

Enhancing language learning through AI-empowered, LLM-supported interactive social robots: A mixed-methods study within a three-phase intervention design framework

In Hong Kong, approximately 42% (N=28,600) of the 67,870 integrators in the 2024–2025 academic year are students diagnosed with specific learning disabilities (SpLD) (Education Bureau, 2025). Since SpLD was formally recognized under Special Educational Needs (SEN) in 2008, targeted resources and support mechanisms have been introduced to address their unique challenges. Teacher education programs now emphasize understanding the cognitive and behavioural traits of SpLD students, equipping educators with evidence-based strategies to support their learning. With advancements in educational technology, researchers and practitioners are increasingly exploring how digital tools can improve learning outcomes and accessibility for SEN students. Social educational robots have shown promise in providing feedback and assistance, helping students overcome learning barriers and enhance academic performance. However, many current solutions follow a “one-size-fits-all” model, which may not meet individual needs. The potential of AI-empowered social robots, supported by large language models, to foster social, emotional, and communication skills in students with dyslexia remains underexplored. The team has initiated some small-scale studies on using robots to support learning among students with SEN. (Fung et al., 2025; Chung et al., 2024). Supportive interactions have been shown to positively influence student engagement, motivation, and language proficiency, addressing both the emotional and functional dimensions of learning. This study further investigates how social robots are designed to engage students with dyslexia from both functional and emotional perspectives. A robot-assisted language learning system will be developed specifically for Chinese language acquisition, following a three-phase framework of invention: Phase 1 (Formative Study), Phase 2 (System Development), and Phase 3 (Pilot Study). Guided by the Self-Determination Theory framework, the study will examine outcomes such as behavioural, emotional, and cognitive engagement, along with intrinsic motivation. In Phase 3, a mixed-methods study will be conducted with 240 primary school students, divided into a control group and two experimental groups. The control group will use traditional paper-based materials, Experimental Group 1 will engage with PowerPoint-based content, and Experimental Group 2 will interact directly with the social robot. To ensure robust findings, a triangulation methodology will be employed, incorporating questionnaires, classroom observations, semi-structured interviews, and language proficiency assessments. The insights support Chief Executive’s 2025 Policy Address, which envisions the integration of artificial intelligence into future education. These findings could inspire theoretically advancement, inform policy decisions, guide resource allocation and shape curriculum design that contribute to a more inclusive and technologically empowered educational landscape.