

Empowering the Bucarabones Community Through STEAM Curriculum



FIGURE A: A FRONT VIEW OF THE CENTRO DE APOYO MUTUO BUCARABONES UNIDO (CAMBU) COMMUNITY CENTER

Sponsor: Centro de Apoyo Mutuo de Bucarabones Unido (CAMBU)
By: William Cifone, Lauren Harrison, Julie Kuhn, Brandon Lui
Advisors: Melissa Belz and John-Michael Davis
Date: February 28, 2024

Introduction

Since 2007, Puerto Rico's Department of Education has closed 673 schools, nearly half of the public schools in Puerto Rico (Abizeid, 2020). Schools are used by their communities as educational, health, childcare, after-school, and recreation facilities. Public schools also serve as a "third place" where people come together to build relationships and supportive networks (Rosenbaum et al., 2021). When a school is closed, a vital resource is taken away from the community. School closures lead to student enrollment decline, a drop in academic performance, and longer commute times (Rivera Rivera, 2022; Rodríguez, 2015; Yedidia et al., 2020). Puerto Rican communities have taken initiative to tackle the school closure epidemic through the rescued school movement, creating community centers and resilience hubs, building a strong sense of community, and providing access to basic resources and information (Qin, 2020).

Centro de Apoyo Mutuo Bucarabones Unido (CAMBU) is one such community center, born of the rescued school movement. Located in southwestern quadrant of Puerto Rico, CAMBU is in the rural town of Bucarabones, with a population of 115 and an average yearly income of \$20,133 (*Bucarabones Barrio, Maricao Municipio, Puerto Rico - Census Bureau Profile*, 2020). CAMBU has transformed one of the community's abandoned schools into an educational, cultural, and recreational development center.

This report represents the work of WPI undergraduate students submitted to the faculty as evidence of completion of a degree requirement. WPI routinely publishes these reports on its website without editorial or peer review.

Background

Due to the lack of STEAM-based opportunities in the public education system for under-represented groups — including Hispanics, African Americans, and women — students feel they will not excel in STEAM programs (President’s Council of Advisors on Science and Technology [PCAST], 2010). Furthermore, the Puerto Rican education system faces notable challenges and disparities, specifically in STEAM (Science, Technology, Engineering, Arts, and Mathematics) education.

Given that the education system in Puerto Rico is characterized by a standardized curriculum, teachers receive incentives for higher test scores and attendance (Rosa, 2021). Pressure to “teach to the test” has hindered teachers' motivation to incorporate qualitative interdisciplinary approaches (Jürges et al., 2005). Rosa (2021) argues such incentives motivate teachers to favor topics that will lead to high test scores rather than increase individual students' interests.



FIGURE B: STUDENTS ENGAGING IN AN AFTER-SCHOOL PROGRAM AT CAMBU

Outside the formal education system, community centers such as CAMBU step up to fill the gap. Through after-school programs, the adaptive education model associated with STEAM addresses the pitfalls found with the traditional education system, acknowledging the needs and experiences of individuals (Bell et al., 2009). Using project-based learning (PBL), a common approach in STEAM programs, is shown to promote greater levels of critical thinking, creativity, and engagement. Some after-school programs that supplement K-12 STEAM education are Destination

Imagination and Studio STEM. These programs utilize Discover, Define, Model, and Transfer (DDMT) to develop students’ curiosity, creativity, communication, and critical thinking (Wang, 2019).

Project Objectives

The goal of this project was to **empower the Bucarabones community by building STEAM-based programs to broaden opportunities for the youth and adults in the community. Our research was comprised of two main objectives:**

1. **Identify educational interests of the adult and youth population at CAMBU.**
2. **Develop and pilot lesson plans for beginner topics that can be implemented and adapted based on students' needs.**

Methods

We conducted interviews and observational studies to determine teaching methods and educational interests for CAMBU programs. During these observations and interviews we covered topics such as STEAM-based interests, pedagogical experiences, teaching experiences, and the successes and areas of growth for CAMBU.

The project then shifted towards developing beginner lesson plans. The previous insights from CAMBU members and professionals informed our topics of choice and teaching methods. We also referenced programs such as Destination Imagination and Studio STEM.

We then conducted pilot lessons at CAMBU with Ms. Fuentes's support. We chose to pilot a google sheets-based lesson for the adult classes and a physics-based lesson for the children's class. During the pilots, the group observed classroom behaviors and conducted post-lesson interviews to identify strengths, weaknesses, and areas for improvement. The lesson plans were then adjusted based on the observed results of the pilot.

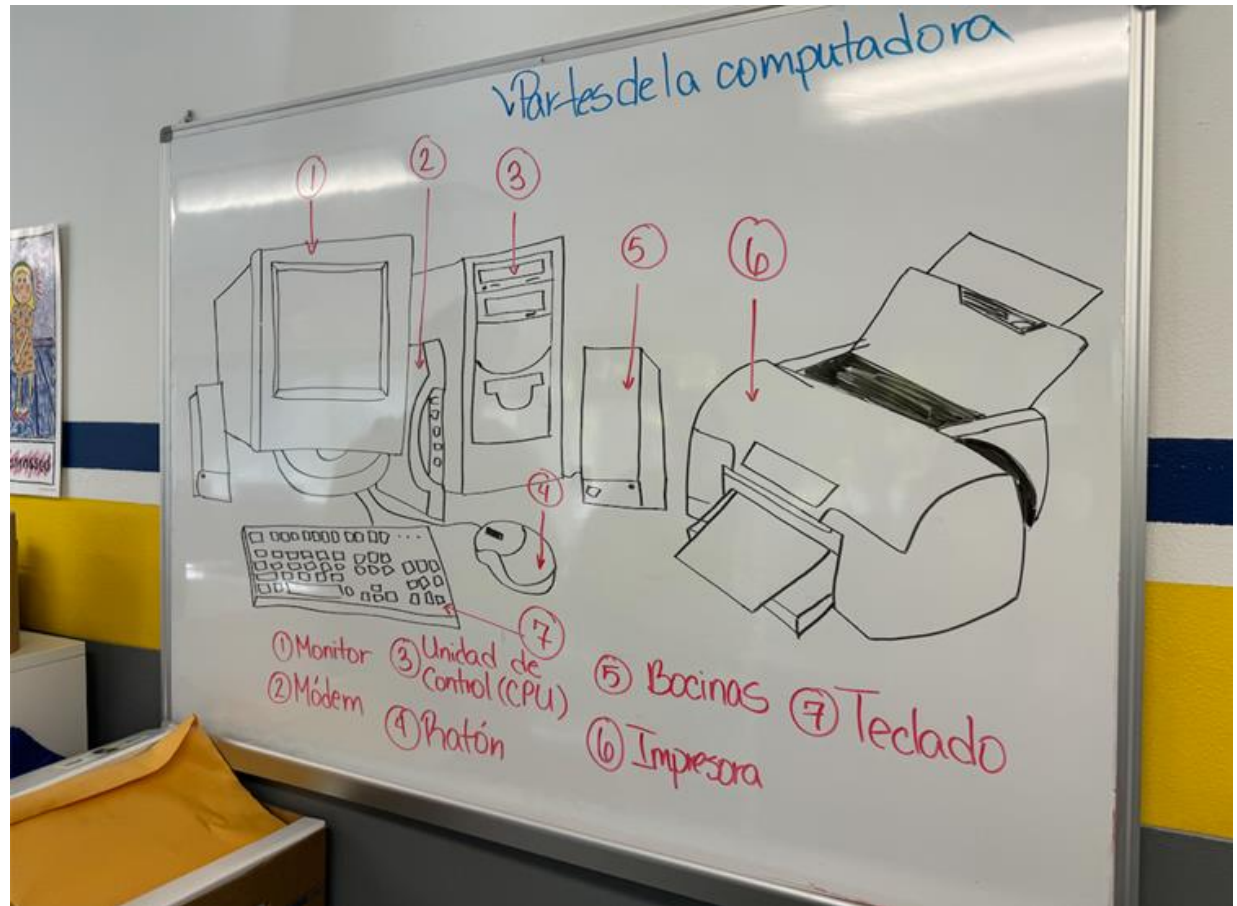


FIGURE C: A WHITEBOARD USED TO TEACH AT A COMPUTER STRUCTURE CLASS AT THE BOYS AND GIRLS CLUB

Findings

Through our interviews and observations of after-school programs, we noted the significance of hands-on learning. This hands-on learning approach ensures long-term engagement and enhances material retention, addressing the shortcomings of standardized teaching methods prevalent in public schools.

To determine engaging STEAM topics to implement into CAMBU, we used the information from interviews with CAMBU students and educational program professionals and considered CAMBU's budget of approximately 500 dollars per month and the materials available.

Based on these observations and interviews we created 21 lesson plans based on the following topics:

- Basic Coding (Scratch)
- Basic Coding (Java)
- Architecture
- Physics
- Chemistry
- Biology
- Google Sheets
- Research using Google Search
- Basic AI Literacy



FIGURE D: TEACHER DEMOING INTERACTIVE PORTION OF LESSON AT CAMBU

Lesson plans were developed with learning outcomes and structured to progress from beginner to advanced levels. The "I do, we do, you do" format was adopted to facilitate hands-on learning, incorporating group activities and independent work to reinforce the learning outcomes.

Following the development of lesson plans, we conducted pilot programs to

assess their effectiveness. The feedback from both adult and youth classes highlighted the need for improvements in flow and clarity, particularly in transitions between the lecture and activity. We adjusted based on observations and student feedback, including the addition of key terms at the beginning of lessons, multiple additional activities for faster-paced classes, and slide decks for visual representation during lectures.

Additional learning resources were provided to enhance instructors' understanding of the lessons and improve retention among students. Detailed explanations and graphics incorporated into the lessons allowed for an easier grasp of the concept by the student. The adjusted lesson plans were reviewed by the main CAMBU instructor, Ms. Fuentes, to ensure clarity and effectiveness in achieving learning objectives.



FIGURE E: STUDENTS PARTICIPATING IN PHYSICS ACTIVITY



FIGURE F: TEACHER GIVING INTRODUCTORY LECTURE FOR GOOGLE SHEETS LESSON

Conclusion

Our project aimed to empower the Bucarabones community by building STEAM based programs to broaden opportunities for the youth and adults. Through our interviews and observations, we created a set framework of engaging STEAM-based curriculum that empowers CAMBU students amid the public education learning gap.

The goal of our lesson plans was to provide CAMBU with the material and resources to teach weekly STEAM-based programs to students. We designed the lesson plans to be low-budget, easily understandable and applicable to the students' daily lives. To empower students for future opportunities, these lesson plans will encourage students to broaden their view of possibilities.

The collection offers a year's worth of lesson plans and is the first step in opening doors for CAMBU's growth. The anticipated growth includes higher student

attendance, engagement, and interest in STEAM-based careers. Through our project, we believe the developed curriculum supplements the empowerment

of future CAMBU students in the face of socioeconomic challenges.

Introduction

Begin by showing the students the Plants Native to Puerto Rico. Discuss with them the plants that grow in Bucarabones. Ask students, "Think about what plants grow around the Bucarabones community. Do you know any of their names? What do they look like?" Then go into the follow up questions.

Plants Native to Puerto Rico:



Seagrass Stiff

Bristle Fern

Golden Pathos

Follow-up Questions:

1. "What are some similarities you can identify in all these plants?"
2. "Does anyone know how plants gain their energy?"

After giving them time to brainstorm, let them know that this activity will involve looking into how plants utilize chlorophyll to grow.

FIGURE G: EXAMPLE OF THE INTRODUCTION PORTION OF A LESSON PLAN