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Incorporating Robotics into the Math Curriculum: A Handbook for the Sixth Grade Teacher

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Introduction

According to Ertmer (2005), in recent years, more educators and students have everyday access to technology in the classroom. As access to technology has increased, new innovative opportunities to educate students has provided ways to integrate robotics into the classroom. The belief that integrating robotics lessons into the math curriculum has helped increase engagement, while supporting and fostering positive attitudes of students, was a foundation for this project's design. However, the standard math curriculum supplied to teachers typically did not include support to integrate robotics. Teachers requested support through lessons to incorporate robotics into their classrooms, while teaching the Common Core State Standards (CCSS) in mathematics.

Background and Need

Learning mathematics had been considered a difficult task, especially when students felt they could not be successful due to previous feedback they had received (Dweck, 2006; Wise, Taylor, Becker, Gladden, Handy, & Thacker, 2007). Students overtime received feedback, from teachers and peers, which led them to have a fixed attitude about their abilities. When students experience repeated negative experiences, it reinforced a negative attitude that over time became a fixed attitude where students do not believe they can change their perceived beliefs. Over time, through this constant feedback, students became fixed in their attitude about their ability in math. Students who found math difficult were more likely to become disengaged in learning math, which led teachers to look for ways to engage all students.

The literature revealed significant gaps in science, technology, engineering and mathematics (STEM) subjects including teaching robotics and student engagement, specifically in intermediate grades. These gaps were noticeably higher when studying diverse populations. According to Weinberg, Pettibone, Thomas, Stephen, and Stein (2007), attitudes about math and engineering formed between the ages of eight and 11, when children were young. Another cause of poor attitudes in math, sometimes referred to as fixed mindsets, were established early in childhood by forces such as parent attitudes and gender stereotypes.

In order to provide support to disengaged students and reduce gender gaps in STEM related fields, teachers needed a resource to assist with teaching robotics and mathematics. The critical need of providing support to teachers was addressed through professional development for teachers, the creation of a robotics handbook to impact the significant gaps that were found in research, and help prepare all students for twenty-first century jobs. A handbook was designed to help teachers to engage students in rigorous problem solving using the CCSS Geometry standards (i.e., 6.G.A.1 Find the Area of Right Triangles and other polygons; 6.G.A.3 Draw Polygons in the Coordinate Plane), while learning robotics and coding.

Robotics Project Sample Lesson

Robotics Platform

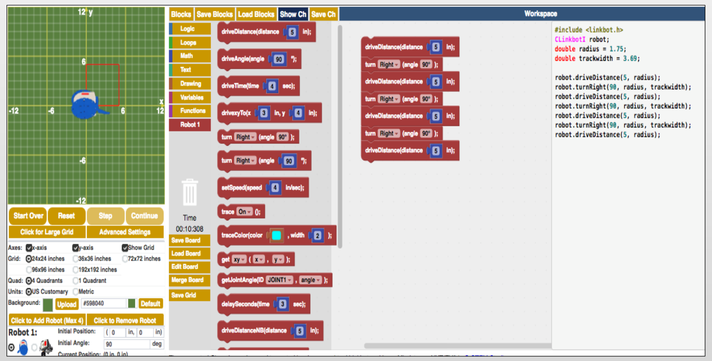
Project Objectives

The purpose of this field project was to develop a handbook and provide professional development for the teachers, which naturally lead to two specific objectives.

- Objective one was to design a handbook to provide professional development support on how to effectively integrate robotics into the math curriculum.
- Objective two was to provide useful information (i.e., lesson plans) to educate teachers on how to effectively integrate robotics into their math curriculum.

Project Design

In order to provide support to disengaged students and reduce gender gaps of STEM related fields, teachers wanted a STEM resource to assist with teaching robotics and mathematics. Robotics used as a hands-on tool to teach mathematical concepts, increased engagement in a non-traditional manner.



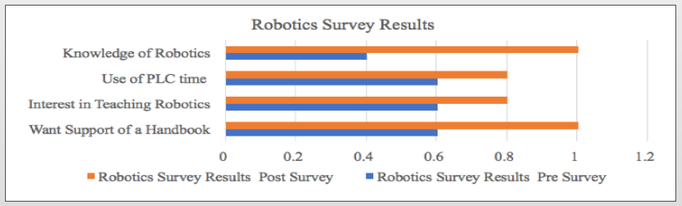
The field project designed a robotics handbook for sixth grade teachers in a Northern California elementary school. The purpose of the project was, if following the use of the handbook, were teachers able to implement robotics into the math curriculum? In order to design a robotics handbook for a team of sixth grade teachers at one Northern California elementary school, the researcher used the foundational knowledge from participating the the Computing-Science, Technology, Engineering, and Mathematics (C-STEM) project and informal conversations with the team. The action research model from Piggot-Irvine (2006) provided the platform for interactive feedback between the researcher and the participants. The model included plan, act, and reflect through three consecutive action research cycles.

Lessons in the handbook were designed using *Google's Suite for Education* applications including *Google Docs*, *Google Classroom*, and *Google Slides*. This facilitated easy sharing and feedback between participants and researcher.

Project Outcomes

The first objective included the design a handbook, which provided professional development support on how to effectively integrate robotics into the math curriculum. The handbook was developed using *Google's Suite for Education.* The interactive nature of the handbook implemented a structure, which supported teachers who wished to help students in meeting the rigor of the CCSS standards. The project handbook included specific, progressive lessons using *Google Docs*, the *Roboblockly* website, a list of the CCSS in geometry, surveys using *Google Forms*, assessments, and technology supports for the teacher.

The second objective provided useful information (e.g., lesson plans), to educate teachers on how to effectively integrate robotics into their math curriculum. The robotics unit lessons were based on an instructional mini-lessons which lasted 15 minutes with a coaching session for independent work of 20-25 minutes for time to practice the skill taught in the lesson The design of the project fostered collaboration between the teacher and learners who needed additional support and also allowed the teacher to assess needs and proficiency level before moving on to the next lesson, and enabled the teacher to provide intervention to students who showed they were still struggling with concepts.



Conclusion

This project included the development of a robotics handbook that integrated mathematics into the lessons. The evaluation of the project by teachers involved showed they were interested in implementing the lessons into current mathematics curriculum. Currently the lessons were being used in five, sixth grade classrooms with the idea to expand to fourth and fifth grade teachers next year. The professional development model which used professional learning community (PLC)meetings the researcher attended and provided training to take back to classrooms and implement will support the teachers who wish to try robotics in their classrooms

Works Cited

Dweck, C. S. (2006). Mindset: The new psychology of success. New York: Ballentine Books.

Ertmer, P.A. (2005) Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational technology research and development*, 53(4), 25-39.

Heinich, R., Molenda, J., Russell, J., & Smaldino, S. (1999). *Instructional media and technologies for learning*. Upper Saddle River, NJ: Pearson Education Inc.

Piggot-Irvine, E. (2006). Sustaining excellence in experienced principals? Critique of a professional learning community approach. *International Electronic Journal for Leadership in Learning*. (10)16, 532-575.

Weinberg, J. B., Pettibone, J. C., Thomas, S. L., Stephen, M. L., & Stein, C. (2007). Impact of robot projects on girls' attitudes toward science and engineering. *In Workshop on Research in Robots for Education* (Vol. 3, pp. 1-5). Atlanta, GA: RSS Robotics Education.

Wise, L., Taylor, L., Becker, D. E., Gladden, F., Handy, K., Thacker, A., et al. (2007). *Development of performance level descriptors for the california standards tests (CSTs) and high school exit exam (CAHSEE).* Alexandria, VA: Human Resources Research Organization.