Does a LEGO Robotics Activity Enhance the Engagement of Students in Learning Concepts of Science, Technology, Engineering, and Mathematics (STEM)?

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1. REVIEW OF LITERATURE

- Robotics instruction, including project-based learning and design competitions, has been introduced into science and technology classes at the elementary, secondary, and university levels with success (Carbonaro, Rex, & Chambers, 2004; Nugent et al., 2010; Petre & Price, 2004).
- Studies have found that students improve in their interest in science and technology (Petre & Price, 2004), improve their 21st century skills (Nugent et al., 2011), and achieve success in a problem-based learning (PBL) environment (Carbonaro, Rex, & Chambers, 2004).
- In the Kingston area, work by Greenspan et al. (2010) has reported positive outcomes using Lego Robotics activities.
- This study based its post-survey on the work of Nugent et al. (2010), who developed the 4H Robotics and GIS Interest Questionnaire, that was specific to a robotics environment.

2. PURPOSE

The goal of the robotics program and the study was to facilitate a LEGO robotics project in schools that would otherwise not have this experience, to enhance students’ engagement in STEM.

3. COLLABORATION

Collaboration of Institutions & Community Partners:

The project brought together interest and expertise from a variety of sources:

4. PROGRAM FEATURES

- Kingston Youth Arts Cooperative (KYAC) purchased 10 robotics kits through grant funding and hired seven instructors.
- KYAC leaders and instructors visited two classrooms with the robot kits weekly from October to March, guiding students in robotics activities.
- The class had combined levels of grades 6, 7, & 8.
- Robotics challenges fostered teamwork, problem solving, creativity, design, & programming.
- The program culminated in Lego Jam, a full day celebration of robotics activities with both schools.

5. RESEARCH METHOD

Data Collection included:

- Pre- and post-surveys showed minimal gains:
  - Science attitudes in various areas
- Teacher interviews and student focus groups revealed the challenges and benefits of this program:
  - Teacher X: “I could watch certain groups progress and become much more confident in making the robots.”
  - Student A: “Now, when I grow up, I want to have something to do with hooking up with technology.”
  - Student B: “I originally never really liked science. But knowing that that was science, I kind of got more interested. Because of the whole aspect that it was involving technology as well.”
  - Student B: “When you think of science, you think of chemicals and all that. This was actually really fun! You’re building this, you’re programming it.”

6. FINDINGS

- Qualitative data analysis revealed that the KYAC program helped teachers overcome three main challenges:
  1. Money: The funding to purchase the robotics kits.
  2. Mentoring: The professional development support needed to learn how to implement the robotics activities and the instructor support to ensure student support during the activities.
  3. Management: Overseeing the physical equipment as well as the planning of classroom activities and integrating topics with other lessons.

The KYAC program helped students in five main areas:

1. Gained technical expertise with robotics and programming.
2. Introduced potential career opportunities.
3. Encouraged perseverance in a non-evaluative context.
4. Developing interpersonal skills with both students and adults (instructors).
5. Provided authentic context for problem solving skills.

7. DISCUSSION

REFERENCES


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“A list of them are quick to quit on a task … With this, it’s a situation where they can look to their neighbor for help, or they can ask the Teaching Assistants as they come around the room. But because they are going to be competing, it’s a challenge, they’re more apt to not give up.” (Teacher, Y)

“It kind of proved that, I guess, that we can, not to give up. If you find something challenging, don’t just give up. You can think of a way to get around it and I guess that really applies to everything in school.” (Student C)