Introduction

When I was an elementary school teacher, I facilitated an after school Robotics club. The club met twice a week and recruited students from grades four through six. The Robotics club centered around the STREAM initiative: Science, Technology, Reading, Engineering, Arts and Mathematics. Our students' programmed Scribbler robots to complete technology, mathematics, engineering and critical thinking tasks. Example tasks included programming the robot to complete a maze or draw geometric shapes. The relevance of programming robots builds competencies such as critical thinking skills and problem solving and the expansion of students' knowledge beyond traditional forms of learning (Bransford, 2000). Other benefits to programming include the advancement of self-expression, expansion of content knowledge, and the development of problem-solving and design strategies (Resnick, 2009).

The Robotics club offered students opportunities to test and develop skills and create foundational knowledge. However, the Robotics club had areas for improvement, such as inconsistent software materials, unclear program structure, poor professional development for the facilitators and lack of students' choices in challenges and tasks. The implementation of a learner-centered environment would be beneficial to the success of the Robotics club. For the purpose of this paper, I will focus on the lack of student autonomy within the Robotics club and the role of facilitators using the learner-centered environment theory. I propose three elements that support the learner-centered environment: learners determining how they learn the content, activation of prior knowledge, and the incorporation of a constructivist environment. I will also provide strategies for the Robotics club to employ in order to alleviate its shortcomings.

Content Knowledge

The Robotics club was created to help students learn how to program robots. Prior to the club, more than half of the students were never exposed to programming software or the functions of robots. The other students had exposure from being in the club the year before. This was an opportunity for knowledge acquisition in a learner-centered environment because the knowledge, skills, attitudes and beliefs that learners bring to the educational setting could be utilized (Bransford, 2000).

However, the club did not create a space for students to choose their own style of learning or develop an understanding of programming. "We realize that most of the curriculum content is controlled by the teacher/facilitator; the students are not participants, they are observers," (Adams & Burns, 1999, p. 12). Not allowing students to be the creators of their own knowledge and guide their own learning, the Robotics club did not succeed in supporting competent twenty-first century learners (Intellectual and Policy Foundations, 2007). To be more supportive of learning, the facilitators should have allowed students to pursue their understanding of content through discovery, conversation, and completion of intellectual products. (Adams & Burns, 1999, p. 12). If the students in the club choose how they learned to program the robots, they would have acquired a wider range of content knowledge and independence in learning. "Knowledge is constructed through a variety of tools, resources, experiences and contexts," (Adams & Burns, 1999, pg. 26).

Content Knowledge Strategy – Student Led Content

To promote students' autonomy of attaining content knowledge, the facilitator can place students' in charge of creating the content and programming tasks (Lock, 2015). A practical application of this strategy would involve students' being responsible for creating the content activities and challenges for a specific week, similar to the setup of the Design of Learning Environment course. Students are learning how to facilitate the programming content knowledge in order to teach their peers a specific skill or application of a skill. "To support rich collaborative learning, students need to be 'active in their process of knowledge acquisition as they participate in discussions, search for information, and exchange opinions with their peers," (Lock, 2015, p. 148). Students' autonomy and confidence increase as they rely less on the facilitator and more on their own resourcefulness for knowledge-creation.

Giving the students' control of applying learning content will engage them in cognitive and analytical conflicts to further develop their critical thinking skills and engagement with content knowledge (Adams & Burns, 1999). Studies have shown that "having control over how one takes in the new information significantly improves one's ability to remember it," create meaning and engage with the content (Faisal et.al., 2012, p. 3). Students autonomy is cultivated when the learners take pride in their work and 'feel' the impact of their ideas and decisions in the education space. The idea of creating the lessons for the week supports the learners' unique experiences and personal connections to the content (Adams & Burns, 1999). If the students' in the Robotics club felt they had agency in the selections of tasks and applications for programming content, their engagement would be evident in the work they created and the learning gained. By employing this strategy, students connect with the content, construct meaning and take ownership of their learning and ability to program the robots (Lock, 2015). Students are producing their own knowledge through constructing learning and understanding.

Activation of Prior Knowledge

The activation of prior knowledge is beneficial to guide students' autonomy (Reiser & Tabak, 2014). Prior knowledge is needed in order for new information to be processed and internalized (Reiser & Tabak, 2014). The students who were previously in the club had prior experiences such as navigating the club's structure, programming content knowledge, and troubleshooting the robot and computer software. These students are considered to be the 'more knowledgeable peer' (Reiser & Tabak, 2014). With instruction and learning, "starting from the structure of a child's knowledge" (Bransford, 2000, p. 134) aids in the activation of prior knowledge.

The 'more knowledgeable peer' (Reiser & Tabak, 2014) possess prior knowledge of robotics programming and the critical thinking skills to solve tasks that will guide the new students' (newcomers) understanding. Meanwhile, the 'newcomers' are taking the prior knowledge from coursework and personal experiences and applying them to programming robots. “Environments that are learner-centered are consistent with the evidence suggesting that learners’ use their current knowledge to construct new knowledge and that what they know and believe affects how they interpret new information,” (Bransford, 2000, p. 153). In the Robotics club, students were not given opportunities to connect their prior knowledge to the tasks of programming a robot.

The facilitators did not fully grasp the students’ knowledge and abilities in relation to the Robotics club. This included students’ ability to devise math computations (determining how far the robot must turn), technology skills (utilizing the Scribbler computer program) and their understanding of the robot’s operations. Also, the facilitators did not recognize the potential of using the ‘more knowledgeable peers’ as guides for the ‘newcomers’ development of understanding programming concepts (Reiser & Tabak, 2014). Instead of getting to know the students’ goals, interests, range of academic knowledge and leadership potential, the facilitators jumped straight into the programming curriculum. “Learner-centered instruction recognizes the importance of building on the conceptual and cultural knowledge that students bring with them to the learning environment” (Bransford, 2000). This recognition presents opportunities for building students’ autonomy. Acknowledging the prior knowledge of the students would help the facilitators understand how to connect the Robotics club curriculum with students’ experiences and interests to create an autonomous learner-centered environment (Bransford, 2000).

Prior Knowledge Strategy - Scaffolding

Scaffolding is a strategy that impacts students’ ability to activate and utilize prior knowledge in the development of learning (Lock, 2015, p. 151). Scaffolding supports the students’ contributions and helps them make real world connections to the content (Reiser & Tabak, 2015). One way to scaffold involves question prompting (Reiser & Tabak, 2015). Prompts are sentence stems or questions that guide learners by asking specific questions about the process or suggesting actions (Reiser & Tabak, 2014). Prompting acknowledges students’ prior knowledge through the asking of specific questions about processes or suggesting particular actions (Reiser & Tabak, 2014, p. 52). Rather than providing the students with the solution to a task, such as programming the robot to navigate through a maze, facilitators prompt the students on their understandings of previous knowledge and misconceptions about robots.

Another approach places the ‘more knowledgeable peer’ (Reiser & Tabak, 2014) in the role of the facilitator to prompt peers about their understanding of challenges or tasks. With the ‘more knowledgeable peer’ the prompts help to regulate the sequence of relevant actions (Reiser & Tabak, 2014, pg. 45). Reiser and Tabak (2014) also describe how “scaffolding enables not only the performance of a task more complex than the learner could handle alone, but also enables learning from that experience,” (p. 45). This prompting will help the students integrate new knowledge their understanding of programming. In addition, this strategy reinforces the premise of a learner-centered environment that focuses on students’ foundational conceptual knowledge (Bransford, 2000). Lastly, scaffolding allows the self-determination of prompting choices and the of guiding an individual through the learning process (Reiser & Tabak, 2015).

Constructivist Environment

Constructivism details how learners construct their own knowledge based on environmental and experiential factors (Lock, 2015). The idea of a constructivist environment requires letting go of "old ways (e.g. teacher-directed instruction) and embracing new ways to empower students within learner-centered, knowledge-building environments," (Lock, 2015, p. 151). Evidence of facilitator-directed instruction in the Robotics club were the weekly programming packets. The packets outlined the activity of the day and step-by-step directions for completing the task. A list of instructions does not equal deep understanding of concepts or critical thinking development; this approach of instructionism is the opposite of constructivism (Lock, 2015). Lock (2015) implies that the approach does not give students' independence or ownership in their learning process.

Faisal, Kapila, & Iskander, 2012 state:

> "Learning through a constructivist approach is essential because students develop a conceptual understanding of the material being learned, rather than learning to recall information. Active learning allows students to learn to ask questions, construct their own understanding, and explain their ideas to others. Teaching strategies and environments that develop such learning in students allow them to respond to new situations and serve as a foundation for lifelong learning." (p. 2).

The Robotics club did not support students' understanding of how to program a robot. The club needed to allow students to create activities, explore or develop their own understanding of programming the robots. Students should feel free to learn through experiences, and be seen as active agents who construct their own knowledge based on prior experiences and interactions with new experiences (Reiser and Tabak, 2014, p. 44).

Constructivist Environment Strategy – Peer Mentors

To cultivate a constructivist environment, I would recommend the strategy of peer mentoring. Peer mentors support and guide their peers in making new discoveries and conceptualizing the content (Lock, 2015). Creating peer mentorship groups leads to the holistic and authentic development of students' understanding of robots and learning how to program (Lock, 2015). Authenticity and collaborations are developed because are students helping each other construct their own knowledge by making sense of the content and context (Lock, 2015, p. 145).

Peer collaboration creates opportunities for learners to internalize content knowledge and meaning from programming a robot. The strategy accesses students' autonomy and broadens their content knowledge of robots by making deeper connections with their peers and allowing freedom into the learning process (Lock, 2015, p. 148). The Robotics club would benefit from peer mentorship due to the strategy's ability to broaden students' content knowledge, their freedom to set goals and access their learning potential.

Conclusion

Learning theories are important tools for analyzing educational experiences and their efficiency (Bransford, 2000). The club had challenges which led to the lack of student autonomy. In order to develop students' autonomy, it would be beneficial for the Robotics club to utilize the learner-centered environment to help guide the program to success and longevity. The Robotics club should utilize the learner-centered environment to allow students to assume control over the content they learn, activate their prior knowledge and create their own meaning and knowledge through a constructivist environment. Along with these elements, it would be beneficial to implement the strategies of student led content 'lessons', scaffolding, and peer mentor relationships. The suggestions and strategies will increase students' autonomy and the success of the Robotics club.

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