COLLABORATIVE LEARNING IN STEAM TEACHING FOR STUDENTS IN THE CENTRAL AMAZON

Juliana Gisele Corrêa Rodrigues[1], Adan Sady de Medeiros Silva[2]
and Jucimar Maia da Silva Junior[3]
[1]*Post-graduation program in Biodiversity and Biotechnology from BIONORTE, Amazonas State University, Brazil*
[2]*Dept. of Meteorology, Amazonas State University, Brazil*
[3]*Dept. of Computer Engineering, Amazonas State University, Brazil*

ABSTRACT

The State of Amazonas has one of the most modern industrial and technological centers in Latin America. As a result, the search for skilled professionals for this job market is constantly growing. It is believed that STEAM teaching is an important tool to improve engagement, creativity, innovation, problem-solving skills, and other cognitive benefits generating more skilled professionals in the technology market. One approach that can be applied to STEAM teaching in schools is collaborative learning through maker culture. From mobile labs the STEM Academy Project takes STEAM teaching to high school students in public schools in the state of Amazonas. In the courses taught, collaborative learning is also applied in order for students to understand topics such as basic electronics, robotics, and programming, thus stimulating students' social skills and shared mutual learning, and attracting them to degree courses in STEAM fields.

KEYWORDS

Maker Culture, Social Skills, Cognitive Benefits, Mobile Labs

1. INTRODUCTION

The State of Amazonas is a Brazilian state located in central Amazonia. It is home to one of the most modern industrial and technological centers in Latin America, the Industrial Park of Manaus. As a result, the demand for qualified professionals to work in this market is constantly growing. It is believed that a tool that can train skilled professionals to work in this job market is STEAM education.

STEAM (Science, Technology, Engineering, Arts, and Mathematics) education has emerged as a new pedagogy in response to the need to increase student interest and skills in Science, Technology, Engineering, and Mathematics (STEM) (Quigley, Herro, & Jamil, 2017). STEAM education merges the arts with STEM subjects with the goal of improving engagement, creativity, innovation, problem-solving skills, and other cognitive benefits and to enhance employability skills (e.g., teamwork, communication, adaptability) needed for career and economic advancement (Root-Bernstein, 2015; Perignat & Katz-Buonicontro, 2018). As STEAM grows in popularity in schools, pedagogical models and approaches are proposed to employ this teaching methodology in these settings.

One approach that can be applied to STEAM education in schools is the maker culture. The maker culture has the potential to promote collaborative learning in education in formal and non-formal spaces, providing practical situations in which students are the protagonists in the construction of their own knowledge and the teacher is the mediator of this process, whether technological or manual. These spaces, whether in a school environment or not, awaken skills such as creativity, proactivity, teamwork, and manual skills in students and/or users, which are fundamental for the formation of citizens with a holistic and complete view of the universe around them (Medeiros et al, 2022). Therefore, this work aimed to employ collaborative learning in STEAM teaching for public high school students.

2. METHODOLOGY

With the search for more qualified professionals for the technological market, the STEM Academy project, developed by the Amazonas State University (UEA), has as one of its goals to take STEAM education to high school students from low-income schools in order to awaken their interest in science, technology, engineering, arts, and mathematics.

Courses are offered in mobile laboratories based on the maker culture. The Project's Mobile Laboratories are trailer-like structures transformed into Maker spaces and equipped with smart TVs, laptops, smartphones, 3D printers, laser cutters, among other electronic components and tools, and have a maximum capacity of 40 students simultaneously. The laboratory structure has 8 tables so that group activities can be developed (Figure 1a).

During the courses, which last one week, the participants learn concepts of microelectronics, robotics, programming, and Industry 4.0, when they build, along with the monitors, prototypes that simulate a semi-autonomous assembly line. First, classes are given on basic concepts about microelectronics, robotics, programming, and Industry 4.0. After that, collaborative learning is employed. Groups are formed where students are encouraged, through group activities, to solve challenges such as assembling a traffic light using Tinkercad software, printing parts in 3D printers for use in later projects (semi-autonomous assembly) and encouraging teamwork.

3. RESULTS

During group activities it is possible to verify the mutual shared responsibility, where everyone is responsible for the success or failure of the group. The engagement of students in solving the proposed challenges demonstrates teamwork and the sharing of knowledge. In these activities, they learn to relate to their peers, understand the opinions of others, and make decisions together. The proposed challenges make the students seek knowledge outside the maker environment, bringing solutions and ideas for the development of the activities. In this way students end up promoting collaborative learning because they are encouraged to develop the activities and challenges proposed during the course and characteristics such as autonomy, initiative, and leadership skills are observed.

Figure 1. A: Internal structure of the mobile laboratory; B: Group activity stimulating collaborative learning

In the last 8 months, the project has already assisted and certified approximately 1000 high school students, who, through their activities after the course, such as school activities in makers rooms and participation in events that involve the STEAM themes, it is possible to identify the interest these students have in the areas of science, technology, engineering, arts and math, developing indispensable skills for the job market, such as leadership, proactivity, and technical conditions to deal with technology. Another result we obtained with the course was the approval of students who took the course through the STEM Academy Project in undergraduate courses in the STEAM area at the Amazonas State University (Figure 2). Of the courses taken in December, 106 students were certified. Of these 106 students, 32 were approved at the University of the State of Amazonas, 15 of them in STEAM area courses, this shows a 47% conversion of the students who were approved heading towards the STEAM area.

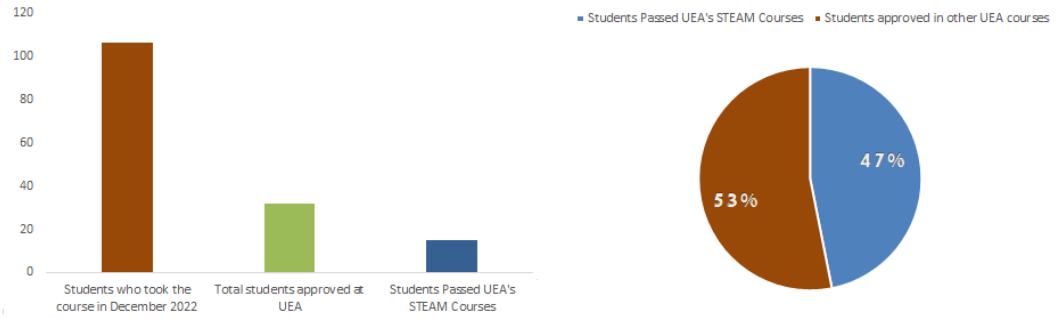

Figure 2. Students who entered the Amazonas State University and took the STEM Academy Project course

4. CONCLUSION

Thus, collaborative learning employed in maker culture through collaborative methodology in STEAM education becomes an important tool to improve engagement, creativity, innovation, problem-solving skills, and other cognitive benefits that will help students in the state of Amazonas to develop and be prepared for the complexities of today's world and to assume a leading role in the technological landscape, as well as direct them to graduate courses in STEAM areas.

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