Fostering Communities of Practice: Insights from an Online Educational Robotics Professional Development Pilot

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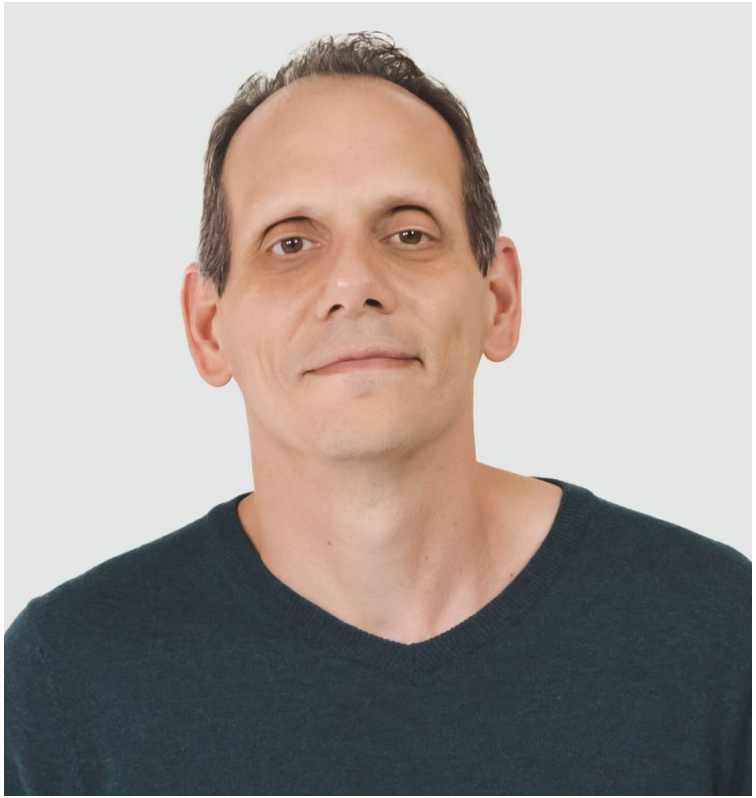
Lauren Harter is the Director of Instructional Technology at VEX Robotics and has a wide range of experience in education. From teaching in the high school setting to developing materials that teachers use in numerous countries, Lauren's experiences have shaped her contributions to the educational community.

Lauren received a double bachelors in Mathematics and Secondary Mathematics Education from Duquesne University in 2016. Shortly after, she began teaching high school mathematics at Serra Catholic High. For two years, she taught 9-12th grade Algebra I, Algebra II, Trigonometry, and Calculus to a wide range of students.

Lauren is nearing the end of her Doctoral studies and is conducting research in teaching practices that promote conceptual understanding in mathematics and teacher quality.

Jason McKenna



Jason McKenna is the Director of Global Education Strategy for VEX Robotics, leading the development of world class curriculum and classroom integration platforms. He collaborates with an expert team of software developers, educators and web designers who are the masterminds behind innovative curriculum and educational solutions available globally.

Joining the team in 2015, Jason's contributions reflect 25 years of expertise and leadership in the field. Respect for his many published works has led him to travel the globe sharing his learnings, and collecting global insights to inform VEX innovation. Jason's solution based approach ensures that smart, creative and research-supported tools equip teachers to confidently deliver impactful educational outcomes.

Jason holds a Masters degree in Curriculum and Instruction from Clarion University of Pennsylvania and is an active member of the Association for Supervision and Curriculum Development (ASCD) and the Computer Science Teachers Association (CSTA).

Abstract

Educational robotics is an effective tool for teaching and learning an interdisciplinary STEM curriculum. Yet, traditional teacher education programs often do not cover engineering and technology as part of the curriculum—most often excluding robotics entirely—leaving teachers underprepared for the application of educational robotics in the classroom.

To help close this gap, an online professional development program was developed and piloted for robots and curriculum spanning from kindergarten through high school. Preliminary results from qualitative observations and quantitative survey data indicate that this pilot program helped teachers increase interest, self-efficacy, robotics and coding knowledge, and develop a sense of community.

Future directions and research based on the results of this professional development pilot are discussed.

Introduction

- A meta-analysis of research concluded that educational robotics increases student learning across STEM topics.
- Yet, for all the benefits of educational robotics in the classroom, the inclusion of robotics instruction for formal teacher education is still lacking.
- Professional development programming could become not only an educational supplement for teachers, but a way to develop a community of practice across a diverse group of teachers.
- Research on virtual robots during the COVID-19 pandemic identified that teachers reached out to virtual communities to problem-solve, suggesting communities of practice may become a more commonplace solution for teachers seeking support for educational robotics.

Reason for the Study

- This study describes an online professional development pilot program for educational robotics.
- The goal was to create a structured series of synchronous learning sessions where teachers from anywhere could join to both develop their knowledge of robotics and computer science as well as interact with other educators using the same robotics.
- To evaluate the merits of this professional development pilot, participants were asked to participate in a pre- and post-survey that included topics of interest, self-efficacy, robotics and coding knowledge, and community of practice.

Methods

- The courses were designed by VEX Robotics. Their educational penetration offers formal, as well as informal, curricular solutions from pre-kindergarten to collegiate.

- One course was planned for each level of robot available (VEX 123, GO, EXP, IQ) but each course was designed in an identical fashion using a flipped blended classroom model. Only the VEX IQ and VEX 123 courses are described in detail for this paper, since those are the only courses that had teachers respond to both the pre and post-surveys.

- Teachers were to complete the work outlined in the syllabus asynchronously, and synchronous class time was designed as a one hour per week Zoom call to provide teachers with useful feedback, given the material and activities completed outside of class.

Results (VEX 123 Course)

- The VEX 123 robot and curriculum is intended for grades K–2, so the participants were early elementary school teachers.

- Most of the questions in the class revolved around how to get more out of 123 with their students. For example, how can I use 123 in more classes, how can I get more time for STEM and Computer Science, how can I work with more teachers? The class shared many strategies to address these issues, so the teachers did feel more confident about those things at the end of class.

- It was consistently emphasized during class that the class belonged to the teachers, and they could take the class into any direction that was most helpful for them. This helped to foster a sense of ownership for the participants. Teachers used the professional learning community site to share their weekly assignments.

Results (VEX IQ Course)

- The IQ robot and curriculum is designed primarily for middle school students, so the teachers in this course were grades six through eight.

- Participants not only increased knowledge about building and coding, but about the curriculum as well.

- Throughout the course, participants were encouraged not only to ask questions in the community, but also to share ideas they are currently using in their classroom, as well as images of this implementation. Teachers who had less experience gave feedback that they found it extremely helpful to be able to visualize how certain aspects of IQ were being implemented in a classroom.

- Posts from the professional learning community forum were shared during class in order to emphasize how useful it can be to not only talk to the VEX Experts, but also to other educators.

Results (Teacher Surveys)

TABLE I. MEAN SCORES FOR ROBOTICS SURVEY INSTRUMENTS.

Participant	Interest		Robotics Self-Efficacy		Robotics & Coding Knowledge		Community of Practice (CoP)	
	Pre	***Post***	***Pre***	***Post***	***Pre***	***Post***	***Pre***	***Post***
#1	5	5	62.5	82.5	4	4	5	4.25
#2	4.35	4.65	77.5	87.5	4	4	3.75	4
#3	4.5	4.95	60	72.5	4	4	3.5	4.5
#4	4.1	4.95	90	100	4	5	3.5	4.75
Total Mean	4.49	4.89	72.5	85.63	4	4.25	3.94	4.38

Teacher Surveys

- The surveys were voluntary, and ten teachers completed the pre-survey instruments. However, only four teachers also completed the post-survey, limiting the comparison to a very small number of participants.

- Even though there were four courses, only four teachers from the 123 and IQ courses completed the post-survey, so those are the two highlighted courses in this paper.

- The results in Table 1 show increased total mean scores for each of the instruments used.

- Robotics and coding knowledge only saw a small increase.

- The increased mean results for the community of practice instrument were also a promising result that aligned with the qualitative data from the courses.

Conclusions

- While the small number of responses to both the pre- and post-survey limit the conclusions that can be drawn, the results do provide positive indications that this online professional development program could help teachers in meaningful ways.
- The observations from the online classes and survey results both show increases in teacher interest, self-efficacy, knowledge, and sense of community.
- Another lesson learned was to offer the surveys in such a way as to maximize response rates for both the pre-survey and post-survey.
- Robotics and coding knowledge only saw a small increase. The increased mean results for the community of practice instrument were also a promising result that aligned with the qualitative data from the courses.
- Even though the sample size for the pilot was small, the experiences and successes of teachers using educational robotics in the classroom should be shared broadly to benefit the applied pedagogy and implementation of STEM curriculum for teachers and students alike.