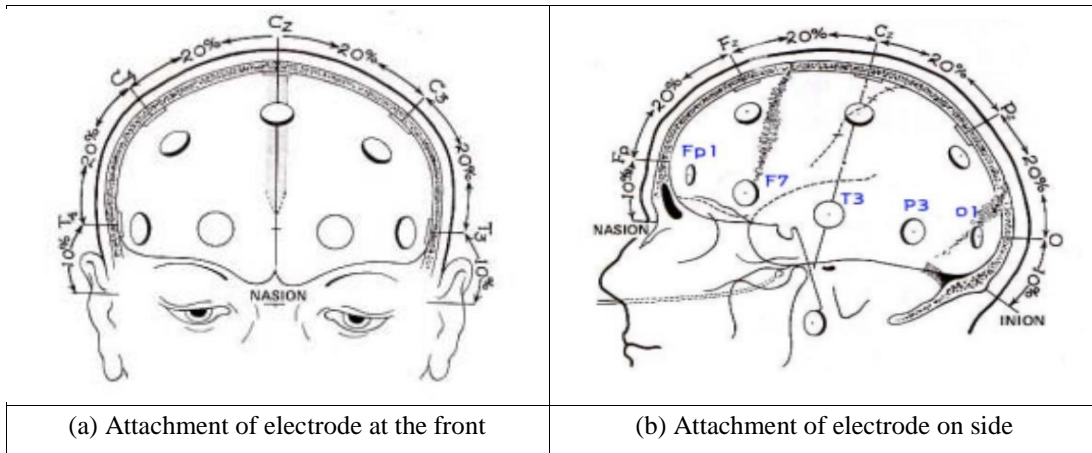


Figure 2. Electrode attaching position

2.3 Curriculum operation

Table 3. Curriculum operation

Items	Experimental group	Comparison group
Timetable (Mon, Wed, Fri - 8weeks)	Mon, Wed, Fri : PE-Mathematics	Mon: Korean-Mathematics Wed: Morals-Mathematics Fri: Society-Mathematics
Physical education contents	Competitive activity(Rugby-style games), Challenging activity(Mat exercises), Expressive activity(Rhythm activity), Leisure activity(Traditional play)	
Mathematics education contents	Addition and subtraction of fractions, Bar graph, Mixed calculation	

2.4. Data analysis

The collected data were processed by sLORETA [8] software to analyze the activation patterns of the brain, and computerized by SPSS 18.0 program for Windows according to purpose of analysis of the data. The analysis of the variance of brain activation within groups before and after the experiment was verified as paired sample t-test, and the analysis of the variance of brain activation between two groups after the experiment was verified as independent sample t-test. The statistical significance for all analyzes was set at $\alpha = .05$.

3. Results

3.1. Homogeneity verification

Table 4. Homogeneity verification

Variable	t(0.01)	t(0.05)	t(0.10)	Significance level
Two-Tailed	3.101	2.834	2.238	0.099

In order to confirm the homogeneity between the experimental group and the comparison group, EEG results were analyzed by independent sample t-test, and the P value was 0.099. As a result, there was no significant difference between the two groups.

3.2. The variance of brain activation within groups

3.2.1. The change of experimental group

The experimental task shows that the pre-placement of the physical education subject with the physical activity before the mathematics lesson affects the cognitive activity of the students. In particular, the gamma band activity appeared across the left and right brains, showing particularly dominant right brain activity.

Table 5. The change of experimental group

Variable	t(0.01)	t(0.05)	t(0.10)	Significance level
Two-Tailed	1.911	1.803	1.747	0.002

3.2.2. The change of comparison group

A significant difference between the pre-post test in the comparison group that did the math class after the non physical education class such as Korean language, Society, and Morals were found in the gamma band of left brain unlike experimental groups.

Table 6. The change of comparison group

Variable	t(0.01)	t(0.05)	(0.10)	Significance level
Two-Tailed	2.411	2.242	2.105	0.004

3.3. The difference of brain activation between groups

Table 7. The difference between two groups after the experiment

Variable	t(0.01)	t(0.05)	t(0.10)	Significance level
Two-Tailed	2.019	1.397	1.282	0.001

After 8 weeks of treatment, the right brain activity of the experimental group was significantly higher than that of the comparison group in both the alpha 2, beta 2 and gamma bands.

3. Discussion

The findings of the study show that the activation of the brain, which is based on solving math problems, can be changed by education and experience. Physical Education - Mathematics Classroom time layout patterns also brought about changes in brain patterns. It is believed that neuroplasticity leads to improvement of positive cognitive ability. From the viewpoint of embodied perception, the process of recognition is also known as rooted in physical movements [9]. As a well-organized intervention program can normalize the atypical brain activation pattern of dyslexia [10], it suggests that a brain cell can be changed by various educational procedures and curriculum reconstruction to improve the brain activity of the children who have learning difficulties. This provides objective and substantive evidence that students can have positive results in learning by placing physical education classes in the front of a particularly difficult subject in the school curriculum. It is expected that the teachers, educators and parents will be able to recognize and apply the value of physical education and physical activity.

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