

Supporting Multiple Programming Approaches in Early Elementary School Computer Science Education

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Abstract— We present VEX123, a robot and accompanying set of programming tools designed for young learners (ages 5-8). VEX123 supports programming via three distinct methods designed to support young learners at various points along the conceptual and developmental programming trajectory. These methods allow learners to program the robot by: (1) pressing buttons on it; (2) using a physical Coder and Coder Cards to define a sequence of commands without interacting with a computer or tablet; (3) defining instructions with a block-based programming language on a tablet or computer. VEX123 is designed to broaden participation in CS education, make computing concepts more accessible to more learners who cannot or struggle to read and support learners at very disparate places on the prior knowledge and ability spectrum. Instead of prioritizing or favoring learners with prior coding experience or kids who have access to robots or tablets at home, the multiple entry points support a wider array of learners. To understand the effects of multiple programming approaches, we conducted a pilot study in a midwestern private school where over 70% of students come from economically disadvantaged households. Through the pilot study, we saw how the different forms of programming supported students at different ability levels and with different prior programming experiences. In this poster, we will present the three programming approaches, the design principles, and the results of the pilot study. This work introduces a new programming tool and a novel programming paradigm to the literature on how to broaden young learners' participation in programming.

Keywords—education robot, computer science education, programming

I. ENGAGEMENT GOAL

We hope to attend in person with VEX123 for audience to examine and play.

II. ENGAGEMENT GOAL

We hope to engage with the RESPECT community to share the design of our education robot VEX123 with multiple forms of programming as well as to receive feedback on our pilot study of the robot and data analysis. Sharing our work with the community will allow us to receive valuable insights and feedbacks and allow us to connect with others with similar works.

III. PROJECT TYPE

This project is mainly an educational technology along with a pilot study project of the robot VEX 123.

IV. PROJECT PHASE

This poster will present two aspects of our work. First, it will present the multiple programming methods of the education robot. Second, it will present preliminary analysis of data from the classroom, teachers and students' feedback from the pilot study.

V. RELEVANCE TO RESPECT

This work focuses on broadening participation in computer science education, especially for students who cannot or struggle to read and for students who had limited access to tablet or computers at home. This work builds on research from the RESPECT community focused on broadening students' participation in computer science education.