

Integrating Chatbot-facilitated Scaffolding with Self-Regulated Learning to Develop Teachers' Intelligent-TPACK: A Randomised Controlled Trial

Teachers' intelligent-TPACK (I-TPACK) refers to their knowledge of how to make effective and ethical use of generative artificial intelligence (GenAI) to enhance curriculum design and instruction (Celik, 2023; Chiu, 2025). Despite growing international emphasis on cultivating teachers' I-TPACK (UNESCO, 2024; Vidal et al., 2023), current professional development programmes seldom embed self-regulated learning (SRL) principles that help teachers plan, monitor, and reflect on their GenAI integration. Previous SRL-based interventions have demonstrated positive effects on learning outcomes, yet few have extended to teacher professional learning or employed GenAI-enabled scaffolding to deliver adaptive and personalised support. To address this gap, the proposed project will develop and test a chatbot-scaffolded SRL (CSSRL) model integrating Zimmerman's three SRL phases with four types of GenAI-enabled scaffolding (representational, cognitive, metacognitive, and motivational) to support teachers' personalised learning. Building on the PI's pilot work, a 15-week online professional development programme comprising five I-TPACK modules will be developed, consisting of an experimental condition (CSSRL) and a control condition (flipped professional development, [FPD]). Both conditions cover identical learning content, but will differ in instructional design. In the CSSRL condition, each module will guide teachers through a full SRL cycle supported by a large language model-based chatbot providing real-time, phase-aligned, and context-responsive scaffolding, whereas the FPD condition will follow a conventional flipped format without SRL structuring or chatbot support. The programme will be evaluated through a randomised controlled trial with 220 secondary school teachers in Hong Kong. Participants will be individually randomised to an experimental condition (CSSRL; $n=110$) or a control condition (FPD; $n=110$). Data sources will include three survey waves assessing teachers' I-TPACK at T1 (pre-programme), T2 (post-programme), and T3 (two-month follow-up), as well as a performance-based task, interviews, artefacts, reflective journals, and chatbot logs. Quantitative, qualitative, and learning analytics approaches will be integrated to evaluate programme effectiveness, identify enabling and constraining factors, and refine the CSSRL model by testing how different scaffolding types align with SRL phases and shape learning outcomes. The project contributes theoretically by establishing an evidence-based CSSRL model integrating chatbot-facilitated scaffolding with SRL phases to enhance professional learning. Building on this model, it represents the first professional development programme offering teachers personalised and adaptive SRL support. Beyond the local context, this low-threshold, scalable, and research-informed programme offers a benchmark for professional development and generates transferable insights to guide international efforts to strengthen teachers' GenAI competency.