

The influence of achieving the Flow State on learning results: A pilot study using Biometric Adaptive System for Individualized Assistance (BASIA)

Abstract

In theory, the flow state — characterised by concentration, motivation and engagement — improves learning efficiency. However, limited empirical evidence links flow states with neurobiological markers and educational performance.

Our study investigates the influence of achieving the flow state on learning outcomes, addressing a gap in understanding how cognitive and neurophysiological processes interplay in technology-supported education. To explore this, a controlled experimental pilot study was conducted with 9 participants randomised into Flow and Anti-Flow conditions. In the learning phase, we have used the online platform Biometric Adaptive System for Individualized Assistance (BASIA), integrating AI-driven personalised content delivery and concurrent electroencephalographic (EEG) monitoring focused on frontal theta and alpha brain activity. Participants completed preand post-tests on biology content and delayed retention assessments, alongside psychological self-report measures. The results show that the Flow group had increased knowledge retention and self-reported flow experiences compared to the Anti-Flow group. Neurophysiological data revealed a positive correlation between subjective flow states and frontal theta power exclusively in the Flow group, while the Anti-Flow group showed opposite patterns. It suggests that flow states correspond with neural indicators of efficient learning.

Our study highlights the potential of integrating behavioural, self-report, and EEG metrics to understand flow in educational contexts and the design of adaptive learning technologies.