COMPARISONS OF BRAIN ACTIVITIES BETWEEN SOLVING FUNCTION TASKS AND MULTIPLICATION TASKS

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A growing number of researchers have used neuroscience as methods to examine student cognitive behaviour when solving mathematical problems. This study presents the examination of brain activities specific to problem-solving of function and multiplication tasks. Multiplication tasks refer to basic calculations (e.g., $3 \times 2 = 6$), whereas function tasks are those requiring to identify characteristics of graphs and their corresponding functions (e.g., quadratic function) (Waisman et al., 2014). E-prime software was used to perform the two kinds of tasks. Students' response accuracy (Acc) and reaction time for correct responses (RTc) for the tasks were adopted to determine the cognitive complexity of tasks.

We used Event-Related Potential (ERP) techniques to collect brain waves occurred during problem-solving processes. The analyses of brain waves focused on the components of P1, P2, P3, and N2. P1 can reveal the cognitive efforts related to information perception, where P2 refers to perception processing. P3 denotes the cognitive effort to synthesize stimuli and reason the outcomes, whereas N2 focuses on mismatch detector or reflect executive cognitive control functions. The wave peaks in terms of amplitudes and latency in accordance with each component were identified. The peak amplitude reveals cognitive effort made during problem solving processes. The latency refers to the speed of stimulus classification resulting from discrimination of one event from another. Shorter latencies indicate superior mental performance relative to longer latencies. 163 Taiwanese high school students participated in the study. Statistical analyses showed that students significantly performed quicker and more accurately on multiplication tasks than function tasks, indicating higher cognitive complexity of function tasks. Analyses on brain waves showed that function tasks caused significantly higher amplitudes and longer latency for P1 and P2 components. The analyses on P3 and N2 components revealed different results. Concerning P3, central area and the area between parietal and occipital of brain causes significant differences in amplitudes and latency between the types of tasks. However, no significant differences were found for frontal pole, antero-frontal, and temporal areas. Concerning N2, brain waves collected from electrodes of P08 and P8 also did not cause significant differences. We will discuss the analyses and research implications.

References

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