

# ***Infrastructure of Community Engagement Using the Isabela Boys and Girls Club FabLab***

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**Abstract** — *There is a need to develop a volunteering culture in order to sustain or to provide a better quality education to the next generation of Puerto Ricans, given the fiscal situation the island is facing. STEM related careers represent the best chance of developing an economy that can compete with the global market. The FabLab, located in the Isabela Boys and Girls Club provides an environment that exposes youth to the makers culture which will teach them about STEM related careers and the skills necessary to compete in the college and labor market. Developing an infrastructure of tutorials and design projects by volunteers that currently work in STEM related careers may ensure that participants develop basic skills required to aspire to venture in to a STEM related field. The volunteer work of the Pro-Bono volunteers has been calculated to be more than \$18,000. This investment of time and knowledge, that otherwise had to be incurred by local government, is a positive externality that will serve the best interest of the community when they become of age.*

**Key Terms** — *Positive Externalities, Volunteer, STEM*

## **INTRODUCTION**

Puerto Rico is facing a critical point in its history. All aspects of life will be affected by the current fiscal endeavors that the community will face. For many years the central government has not had the financing capabilities to sustain basic services for its citizens and the quality of these have been reduced. This environment pushes concerned citizens and responsible government officials to develop alternatives that will sustain the basic

services. Bold and new ideas have to be attempted and an evolved culture has to be introduced in order to achieve this goal. This has to involve investment by the private sector and private citizens that donate their time and knowledge for developing a new infrastructure that will benefit the local community in a short term and long term. Citizens within communities need to get involved in the needs of their communities and develop a structured infrastructure that welcomes the help of potential volunteers. In particular, it is important to strengthen the development of youth that will serve as productive citizens and that will benefit the local community [1].

Future competitive careers in the global market are within the STEM areas. It is imperative that the new generation of students are heavily influenced by the prospect of competing in these markets. The private sector in Puerto Rico has stepped up and with significant help of other donations, have invested in creating the foundations of a FabLab in the Isabela Boys and Girls Club. A FabLab, or Fabrication Laboratory, is a place that is equipped with computer aided tools that are considered flexible and that can manage a wide array of materials.

There are Isabela FabLab has a router, a CNC, a 3D printer, a Laser cutter, Vinyl cutter as well as basic construction tools. It is very convenient that this laboratory is within the premises of the Boys and Girls Club of Isabela. The prospect of having youth directly exposed to tools and materials that will inspire them to enter the DIY or Makers culture will enable the local community to be more involved into making the exposure to STEM topics even more possible. This scenario represents a great opportunity to develop the desired infrastructure

that enables potential volunteers with STEM related knowledge interact with tools that they value and provide guidance to youth on how to work with them.

## **METHODOLOGY**

To achieve a positive impact in the community with minimum monetary investment and improve the probability of developing successful and productive youth, there are many steps that need to be planned, executed and iterated in order to achieve the goal of developing the desired infrastructure. Also, it is in the best interest of government and the community to develop positive externalities. It is desired to increase the supply, demand and quality of educational services. These are:

- Set up a plan - The desired goal is to have an integration of the community by developing a volunteer infrastructure such that there is an incentive to donate time and knowledge to the FabLab. This would require to coordinate with Boys and Girls Club management the approach that need to be taken in order to have a successful implementation of this effort. This would also require to understand the needs and desires of the youth being impacted by the modules that are developed.
- Recruit Volunteers - The effort requires people that are committed to help with this effort. Many people live busy lives. Developing modules based on STEM requires time and effort. It also requires people that possesses STEM related knowledge. The most important part of the recruitment is to have volunteers motivated to come back consistently.
- Analyze possible future state by extrapolating results - Based on gathered data an analysis will be made to calculate the positive externalities of having volunteers working in the Isabela Boys and Girls Club FabLab.

## **VOLUNTEER INFRASTRUCTURE PROJECTS**

The core of this project is the development of the workshops and tutorials that will serve as the knowledge base and skill development between the tools and materials in the FabLab and the youth in the Isabela Boys and Girls Club. The goal of the development of these projects is to, in some cases, standardize the way youth learn so it is consistent and easy to follow. This will make more attractive the idea of investing time and knowledge back to the community. There are several projects that have been developed. These projects are:

- Camshaft Tutorial - The purpose of this tutorial is to develop CAD skills and present them with the concept of circles, rectangles, angles, and all other geometric figures that can be used to develop an idea in their minds into a solid they will be able to print. These tutorials will be saved in YouTube and will be expedited when there is a participant interested in learning about CAD. The development of video tutorials that will present in a step by step process the sketch and 3D designing using a CAD program. The Camshaft tutorial consists of 4 parts: Base, Link, Piston and Rotational Device. The videos can be supervised by one volunteer and at least 4 participants can take the tutorials at a time.
- United Way Auto and Motorbike Design - This design was an initiative that could be used to promote the FabLab. This is a one-time design challenge that will expose youth to concepts of machine design and project management. This design challenge is for an award that is going to be given to outstanding supporters of the community. It consists of an award portraying a Ford Mustang and another portraying a Motor Bike. It is a modular design that should include a base, a gear mechanism, including material and bike/car model. This design will be manufactured using FabLab tools and low cost materials. Although this is a onetime project, it will inspire volunteers and participants to develop similar projects in the future. This

project was imparted by two volunteers and impacted 5 participants.

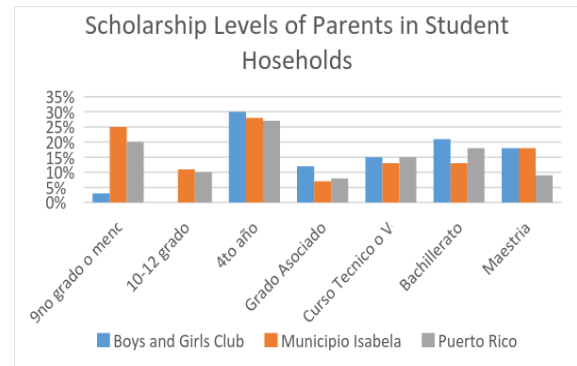
- Hardware tutorial - This tutorial is important because it teaches the basics on all hardware in the FabLab. This tutorial is aimed at youth as well as volunteers. A tutorial was/will be created for the 3D printer, the router, the CNC, the Laser cutter and the vinyl cutter. A safety training will also be created to ensure all participants understand the safety culture inside the FabLab. This tutorial can be imparted at any moment that the FabLab technician understands is necessary.
- Hydroponics workshop: a new project is being developed related to what represents the agriculture of the new century. This workshop will teach students on how to set up their own hydroponics as well as basic knowledge of crops that can be grown and how to take care of them. This educational project will enable participants to grow their own food and may serve as a small business opportunity as well as food sustainability within their homes and communities. It will be imparted by one volunteer and at least participants can learn from this personalized mentorship program.
- Submarine Design Challenge – this new project aims at developing the design and construction of a submarine. The participants need to weld, develop a water proof cavity and design and build a control that fits all the necessary hardware to control the submarine. This design challenge will be imparted by two volunteers and will impact 4 groups of 3 participants at a time. This design challenge will also have the additional factor of competition, which boosts the desire of participants to be part of the activity.

All these activities have been measure in terms of time spent at developing such tutorials. The results from the analysis will serve as data points to be presented to all volunteers to keep them motivated. It is important to present them with the data that proves their impact in the community and

how it is important that they support the effort they are making on the long run.

## ANALYSIS

Motivating youth to participate in extracurricular activity significantly reduces the probability of them getting involved in illicit activities, sexual behavior and actions that do not represent the best interests of their future selves. Also, since volunteers working on the FabLab have a STEM related degree they serve as role models that have achieved more than what the average parent achieves. Figure 1 shows the scholarly level of parents of participants in the Boys and Girls Club. Most parents have a scholarly level lower than a bachelor's degree. The initiative aims at developing the base for youth to explore STEM related topics so they are inspired to explore carriers based on what the competitive market will look like when they become of productive age. It is imperative that youth have experiences that create a path for them to follow. Michael Bloomberg has recently donated \$50 million to the Boston Museum of Science [2]. He says that being exposed to the science environment in the museum has been the most important influence that his parents could have provided.



**Figure 1**  
**Scholarly Level of B&G Parents**

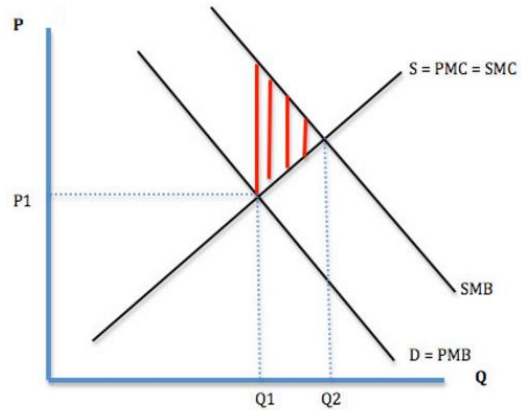
All the tutorials were developed with the help of volunteers that had knowledge about STEM topics. These volunteers can be categorized as Pro-Bono. These value of volunteering time is currently estimated as \$23.56 per hour [3]. The effort of developing the projects in an organized way started in June 2016. More than 4 hour per week have been donated by 14 volunteers. This totals 768 hours as

of today. The value that this effort has been introduced can be amounted to \$18,094. To put this into perspective, the effort by a portion of these volunteers will affect at least 2 participants at any given moment. Some tutorials are given in a video format and can be easily accessed by anyone within the community.

The effort invested by volunteers can be considered a positive externality. A positive externality occurs when a product that is consumed causes a positive benefit to a third party [1]. In this case, on top of the positive externality consumed by students in getting an education, which is a private gain that benefits the society, the participant will also benefit at acquiring knowledge that would not have been possible to acquire in the standard school curriculum. Also, participants are encouraged to share that same knowledge with other participants. Educating other people will benefit those interested and in the future, society may benefit from the taxable income of a productive member of society that may work in a STEM related career. Science and technology careers earn \$65,000 on average. Non-STEM majors earn \$15,000 less [4]. This means that the tax base will increase as a result of having more people producing in STEM related fields.

The chart below shows a general example of positive externality which can apply to the Boys & Girls Club Isabela FabLab Volunteering Infrastructure. The y axis represents the cost of a product or service P and the x axis explains the quantity in the market for the market demand. Q1 represents current status, which is having no infrastructure program that exposes youth to STEM related modules and projects. Q2 is the desired state at which the investment of education will maximize at current demand. SMB is the Social Marginal Benefit and PMB is the Private Marginal Benefit. PMC is the Private Marginal Cost and SMC is the Social Marginal Cost. By improving the quality and quantity of education, which will have no cost and which has been estimated at \$18,000 of volunteer work, which will increase the external benefit. This is shown in the red area in the chart below.

Also, it is desired that a culture of one hour a week is established in order to sustain the growth of activities in the Boys and Girls Club at the same time that cost are kept at a minimum.



**Figure 2**  
**Positive Externalities Chart**

## CONCLUSION

The analysis and project evidences the need of volunteering in the STEM related educational environments. Citizens mostly give a monetary contribution to charity or local community efforts. These contribution is subsidized and incentivized by tax credits. This has encouraged the supply of merit goods. In this case, all the hardware necessary to build a FabLab. Although investing in the community strategically can improve the quality of life of some people, the culture of caring for others has to complement their efforts with volunteering. Volunteering programs are implemented there will be a positive contribution to society. In this case, the cost of educating youth in STEM related fields comes at no cost to the government. STEM related careers are the future competitive job market. The project achieved the development and implementation of tutorials and workshops that are repeatable and that motivates youth to explore STEM related activities. This infrastructure, which can be imparted by people who possess basic STEM related knowledge motivates the community to volunteer and expose youth to STEM related fields will serve the best interests of future generations. It is concluded that this effort creates positive externalities [5] to the Isabela Boys and Girls club since the paid employees, with the exception of the FabLab technician do not possess the STEM related knowledge needed in order to create tutorials and projects. Also, participants will become more interested in STEM related fields and the probability

of constructing a career aligned with this vision will expand the tax base.

This project developed the infrastructure and based on empirical data presents a projection on how this infrastructure will impact the community. However, the positive impact will be seen in a long term. Unfortunately, these processes will take time and it will not be possible to assess the full extent of the impact this effort may have.

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