

Exploring Impacts of GenAI-empowered Dialogic Interactions on Children's Chinese Handwriting Learning based on Multimodal Data Analysis

The central role of handwriting in written communication has been increasingly taken over by convenient typewriting in the digital age. This change has resulted in a notable decline in handwriting literacy (i.e., character amnesia), particularly in non-alphabetic scripts like Chinese characters, known for their high visuospatial complexity. Moreover, the prevalence of phonology-based input methods (utilizing phonology rather than orthography to input Chinese characters) exacerbates character amnesia due to the untransparent grapheme-phoneme conversions in the Chinese writing system. This shows that insufficient handwriting practice in the digital age severely interferes the normal development of Chinese reading and writing ability among young children. Thus, promoting Chinese handwriting learning has become more crucial than ever before. Rote copying practice is a widely-used method in Chinese handwriting education. However, this traditional method presents two salient problems. First, it is tedious and boring, leading to low learning engagement. Second, it focuses on rote memorization without establishing meaningful linkages between pronunciation, orthography, and semantic meaning, leading to poor performance in dictation. This project aims to address the two problems by leveraging generative artificial intelligence (GenAI). In Phase 1, we will develop a GenAI tutor to provide dialogic interactions with students during copying practice. The interactions will be guided by the feedback model of ASK-TELL-ASK, which includes reflecting on handwriting performance and asking questions related to the pronunciation, orthography, and semantic meanings of the character. The GenAI tutor will be built using an open-source large language model, iFLYTEK Spark LLM, and integrated into a self-developed Android mobile application for Chinese handwriting learning. In Phase 2, a randomized control trial design will be performed to assess the effectiveness of the GenAI tutor. 186 Hong Kong children (aged 6-7) will be randomly assigned into treatment and control groups and will learn new Chinese characters either by rote copying practice alone or with the GenAI tutor. Their brain activities will be continuously recorded using electroencephalogram (EEG). The impact of the GenAI tutor on Chinese handwriting learning engagement and performance will be evaluated by applying linear mixed models to analyze between-group differences at both the behavioral and neural levels. The GenAI tutor developed in this project aims to improve teaching and learning practice for Chinese handwriting in the digital age and inform relevant policy development both within and outside Hong Kong. Moreover, it will contribute to the establishment of new norms in student learning design in the GenAI environment.