Special Education Teachers Evaluating the Accessibility of CS Educational Robotics

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ABSTRACT

All students benefit when computer science (CS) materials are accessible, but it is critical for students with disabilities. In order to provide opportunities for all students to be successful, it is important for teachers to be able to evaluate the accessibility of their lessons and technology. One way to evaluate accessibility is the POUR framework. The POUR framework represents what can be Perceived through the senses, how users can Operate a material or technology, how it is Understandable to users, and the overall Robustness. POUR provides a promising way for K-12 CS teachers to evaluate accessibility for their learners. We describe how the POUR framework was used by a cohort of teachers to evaluate VEX 123 for their learners with disabilities. Findings from the teacher POUR analysis revealed that overall, the teachers noted that the VEX 123 provided the necessary range of entryways into coding through its three modalities: The touch coding on the robot itself, the coder cards, and VECcode (the block-based coding environment). At the same time, the teachers indicated that some students with disabilities faced a number of motor and sensory difficulties. Overall, this study showcased a way for teachers to provide insight into the level of accessibility of CS education tools specific to their students' strengths and needs.

KEYWORDS

Teacher Education, Computer Science Education, Teachers' Identity, Teachers' Values

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1 INTRODUCTION

One way CS education can be supported is through the use of accessible materials. It has been suggested that accessibility can be better maximized if accessibility is considered at the start of the design or evaluation process, not as an afterthought [8]. However, with many CS education tools, this is not always possible as these were not designed with accessibility in mind [**?**].

Teachers are essential to understanding how educational products have been used or not used in the classroom as they routinely interact with the technologies, use them with students, and evaluate its usage [1]. Hence, partnering with teachers to provide feedback on the accessibility of CS education tools and robotics can help to ensure that CS instruction is inclusive of all students.

One way for teachers to evaluate accessibility is through using the Perceivable, Operable, Understandable, and Robust (POUR) guidelines [4]. POUR was created to streamline accessibility guidelines for websites [5]. It now can be used to evaluate accessibility, including educational materials [9]. Yet, little research has applied the POUR principles to CS education.

We picked VEX 123 as a product to examine due to commitment from VEX to make their technologies more accessible. Additionally, educational robotics are important for increasing student learning, motivation, and semse pf well-being [2]. VEX 123 is a hybrid educational robot aimed at pre-kindergarten through early elementary students; generally it is an entry point of CS education for the youngest learners [7]. VEX 123 is distinguished by its three ways to program: directly manipulating touch buttons on the device, tangible coding through a blue-tooth enabled coder and code card system, and programming done on the VEXCode online coding platform [10].

Figure 1: Three ways of coding with VEX 123

We created a professional development module for special education teachers on using the POUR framework to evaluate the CS education tools that they use with learners with disabilities. This module is part of a larger project funded by Google aimed at wide-scale professional development focused on computer science inclusion and accessibility. As part of the module, the teachers were asked to examine a technology they used in the classroom as well as taking part in a group discussion of VEX 123 and POUR. This

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poster presents the findings of the teachers' POUR analysis of the VEX 123.

2 TEACHER POUR ANALYSIS OF ROBOTICS

Data that was used as part of our understanding of how teachers used the POUR framework were: (1) Notes from meetings with the teachers as they described their experiences with the VEX123, and (2) materials that teachers created within their professional development course management system (CMS). These sources of data were deductively analyzed for themes within each of the POUR principles. POUR analysis data was classified according to concerns teachers brought up. Data from the meetings was categorized based on particular sub-questions for each POUR principle.

2.1 Perceivable

Teachers felt the three ways to code was useful and that the pictures were helpful to younger, preliterate children. One concern was that even though there was audible feedback, it was not necessarily loud enough in order to be heard; adding a bluetooth speaker was suggested. Another concern involved students having motor difficulties in particular with regards to getting coder cards in and out of the coder. Teachers also believed that braille for the coder cards would be helpful for students with visual impairments.

2.2 Operable

Like with perceivability, the teachers acknowledged that the touch-coding on the VEX 123 robot as well as the use of the coder cards allowed most of their students to engage in CS in positive ways. At the same time, teachers thought the coder cards might be problematic for students with some motor disabilities. Some were also concerned that some students might not be able to use the touch buttons and drag and drop independently.

2.3 Understandable

Teachers felt that VEX 123 was very understandable, especially the touch-coding robot. In fact, the physical output of the robot helped reinforce concepts that were otherwise generally abstract. Teachers did note different levels of complexity between the three ways to code, which allowed students with different experiences and levels of understanding to all engage with the computational activities. One suggestion that teachers made was to incorporate strategies for students to ask for help when they struggled with understanding computational concepts. For example, they suggested making "help" cards with messages about the level of help needed.

2.4 Robust

Teachers indicated that they struggled with making VEX 123 compatible with assistive technologies such as eye trackers and switches. This challenge sometimes involved understanding how the assistive technologies interfaced with the VEX 123 and sometimes was an issue of true compatibility. The pairing of devices could also be lost very quickly. Teachers had mixed opinions on durability with one saying it was durable when students dropped the device with another discussing the fragility of the board and strips.

3 DISCUSSION

There is growing research suggesting that educational robotics can support learners' understanding of computational thinking in engaging ways [7]. However, many of these studies have not focused on the inclusion of learners with disabilities [6], [**?**]. This study demonstrates POUR as a potential framework to address accessibility.

Although there are ways we could improve the accessibility module presented to the teachers, this study added to ways teachers can evaluate educational technologies used to teach computer science concepts with accessibility in mind. As demonstrated here, teachers voiced a variety of positives and areas of improvement. Analysis was tempered by the needs of teachers' students.

While we have concentrated on VEX 123 in this study, the POUR method is technology agnostic. Future work will incorporate a greater range of educational technologies used to teach programming. We also still do not have a deep understanding of how teachers may evaluate accessibility together or what students think of these technologies which form limitations of this work. Dyadic interviewing may form new perspective.s [3].

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