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# Using Robots to Teach Mathematics to First-Grade Students: Preservice Teachers' Perspectives

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## Introduction

In the past years, STEM has made its way into educational curricula. Students need a proper preparation to academically succeed in mathematics and technology to ensure the option of a STEM-related career such as engineering (Leonard, Buss, Unertl, & Mitchell, 2016). The use of robots in the classroom allows students to develop interest in STEM-related topics. Integrating robotics in education made students more comfortable with STEM applications, helped them develop 21st century skills, and increased their interest in pursuing STEM-related fields (Brand, Collver, & Kasarda, 2008). This highlights the important role that robotics can play in bridging classroom instructions with STEM. In order for teachers to integrate different technologies in their teaching, they need to have adequate experiences that are linked to an active participation in professional development programs (Kong, Lai, & Sun, 2020). Teaching using technology also requires teachers to develop their Technological Pedagogical Content Knowledge (TPACK; Koehler & Mishra, 2009). Engaging teachers with effective professional development programs that integrates robots can support the development of their TPACK and computational thinking (Kong et al., 2020).

The aim of our study is to support preservice teachers (PSTs) to develop positive attitudes towards using technology as a new way to teach mathematics and to support them develop their TPACK to integrate robots in teaching mathematics. In this report, we present the experiences of 16 PSTs who engaged in learning and teaching activities with robots Then taught mathematics to first-grade students using robots.

## Methods and Participants

The participants in this study included 16 PSTs, 14 females and 2 males from an elementary education program. Prior to taking the robots into the field, the PSTs had the opportunity to use the robots with one another in an educational setting. During this time, the PSTs became familiar with the different roles when using the robot. After experimenting with the robots, the PSTs gained necessary background knowledge which allowed them to teach the first-grade students using robots. The PSTs engaged first with activities that asked them to program simple robots to solve mathematical problems. After this learning session, PSTs designed and implemented mathematical activities that integrated robots in a first-grade classroom.

The PSTs worked in teams of two to teach mathematical concepts to first grade students using robots. There were four first graders assigned to each team, in which each student was

assigned a role. The roles included programmer, debugger, engineer, and recorder and the roles were rotated throughout the experience. One activity that the teams used included the use of a number ladder (numbers 1-15) to demonstrate addition and subtraction by programming the robots to move up and down the ladder. The first-grade students were not told that they were using the number ladder to add and subtract, although they were demonstrating their understanding of those concepts. Some of the first-grade students were able to recognize that they were doing addition and subtraction while using the number ladder. Other activities included programming the robots to move around a grid of numbers to respond to different tasks.

## **Data Collection**

In this study, the data were collected using qualitative measures to gain an insight into PSTs' perspectives about using robots to teach mathematics to first-grade students. After the teaching session, the PSTs were asked to reflect on their experience by responding to five open-ended questions. The open-ended questions aim to elicit PSTs' perceptions regarding using robots to teach mathematics. To analyze their reflections, we used conventional content analysis to understand their perceptions of using robots in mathematics classrooms. The teachers displayed positive attitudes and perspectives after teaching with robots. They reflected on the benefits of integrating technology such as robots to teach various mathematical topics.

## **Results**

Our qualitative analyses revealed that preservice teachers' reflections focused on two main categories: first-grade students' engagement and implementing robots in teaching mathematics. While reflecting on first-grade students' engagement during the activities, preservice teachers attended to students' interaction with each other, students' expression of positive feelings, and how students engaged with the mathematical content. For the second category, implementing robots in teaching mathematics, preservice teachers reflected on the use of technology, such as robots, to approach mathematics in a new way. Overall, the teachers' responses provided important insights into how they perceive their experience of using robots to teach mathematics to first-grade students.

Preservice teachers' reflections on first-grade students' engagement were subcategorized into three subcategories: a) students engaging with each other, b) students expressing their positive feelings, and c) students interacting with mathematical content. When the students were engaging with each other, the preservice teachers reflected on first-grade students collaborating and learning from each other. Preservice teachers attended to how first graders supported each other during the activities. The preservice teachers also reflected on the importance of collaboration. PSTs' reflections within the second subcategory, students expressing their positive feelings, included statements highlighting how students reacted after completing a given task during their experience with robots. Teachers observed positive reactions from first grade students during the activities. One teacher reported, "My favorite part was seeing how excited the students got when they achieved their goal with the robots it was genuine excitement and pride". The third subcategory involves preservice teachers' reflection about students' interaction with the mathematical topics during the activities, specifically, addition and subtraction. The teachers attended to how students engaged with the mathematical content and reflected on how students expressed or demonstrated their mathematical understanding.

The second main category concerns implementing robots in teaching mathematics. Preservice teachers' reflections focused on two subcategories: a) operating robots and b)

instructions or guidelines during the learning activities. Observing first-grade students learning about and operating the robots allowed preservice teachers reflected on the necessary skills to use the robot. In order to decrease the difficulties while using the robots, the preservice teachers mentioned that students "...have to clear the previous data before being able to move on to a new pattern and they should just in general learn what each button does before using them". The first-grade students were given instructions and guidelines on which the preservice reflected to properly interact with the robots. These instructions and guidelines included the treatment of the robots.

These findings indicate that preservice teachers had the opportunity to examine and reflect critically on implementing robots in mathematics lessons. Their teaching experience allowed them to observe the affordances of technologies such as robots and how such technologies can support students develop their mathematical knowledge. It also allowed them to reflect on the pedagogical aspects of integrating technology in mathematics lessons and how students might react during learning activities. Teachers' reflections indicate that they did not expect students to engage and react in the way they did, especially since they are in first grade. Preservice teachers also had the opportunity to reflect on their perception of teaching and learning mathematics. They indicated that mathematics can be taught in engaging and creative ways using technology.

## References

- Brand, B., Collver, M., & Kasarda, M. (2008). Motivating students with robotics. *The Science Teacher*, 75(4), 44-49.
- Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education*, 9(1), 60-70.
- Kong, S.-C., Lai, M., & Sun, D. (2020). Teacher development in computational thinking: Design and learning outcomes of programming concepts, practices and pedagogy. *Computers & Education*, 151, 1-19. doi:10.1016/j.compedu.2020.103872
- Leonard, J., Buss, A., Unertl, A., & Mitchell, M. (2016). Using robotics and game design to promote pathways to STEM. In M. B. Wood, E. E. Turner, M. Civil, & J. A. Eli (Eds.), *Proceedings of the 38th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*. Tucson, AZ: The University of Arizona.