

Empowering Teachers to Foster Children's Computational Thinking with Coding Robots: A Cluster Randomized Trial

Computational Thinking (CT) enhances creativity, critical thinking, and collaboration—essential skills for thriving in the 21st century (Curriculum Development Council, 2020). The rise of age-appropriate coding robots has accelerated worldwide efforts to develop young children's CT (Bers et al., 2022). However, empowering teachers to deliver effective robot-based CT education remains a challenge (Chevalier et al., 2022). As Hong Kong lacks evidence-based and scalable professional learning approaches and programs, too few of its kindergarten teachers have the skills to integrate CT and robotics into their curricula (*Yang et al., 2022). To address this gap, our project proposes a three-phase iterative approach to train teachers in fostering children's CT with robots. Informed by Constructionist and Situated Learning Theories, this approach involves iterative cycles of (re)design, practice, and reflection, which have been validated in the PI's pilot study (DRG2022-23/002). Building upon this approach, we will implement and evaluate our professional development program—Computational Thinking for Early Childhood Educators (CT4ECE). Using a cluster randomized trial, 12 Hong Kong kindergartens will be randomly assigned to receive CT4ECE or be in an active-control group. Approximately 60 teachers from six treatment kindergartens will undergo nine weeks of CT4ECE professional learning, while 60 teachers from six control kindergartens will receive a conventional program involving lectures and lesson plan study sessions covering the same content as CT4ECE, without utilizing the three-phase iterative approach. All teachers and about 360 children (10 students per class, with three classes ranging from K1 to K3 per kindergarten) will take pretests, posttests, and delayed posttests (six months post). If the participants differ substantially across groups, we will use statistical matching to create equivalent subsets. We will assess teachers' CT competence and children's CT using validated scales via difference-in-differences multilevel structural equation modeling with residual centering. We will videotape and analyze teachers' activity implementation in CT4ECE classrooms. We will interview 30 diverse teachers from the CT4ECE group to investigate factors influencing the implementation fidelity and training effects. This project aims to be the first to rigorously evaluate the impact of an evidence-based professional development program on early childhood teachers' competence and children's achievement in CT. Our findings will inform (a) teacher educators, learning technologists and policymakers, and (b) the framework of CT-focused teacher development to prepare technology-proficient early educators and foster children's learning in a fast-changing digital society.