AI Conversational Agent for Developing Preservice Teachers' Responsive Teaching Skills in Mathematics Education

Dabae Lee[1], Sheunghyun Yeo[2], & Corey Webel[3],
[1]Kennesaw State University, [2]Daegue National University of Education, [3]University of Missouri

I. SUMMARY
This experimental study examined the use of an AI-based chatbot in mathematics education to enhance preservice teachers' (PSTs) responsive teaching skills. Effective mathematics teaching involves being responsive to students' mathematical ideas, but PSTs have limited opportunities to practice this skill. In this study, we had PSTs pose questions to a chatbot that simulated a virtual student with a partial understanding of fractions. The intervention's effectiveness was evaluated by employing a randomized controlled design with pre- and post-assessments. The results indicate a large significant effect.

II. Introduction
The intelligent tutoring system is the most widely used AI-based system (Feng & Law, 2021). Intelligent tutoring systems provide a way to scale individualized instruction by assessing student knowledge and adjusting instruction accordingly (Graesser et al., 2001). However, in such systems, users are considered knowledge recipients playing a passive role, rather than contributors playing an active role in their learning. AI-based chatbots have the potential to provide more interactive and flexible learning platforms than intelligent tutoring systems. In this study, we examined how an AI-based chatbot could be used in mathematics education to effectively enhance preservice teachers' (PSTs') responsive teaching skills.

III. Research Methods
This experimental study examined the effectiveness of using the chatbot on improving PSTs' noticing abilities. We employed a randomized controlled design. The participants, PSTs enrolled in a mathematics methods course in a teacher preparation program at a southern university, were randomly assigned to four sections with four different instructors. The same instructional materials were used to teach fractions content and professional noticing. There were two conditions: experimental (two sections, n=25) and control (two sections, n=25). In the experimental condition, participants interacted with a chatbot acting as a virtual student who displayed a partial understanding of fraction concepts when solving a fraction addition task. They posed questions as they would to a student to explore the virtual student's thinking and facilitate learning. The chatbot was programmed to appropriately respond to the questions. In the control condition, participants also used a chatbot. The chatbot elicited participants' questions but did not respond to the questions. Pre- and post-assessments were administered before and after the chatbot activity to see how the PSTs' noticing abilities (attending, interpreting, and responding to student thinking) changed.

IV. Results
In the pretest, no statistical difference in noticing skills was found between the two conditions. After implementation, a significant difference was found in the responding component among the three noticing components (Control Group: $M = 1.16$, $SD = 0.47$; Experimental Group: $M = 1.96$, $SD = 0.84$; t value = 2.30, $p < 0.05$). Cohen's d was 1.18, which indicates a large effect (Cohen, 1988).

V. Implications
This finding contributes to existing knowledge by providing an effective example of how AI can support the development of a teaching skill that is important for student learning: responding to student thinking by supporting and extending that thinking. Our research has shown that AI-based chatbots may provide a low-stakes, relatively authentic, and personalized learning experience where PSTs can practice and develop their responsive teaching skills prior to experiencing the full complexity of interacting with real students.

REFERENCES
Full references are ommited due to the page limit.