# A Study of Preservice Teachers Developing Teaching Competencies with VEX GO Robotics

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**Abstract:** There is global impetus to include the learning of STEM skills across k-12 school curricula to keep abreast of changing occupational, economic and societal needs. The province of Ontario, Canada implemented a revised Grades 1-8: Science and Technology curriculum in 2022 that emphasises STEM learning across the elementary grades. However, majority of elementary teachers in Canada are generalists – they are expected to teach all subjects such as language, science, mathematics, and the arts. In this type of teacher education context, where majority of the elementary preservice teachers (PTs) do not have undergraduate degrees in the STEM disciplines, there is need to provide them with STEM experiences to develop their STEM knowledge and skills and their teaching competencies for elementary school STEM teaching. The literature shows that educational robotics (ER) can develop STEM skills in k-12 students. This paper reports on a study that examined how middle-school preservice teachers develop confidence and knowledge to teach about coding with VEX GO robotics. Data sources for n = 50 preservice teachers included a pre-questionnaire on prior knowledge, a pre- and post-questionnaire on confidence to teach with robotics, and a worksheet to guide activities and record coding solutions. Preservice teacher (PT) participants volunteered to participate and signed a consent form, approved by the university research ethics board. The quantitative data were analysed with SPSS version 29. The results were statistically significant for the effect of the robotics intervention on PTs' confidence about their competencies to use robotics in teaching and learning of middle school science and a large effect size was observed. The findings also revealed that PTs' participation in the robotics activity resulted in a gain in their reported knowledge about robotics to integrate in teaching and learning. The results inform the design of instructional experiences in Teacher Education courses to improve elementary preservice teachers' self-efficacy and competencies to teach with robotics in classrooms and also provide insights into the design of ER learning experiences for elementary school contexts.

**Keywords:** Preservice Teachers, Robotics, Self-efficacy, Teaching Competencies, STEM, Quantitative

## 1. Introduction

Over the past two decades, the implementation of educational robotics (ER) in educational settings has been widespread (Benitti, 2012; Darmawansah et al., 2023). Educational robotics (ER) involves the use of robotics kits, programming software, and computers as hands-on learning tools to foster problem-solving, critical thinking, collaboration and learning of STEM concepts and ideas (Eguchi, 2016, 2021). ER has been consistently implemented in informal learning settings such as in afterschool programs to develop k-12 students' STEM knowledge and skills (Benitti, 2012; Anwar, 2019). ER programs in formal school settings have been initiated as part of research projects (e.g., Papanikoloau, Frangou, & Alimisis, 2007), school board professional learning initiatives (e.g., Sinay et al, 2016) or introduced to enhance creativity and interest in STEM (e.g., Hendricks, Alemdar, & Ogletree, 2012; Master et al, 2017). The inconsistent implementation of ER to support STEM learning in schools is in part due to barriers such as typical school structures with discipline-based subjects and lack of funding and resources (Chiu, Price, & Ovrahim, 2015; Margot & Kettler, 2019). However, in the past decade, rapid scientific and technological advancements and the emergence of new interdisciplinary fields such as bioengineering and automation have spurred many countries to plan strategies for economic development that include integrating STEM and computing skills in formal school curricular (Vegas et al., 2021). Many countries have introduced STEM and computer science (CS) into school curricular over the past eight years. For example, South Africa introduced STEM, coding and robotics in their national curriculum in 2020 and implemented this curriculum incrementally in 2023, 2024 and 2025 (Department of Basic Education, 2024), and as a response to the European Commission's Digital Education Action Plan (European Commission, 2018), the Italian Ministry of Education in 2019 legislated that computer science and computational thinking (CT) be included in primary school curricula by 2022. Similarly, the Ministry of Education in the province of Ontario, Canada revised the science and technology grade 1-8 and grades 9 curricula in 2022 to include the development of STEM skills such as computational thinking, coding, and innovation as student learning expectations or outcomes. ER is recommended as a strategy for students to learn about science and technology concepts, do science, and develop solutions to technological problems in a hands-on, experiential way (Ontario Curriculum and Resources, 2022).

However, the inclusion of STEM and coding skills into the elementary science curriculum has exacerbated challenges already experienced by elementary PTs. In Ontario, elementary teachers are generalists; they are required to teach all subjects such as math, science and technology, language, visual arts, music, and physical education even though they do not have undergraduate degrees in every curricular subject. In the science and technology subject, PTs are required to teach middle-school students, fundamental concepts of science and technology related to four strands: life systems, matter and energy, earth and space systems and structures and mechanisms (Ontario Curriculum and Resources, 2022). Since 2022, elementary teachers are also expected to provide students with coding and automation experiences. It has been found that elementary preservice teachers (PTs), with minimal formal education in the STEM and CS subjects, exhibit low levels of STEM knowledge and confidence to teach science (Kazemour, 2015).

This paper reports on a study that investigated how elementary PTs developed confidence to teach and knowledge of teaching competencies with respect to VEX GO robotics. The study builds on prior studies (e.g., Jaipal-Jamani & Angeli, 2017) that reported on PTs experiences learning with different robotics applications such as LEGO WeDo.

## 2. Literature Review

The literature provides an overview of the theoretical framework of teacher knowledge for teaching with technology and a brief review of studies on teacher and PT self-efficacy teaching with robotics.

### 2.1 Teacher Knowledge for Teaching With Technology

There is widespread consensus among teacher educators that learning to teach a subject involves teachers learning the disciplinary content (C), the pedagogy (P) involved in teaching, and the pedagogy unique or appropriate for teaching the content (the intersection of C and P) referred to as pedagogical content knowledge (PCK; Shulman, 1987). Likewise, learning to teach content with technology such as robotics involves teachers learning how to use the technology to teach content in ways that promote student learning of skills and content. With respect to teaching with technology, Koehler and Mishra's (2009) TPACK model provides a reliable framework for understanding teacher knowledge in this expanded context. In developing the TPACK model, Koehler and Mishra built upon the PCK model and included technology knowledge. The two technology knowledge (T) intersections with C and P, in this three-component, TPACK model give rise to two other knowledge components: Technological Content Knowledge (TCK) – knowledge about the ways in which technology can be used to represent and transform the content, and Technological Pedagogical Knowledge (TPK) – knowledge about the affordances and constraints of tools and how it affects pedagogical designs and strategies in relation to the disciplinary context (Koehler, Mishra, & Cain, 2013).

Besides TPACK being a theoretical model that elucidates teacher knowledge of content, pedagogy and technology and their knowledge intersections in the practice of teaching, the updated TPACK model explains the development of teaching with technology in practical educational contexts (Petco et al., 2025).

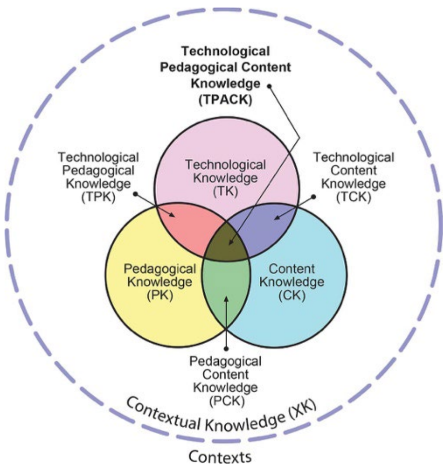


**Figure 1: The updated TPACK model (Petco, Mishra & Koehler, 2025)**

In figure 1, contexts or external influences is outside the dotted line and contextualised knowledge (XK) in on the inside of the dotted line. Contextual knowledge includes knowledge of the characteristics of the learner and classroom environment which promotes the transfer of teachers' technology teaching competencies from one context to another (Petko et al, 2025). TPACK and TPACK-related contextualized knowledge therefore develop in "specific practical contexts" (Petco et al, 2025, p.4). The TPACK model, through the contextual knowledge component, reflects and reinforces the situated nature of how teachers learn teaching competencies. According to Roth and Jornet, (2013, p. 7), "learning is not viewed as the acquisition of knowledge contents but in terms of expanding the leaner's action possibilities" in other contexts. The authors explain that "it is not an internal model that transfers to another setting but a set of subject-environment relations". The situated theory of learning therefore explains that teaching competencies and skills are transferred when learned in situations that have similar situational aspects to those in which they are applied (Roth & Jornet, 2013). Competence is viewed as the latent cognitive abilities and affect-motivation that underlie performance in real world situations (Blömeke, Gustafsson, & Shavelson, 2015). In the real world of teaching, research has shown that transfer of knowledge by PTs is facilitated when learning with technology is situated in practical experiences that closely resemble conditions in real K-12 classrooms (Tondeur et al, 2012).

### 2.2 Teacher Self-efficacy Teaching With Robotics

Martin, Dennen and Bonk (2020) capture the current context for teaching by stating that "effective teaching has become more challenging with the introduction of digital and robotic technologies" (p. 221). Learning to teach with technology requires digital competencies that include being confident, critical, and responsible when using technologies for teaching and learning (European Union, 2018). Confidence or self-efficacy to teach is the belief or conviction that a teacher has in their ability and capability to execute a teaching task to achieve learning outcomes in a specific context (Bandura,1977; Tschannen-Moran & Woolfolk Hoy, 2001). Research shows that PTs with low self-efficacy beliefs to teach content will not readily integrate the content into their classroom teaching (Tschannen-Moran & Mcmaster, 2009). It can be argued that self-efficacy beliefs, like teaching competencies, are likely to transfer if the teacher encounters a teaching context that has similar situational aspects in terms of resources and constraints. However, in the current global context characterised by rapidly changing digital technologies, PTs may experience challenges because of a lack of knowledge and skills to use unfamiliar technologies, Hence, Tondeur et al (2025) argue that for PTs to develop strong digital competencies in ways that will help them gain confidence to teach with the technology, they need multiple exposure to strategies that foster technical, pedagogical, social and wellbeing or emotional competencies. In a recent meta-analysis, Tondeur et al updated the strategies in their Synthesis of Qualitative Data (SQD) model to prepare PTs for teaching with technology in changing digital classroom contexts. These strategies include: 1) familiarization through modelling pedagogical approaches and hands-on exploration, 2) reflective practice by critically reflecting on affordances and limitations of technology and doing research-based tasks, 3) collaborative instructional design activities to create rich digital learning experiences, 4) a cycle of scaffolded authentic teaching experiences and feedback support, and 5) supporting affective characteristics such as attitudes and beliefs, emotions and sensitivities to cultural and equitable views on the use of technology. Strategies such as modelling, scaffolding, curriculum alignment, hands-on coding experiences and reflective feedback with robotics can improve elementary PTs pedagogical content knowledge of coding and can result in gains in PT teaching efficacy beliefs to code with robotics (Kaya et al, 2020).

## 3. Methodology and Methods

The study design was a quasi-experimental, one-group pretest-posttest (Bernard, 2012). The research questions investigated were:

- What effect did the robotics activity have on PTs' self-efficacy to teach with VEX GO robotics?
- How did the robotics activity affect PT's knowledge about robotics for teaching and learning?

### 3.1 Study Context and Participants

This study occurred at a Canadian University in Ontario in the winter of 2023. Preservice teachers were in year 5 of a 6-year Concurrent Education, Junior Intermediate (JI) program which consisted of a 4-year honours undergraduate degree with mostly non-science majors and some education courses, followed by the 2-year Bachelor of Education (B.Ed.) teacher certification degree. During the 2022-2023 academic year, PTs completed language, math and some curriculum foundations courses in the fall semester of the B.Ed. program. This was followed by a 6-week school placement in a grade 4 - 8 classroom where PTs taught language and math and other subjects depending on what the host teacher at the school taught. All JI preservice teachers returned to the university for the winter semester and then completed the 12-week science and technology methods course. In this course, they were introduced to the Ontario science and technology curriculum for grades 4 – 10 through theoretical and practical activities on topics such as unit planning, lesson planning, assessment, scientific inquiry, engineering design, scientific research, science micro-teaching, cross-curricular subject connections, environmental education, Indigenous perspectives, coding with microbits and automation with robotics. Due to the many curriculum topics covered in the course, one three-hour session was spent on automation and robotics.

The ER activity with VEX GO robotics was taught by the author to PTs in three class sections. Each section had enrolments that ranged from 20 to 30 students. The robotics class began with an interactive lecture that introduced the definition of automation and robotics, examples of applications of robots, explanation of coding concepts such as algorithms, program, debugging, coding languages, and science curriculum connections. The author then demonstrated how to use the VEX GO robotics coding platform and explained the worksheet activities. Preservice teachers worked in groups of 3 or 4 and followed the directions on the scaffolded worksheet on how to build the robot driving base, connect to the codegogo.vex.com coding platform website. The coding exercises guided PTs to code the base robot to make simple moves in a straight line followed by a simple challenge, to coding for turns, and then creating code for a complex, yet familiar, real world challenge: to autonomously park the driving base using parallel or perpendicular parking. A total of 50 PTs completed the pre- and post- data questionnaires.

## 3.2 Ethical Considerations

Permission to conduct the study was obtained from the university. Since the researcher/author was the instructor of the course, a graduate research assistant invited PTs to participate in the study. PTs were told that participation was voluntary and that they could withdraw at any time from the study without penalty; there would be no effect on their grades. There were a few students in each class section who did not provide consent; these PTs participated in the robotics activity but their data were not included in the study.

## 3.3 Data Sources and Data Analysis

Sources of data for this paper included a questionnaire that asked about prior experiences with robotics, a robotics questionnaire that included 4 items about PT confidence on their skills to use robotics in teaching, and two questions on knowledge of robotics for teaching. All data were analysed using IBM SPSS Statistics version 29.0.1.0.

The robotics self-efficacy questionnaire consisted of 4 items that rated confidence on a scale from 0 to 100 (from not confident to completely confident) and coded in SPSS from 0 to 10. Items were 1) I feel confident that I have the skills necessary to use robotics coding applications for simple classroom STEM activities such as robots moving forward, 2) I feel confident that I have the skills necessary to use robotics coding applications for more complex classroom STEM activities such as coding for parallel parking and motion sensors, 3) I feel confident that I can help students when they have difficulty coding robots to perform simple tasks (e.g., use of moving and turning motions), and 4) I feel confident that I can help students when they have difficulty with coding robots to perform more complex tasks (e.g., avoiding collisions using sensors, creating variables with if.. then conditions). The same questionnaire was administered prior to the robotics intervention, Cronbach's alpha = 0.930, and a week after the robotics intervention, Cronbach's alpha = 0.944, suggesting a good level of reliability.

The two knowledge items scored on a Likert scale of 1 (strongly disagree) to 5 (strongly agree) were, 1) I have sufficient knowledge of coding as it applies to robotics, and 2) I have sufficient knowledge about robotics to integrate in teaching and learning JI science. A test was not used to measure knowledge as tests are not used to assess PTs learning in this course. The same questionnaire was administered before and a week after the robotics intervention. The Spearman-Brown Coefficient (Eisinga et al., 2013) was used to test for reliability; pre-knowledge Spearman-Brown Coefficient = 0.741; post-knowledge Spearman-Brown Coefficient = 0.786 suggesting an acceptable level of reliability for the two items.

All pre- and post-data were tested for normality. The resulting Shapiro–Wilk significance values were less than 0.05 indicating the data did not follow normal distribution. Hence, the non-parametric Wilcoxon Signed test was used to compare all pre- to post-data scores and the effect size was calculated with the formular: $r = z/\sqrt{2n}$ with values for $r = 0.10$ (small effect), 0.30 (moderate effect) and 0.5 (large effect; Fritz et al, 2012).

# 4. Results

## 4.1 Demographics and Prior Experience With Robotics

Fourteen males and 36 females participated in the study as shown in Table 1.

**Table 1: Number of male and female preservice teacher participants**

| Gender | | |
|---|---|---|
| | N | % |
| male | 14 | 28.0% |
| female | 36 | 72.0% |

Figure 2 illutrates PTs' prior experiences with coding and robotics. 46% of the PTs had few prior experiences with robotics (the one experience many had was coding a different robot application in their math methods class in the fall semester), 24% had some experiences (math methods class and some exposure teaching coding with mainly Scratch at schools), and 28% had used robotics many times (math methods, prior university courses, taught coding during practicum or used robotics to teach at STEM summer camps).

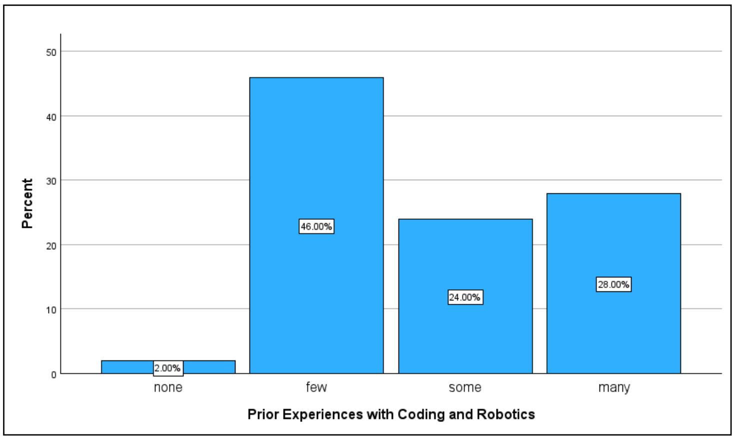


**Figure 2: Preservice teachers prior experiences with coding and robotics**

## 4.2 Preservice Teachers' Self-efficacy to Teach With Robotics

Null Hypothesis: Ho: There is no difference in preservice teachers' self-efficacy to teach with robotics before and after the robotics intervention.

Alternate Hypothesis: H1: There is a difference in preservice teachers' self-efficacy to teach with robotics before and after the robotics intervention.

The sum of 4 knowledge items (total score equal to 40) was compared pre and post intervention.
The Wilcoxon Signed Test revealed that PT post self-efficacy scores (*Mdn rank* = 26) were statistically significant compared to pre self-efficacy scores (*Mdn rank* = 12.5) with W= 1078.50, $z = -5.879$, $p < 0.001$ as shown in Tables 2, 3 and 4. The null hypothesis is rejected and the alternate hypothesis is accepted indicating that the robotics intervention did result in gains in PTs' self-efficacy. The findings show a large effect size of $r = z/\sqrt{2n} = 5.879//\sqrt{2*50} = 0.5879$.

**Table 2: Descriptive statistics for PT pre-post self-efficacy to teach with robotics**

| Descriptive Statistics for Four Items on Self-Efficacy | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | N | Mean | Std. Deviation | Minimum | Maximum | Percentiles | | |
| | | | | | | 25th | 50th (Median) | 75th |
| PREsum | 50 | 13.3900 | 9.69446 | .00 | 38.00 | 4.0000 | 12.5000 | 19.5000 |
| POSTsum | 50 | 25.2400 | 7.18718 | 4.00 | 38.00 | 22.7500 | 26.0000 | 30.1250 |

**Table 3: Wilcoxon signed ranks test for PT pre-post self-efficacy to teach with robotics**

| Ranks | | | | |
|---|---|---|---|---|
| | | N | Mean Rank | Sum of Ranks |
| POSTsum – PREsum | Negative Ranks | 1[a] | 2.50 | 2.50 |
| | Positive Ranks | 45[b] | 23.97 | 1078.50 |
| | Ties | 4[c] | | |
| | Total | 50 | | |
| a. POSTsum < PREsum | | | | |
| b. POSTsum > PREsum | | | | |
| c. POSTsum = PREsum | | | | |

**Table 4: Statistics for Wilcoxon signed ranks test for PT pre-post self-efficacy to teach with robotics**

| Test Statistics[a] | |
|---|---|
| | POSTsum - PREsum |
| Z | -5.879[b] |
| Asymp. Sig. (2-tailed) | <.001 |
| Exact Sig. (2-tailed) | <.001 |
| Exact Sig. (1-tailed) | <.001 |
| Point Probability | .000 |
| a Wilcoxon Signed Ranks Test | |
| b Based on negative ranks. | |

## 4.3 Preservice Teachers Knowledge of Robotics for Teaching

With respect to knowledge item 2, *I have sufficient knowledge about robotics to integrate in teaching and learning of Junior-intermediate (JI) science*, only 4 % of PTs reported that they agreed with this statement prior to the intervention (see figure 3).

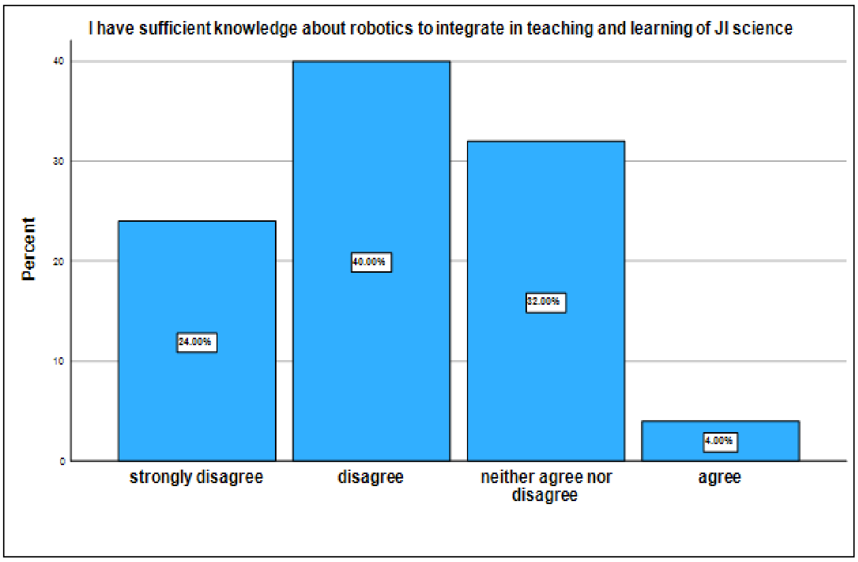


**Figure 3: Pre-intervention knowledge about robotics to integrate in teaching and learning**

After the robotics activity, 62 % PTs agreed and 10% strongly agreed that they had sufficient knowledge about robotics to integrate into teaching and learning (see figure 4)

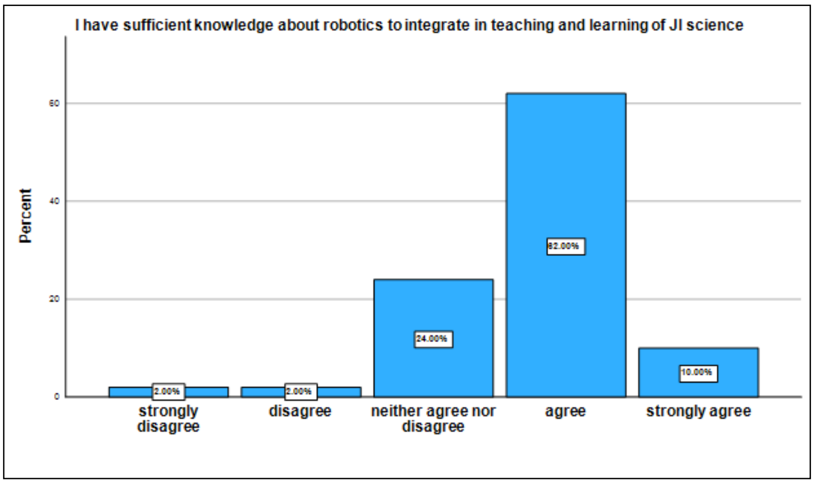


**Figure 4: Post-intervention knowledge about robotics to integrate in teaching and learning**

Preservice teachers' knowledge about robotics for teaching was compared statistically to find out the impact of the robotics intervention. The sum of the pre- and post-scores for both knowledge items did not follow normal distribution; Shapiro–Wilk significance values were less than 0.05. Hence, the non-parametric Wilcoxon Signed test was used to compare knowledge gains from pre- to post-data with statistical data shown in Tables 5, 6 and 7. The hypotheses were:

- H0: There is no difference in PT knowledge about robotics for teaching before and after the robotics intervention.
- H1 There is a difference in PT knowledge about robotics for teaching before and after the robotics intervention.

The Wilcoxon signed-rank test showed a statistically significant median rank difference between post-reported knowledge about robotics for teaching (*Mdn rank* = 8) when compared to pre-reported knowledge of robotics for teaching (*Mdn rank* = 4) with W = 1128, $z = -6.006$, $p < 0.001$. The results indicate that PTs gained knowledge about robotics for teaching as it applied to the VEX Go robotics after participating in the robotics intervention. The effect size was $r = z/\sqrt{2n}$; $r = 6.006/\sqrt{2*50} = 0.6006$ which indicates a large effect size suggesting that the VEX GO robotics intervention did have practical significance for PTs to learn knowledge about robotics for teaching.

**Table 5: Descriptive Statistics for PT knowledge about robotics for teaching**

| Descriptive Statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | N | Mean | Std. Deviation | Minimum | Maximum | Percentiles | | |
| | | | | | | 25th | 50th (Median) | 75th |
| SUMPREknowledge | 50 | 4.4200 | 1.62995 | 2.00 | 8.00 | 3.0000 | 4.0000 | 6.0000 |
| SUMPOSTknowledge | 50 | 7.3600 | 1.33646 | 2.00 | 10.00 | 6.0000 | 8.0000 | 8.0000 |

**Table 6: Ranks for the Wilcoxon signed ranks test**

| Ranks | | | | |
|---|---|---|---|---|
| | | N | Mean Rank | Sum of Ranks |
| SUMPOSTknowledge - SUMPREknowledge | Negative Ranks | 0[a] | .00 | .00 |
| | Positive Ranks | 47[b] | 24.00 | 1128.00 |
| | Ties | 3c | | |
| | Total | 50 | | |
| a SUMPOSTknowledge < SUMPREknowledge<br>b SUMPOSTknowledge > SUMPREknowledge<br>c SUMPOSTknowledge = SUMPREknowledge | | | | |

**Table 7: Wilcoxon signed rank test statistics**

| Test Statistics[a] | |
|---|---|
| | SUMPOSTknowledge - SUMPREknowledge |
| Z | -6.006[b] |
| Asymp. Sig. (2-tailed) | <.001 |
| Exact Sig. (2-tailed) | <.001 |
| Exact Sig. (1-tailed) | <.001 |
| Point Probability | .000 |
| a Wilcoxon Signed Ranks Test<br>b Based on negative ranks. | |

## 5. Discussion and Implications

With the expectation that coding and automation concepts, be taught in elementary schools in Ontario, Canada since 2022, this study investigated the effect of a robotics intervention with VEX GO robotics on junior-intermediate (JI) preservice teachers' (PTs') self-efficacy and knowledge with respect to robotics for teaching. All findings were statistically significant. PTs self-efficacy to teach with robotics after the intervention increased from M= 13.39 to M= 25.24 with a large effect size observed (r = 0.5879). While the intervention did improve participants' self-efficacy, the means suggest that PTs are still not fully confident and will require more practice. PTs' knowledge about robotics for teaching showed strong gains from pre- to post-intervention with effect size (r) = 0.6006. These findings together suggest that the targeted, scaffolded intervention that guided PTs learning from simple to more complex coding tasks was effective at improving PTs' self-efficacy to teach with robotics and it improved their knowledge about robotics for teaching and learning in JI science. Other studies which have used scaffolded programming strategies specific to robotics applications have reported gains in PT self-efficacy to teach with robotics (Jaipal-Jamani & Angeli, 2017; Kaya et al, 2020; Schina et al, 2021). The use of a scaffolded programming strategy to teach PTs how to integrate specific robotics coding applications into teaching and learning also supports calls for the use of targeted strategies to develop PT digital competencies (Tondeur et al, 2025). Besides scaffolding, collaboration, authentic experiences, and critical reflection on pedagogy are strategies that can be used in Teacher Education programs to develop PT competencies. These strategies also add to contextual knowledge for developing TPACK (Petco, Mishra & Koehler, 2025). As illustrated in this study, PTs participated in robotics activities that were designed to model classroom pedagogy and were linked to middle school curricular learning outcomes. PTs collaborated in groups of 3 and 4 similar to how middle school students work in a classroom, the instructor modelled how robotics concepts were to be introduced by the teacher, and PTs participated in hands-on robotics activities to learn coding and problem-solve an authentic, real-world problem – parking a vehicle autonomously. PTs, in their role as middle school learners, experienced the activity as learners in a practical context similar to a classroom. As they experienced the affordances and constraints associated with the technology, they were developing TPK. The choice to use VEX GO robotics was made because the two local schoolboards provide these robotics resources to schools. Using the same robotics resources used in the local classroom context increases the similarity of situational aspects and improves transfer of teaching competencies into the classroom (Roth & Jornet, 2013).

## 6. Limitations of Study

The study results are based on self-report data and reflect PTs perceptions of their self-efficacy and knowledge at a particular point in time. Due to how the Teacher Education program is designed, PTs could not be observed in real classrooms teaching with robotics to find out if they did make the transfer of competencies learned into the classroom. The small sample size limits generalizations of results to JI PTs in other universities or to the secondary PT population due to different contextual factors. For example, secondary school PTs, with specialised science majors may have different prior knowledge with STEM skills and robotics. While the ratio of males to females in the study was not balanced, 28:72, it is consistent with trends in the population of elementary male and female teachers in schools in the region. The ratio reported for male: female teachers at the two schoolboards in the Niagara region in 2019-2020 was 21:79 (Government of Ontario. 2020). Similar to Piedade et al (2020) findings, a correlation test revealed that the gender of PTs did not have an effect on PT self-efficacy or knowledge of robotics. There was a correlation between prior knowledge and PT self-efficacy which is beyond the scope of this paper due to word limitations. The results are also limited to PTs' experiences learning how to teach with VEX GO robotics and may not necessarily reflect how their teaching competencies and self-efficacy would be affected if using another robotics application.

## 7. Conclusion

The findings of this study indicate that the modelling of robotics teaching and learning in a similar school classroom context, and with an authentic robotics problem context, supports the transfer of technological pedagogical knowledge and teaching competencies into the real classroom reinforcing the current literature (Petco, Mishra, & Koehler, 2025; Tondeur et al, 2025). The use of these strategies in the science and technology methods course resulted in positive gains for PTs in terms of self-efficacy and knowledge to teach robotics. Since there is a significant correlation between PT self-confidence and knowledge of robotics (Piedade et al, 2020), the modelling of pedagogy in authentic contexts is recommended as a practical strategy for developing elementary PTs' self-efficacy and TPACK knowledge for teaching with robotics.

## Ethics Declaration

This study received ethics clearance through the Research Ethics Board at Brock University.

## AI Declaration

No AI tools were used in the writing of this paper.

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