Implementation of a STEM Summer Enrichment Program in a Low Income Community

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Dr. Salman A. Siddiqui received his B.S., M.S. and Ph.D. degrees from Florida State University, Tallahassee, FL, from the FAMU-FSU College of Engineering in the field of Electrical Engineering in 2000, 2002, and 2012, respectively. The M.S. degree was in the field of communications while the Ph.D. degree was in the field of Robotics. He has a passion to teach and to make it interesting and simple for students to advance in the field of Electrical/Electronic Engineering and STEM in general. He has been teaching as an adjunct Professor at the FAMU Electronic Engineering Technology program since 2010.

Implementation of a STEM Summer Enrichment Program in a Low Income Community

Studies have shown that providing adequate social and academic support from early stages of the education process of a child increases graduation rate in K-12 along with the number of freshmen students entering higher education[1]. With constant inflation and inevitable recessions, the cost of living today is higher than ever. It becomes a problem when a student who needs just a little extra help cannot get it because the teacher has over 40 students, both the parents work to provide for the household, and good tutors cost too much. This coupled with other social and economic issues, creates a certain path for failure for students that come from low income households. The number of underrepresented and low income students dropping out of school continues to increase yearly and the graduation rate gap between this group of students and their counterpart continues to widen. With the help of educational institutions, local and national governmental entities, and the community, this trend can be changed[2, 3].

This paper presents the experiences of implementing an intensive summer program (Community Summer Training and Enrichment Program –CSTEP) in a low income community. The project was structured into three phases: The first phase constituted of supporting students from k-12 academically; the second phase was to support parents with technical skills necessary in workforce to earn a better income; and the third phase was to explore the idea of a learning garden designed to teach students essential concepts and terminologies in STEM (Science, Technology, Engineering, and Mathematics) fields while playing. This paper covers phase 1 of the research experience. It presents the curriculum developed for CSTEP, results of the program, analysis of program in terms of the challenges and goals achieved and plans for continuous improvement and future expansion.

Low Income Housing and Communities

The low income housing is administered by the Public Housing Agency (PHA), which has 1,835 housing choice vouchers in its Section 8 program. This program is federally funded by U.S. Department of Housing and Urban Development (HUD), which subsidizes the rent for eligible very low-income families, the elderly, and the disabled to afford decent, safe, and sanitary housing in the private sector. The rents for the housing units must be reasonable and pass the Housing Quality Standards (HQS) inspection of PHA, who conducts the inspections and determines the fairness of the rent request. The Section 8 eligible family pays a percentage of its income for shelter and utilities (generally 30% to 40%) while the PHA pays the difference directly to the owner of the rental unit[4]. A family that is issued a housing voucher is responsible for finding a suitable housing unit, of the family's choice, where the owner agrees to rent under the program. This unit may include the family's present residence. Under certain circumstances, if authorized by the PHA, a family may use its voucher to purchase a modest home. There are three special purpose voucher programs in Section 8[3, 4]:

1. Mainstream Program – Vouchers exclusively for persons with disabilities.
2. Family Unification Program – Vouchers for persons referred by the Department of Children and Families, whose children have been removed from the home or

are at risk of being removed, and the lack of affordable housing is a contributing factor.

3. Foster Care Youth Transition Program – Vouchers for youth aging out of the foster care system that are wards of the state. This program only serves clients referred from the Department of Children and Families.

To be suitable for the implementation of the summer intensive program, a housing complex must be 100% under Section 8. In addition, the housing complex must have a community center where enrichment programs can be offered. These community centers would provide the perfect environment to support this type of program due to proximity of housing complex and a safe environment for the students.

Community Summer Training and Enrichment Program – CSTEP

The community summer training and enrichment program (CSTEP) is an outreach program in Science, Technology, Engineering and Math (STEM) intended to support K-12 students and parents who reside in low income communities and in the surrounding areas. There are three main goals with this initiative: (1) support local students academically by exposing them to engineering through robotics, science through cooking, arts and crafts through hands-on activities, leadership skills through sport competitions and various other programs; (2) support parents by providing them with technical skills necessary in the workforce; and (3) explore the idea of a STEM playground.

The first phase of the program was launched this past summer 2012 solely by volunteers from local universities and from the community. First, the program organizers started by establishing relationships with various community centers to set up the grounds for the summer program. Volunteers visited the centers throughout the year to provide academic assistance to the resident students. This allowed the organizers to single out a center that would be more suitable to implement the CSTEP program as a pilot. This decision was based on the needs and the size of the community. The idea was to maximize the impact of the program in order to create a solid basis for expansion to other community centers in the future.

Once the center was selected, the first phase of the program was launched with the following goals:

- Provide tutors for all subjects to students of all ages and of all levels
- Expose young children to the STEM fields
- Organize science expos and competitions (e.g., Brain-Bowl competitions, Mouse trap cars, Bridge building, Egg drop competitions, etc.)
- Hold academic, technical, and professional development seminars to help students of all ages assimilate and adjust to new technologies or new policies regarding any subject that may influence or affect students in any way
- Plan field trips to expose children to new ideas and creative ways of thinking
- Invite professionals from various industries to come and speak to the children and give them insight into their current interests and majors

Program Logistics

When designing a program which involves children, it is essential to follow state and local guidelines in order to ensure their safety and well-being.

Table 1 Forms included in the Registration Package

Form	Purpose
Participant Registration Form	Acquire personal information from students and parents/guardian
Release Statement	Release and forever discharge the Camp, its units, agents, volunteers and employees from all claim of liability for any damages or injuries which may be sustained while my child is at camp
Author Consent to Publication	Grant permission for the Camp organizers to publish any work in any publication, including website and blog, using participants first name, last initial, and age
Photography and Videotaping Release	Grant permission for the Camp to photograph/videotape participants while they participate in program activities
Authorization for Treatment	Grant permission to the medical personnel selected by the camp directors to order treatment and necessary transportation for participants
Authorize Student Release	To authorize release of participants to someone other than the parents/guardian.
Field Trip Permission Form	To grant permission for participants to travel off site with staff and volunteers from the Camp to attend field trips and any other activities.
Participant Guidelines	Describes the program guidelines to be followed by participants and parents/guardians.
Participant Agreement	Signed by parents/guardians and participants agreeing to follow the participant guidelines
Disciplinary Policy	Describes the disciplinary procedures to be used in case a participant continuously breaks the behavioral guidelines imposed by the program

Thus, one of the challenges was to make sure that the volunteers were properly screened and did not pose any danger to the children and the community. Being that we were dealing with minors, it was required to have the proper forms from the parents signed in order to avoid legal drawbacks. Most of these forms were included in the registration package. Table 1 shows the complete list of forms used in the initial phase of the program.

The program had a total of 30 students from ages 7 through 13. Table 2 is a breakdown of participants' ages, grades, and gender. There were a total of ten student volunteers, two instructor volunteers and assistance from two part-time employees from the Section 8 housing complex.

Table 2 Participant Demographics

Grade Level	Age Group	Male(s)	Female(s)	Total participant per grade level
1st	6 to 7	1	2	3
2nd	7 to 8	1	2	3
3rd	8 to 9	4	1	5
4th	9 to 10	6	5	11
5th	10 to 11	2	2	4
6th	11 to 13	3	1	4

In addition to these common logistics, there were regulations related to the institutions involved. Most institutions have procedures and guidelines to be followed when being used to support initiatives in their communities.

Program Curriculum

The CSTEP program was implemented from June 11, 2012 to August 17, 2012. The curriculum was designed to cover the entire week (Monday through Friday) from 2:00 PM to 8:00 PM, making it a very intensive program. This time frame corresponds to the time the students were out of school for the summer break. The program aimed to keep these youngsters out of the streets throughout the summer and expose them to several fields creatively, i.e., engineering through robotics, science through cooking, arts and crafts through hands on activities, leadership skills through sport competitions and various other programs. Each week was dedicated to a specific topic as illustrated in Table 3. Different activities, within the topic, were carried out from Monday to Thursday. Friday was reserved for field trips, games, videos and special speakers on the topic of the week. The topics covered per week were arts & crafts, science and technology,

robotics, sports & recreation, multicultural experience & social skills, nutrition & hygiene, African American experience, performance & art, and computer literacy. At the start of each day, a short lecture related to the topic was presented by the professors or presented through a video. The topic of the day and the educational goals were introduced at that time. The educational portion was normally embedded in the daily activities in a fun and playful way. The goal was to make the learning environment less structured and more unconventional to stimulate students' interest in learning. In addition, students were tested before and after the subject topics were presented to gauge their understanding of the topics.

Table 3 Weekly Curriculum and Educational Goals

Week (s)	Topics	Educational Goals
Jun. 18 – Jun. 29	Arts & Crafts	Geometry, Shapes, Critical Thinking, System of Measurement, Artistic Imagination
Jul. 02 – Jul. 06	Computer Literacy	Computers, Files, Folders, Saving, Copying, Pasting, Printing, MS Office
Jul. 09 – Jul. 20	Science &Technology	Engineering, Math, Physics, Robotics, Electronics
Jul. 23 – Jul. 27	Sports & Nutrition	Animal and Food Science, Chemistry, Biology
Jul. 30 – Aug. 03	Multicultural Experience	Music, Dance, Food, Religion of different countries around the world
Aug. 06 – Aug. 10	Performance Art	Reading, Writing, Poetry, Singing, Dancing, Acting
Aug. 13 – Aug. 17	Exposition & Celebration	Presentation, Networking, Social Skills

Arts and Crafts

Arts and Crafts were covered from Jun. 11 to Jun. 29. The educational objectives included geometry, shapes, system of measurement, artistic imagination and critical thinking. Using the art of Paper Mache, students were introduced to shapes, primary and secondary colors, artistic imagination and critical thinking. When designing the Marshmallow Catapult and Popsicle Stick House students were also introduced to some construction technology such as the house foundation and the general structure of a building. They also used clay to explore their imagination.

Figure 1 Arts & Crafts Activities: (a) Clay Work, (b) Popsicle Stick House, and (c) Painting

All components of this topic involved critical thinking as the students would conceptualize, build, and paint their art & craft pieces using their creativity. On Friday, the students were taken to the local park to play and paint. Figure 2 depicts some of the work from that week.

Computer Literacy

Computer literacy was introduced early so that the students would get an early start working on projects that involved computers, such as writing and presentations. During the week of Jul. 02 to Jul. 06, students were introduced to basic concepts of computer hardware and software. Folders and file structures were presented and shortcuts for saving, copying, pasting and printing were introduced. Finally, Microsoft Office was introduced with emphasis on Microsoft Word and Power Point. The community center was equipped with ten computers with internet access and one networked printer. The computers were updated and maintained by volunteers from the summer program.

Science and Technology

During the weeks of Jul. 09 to Jul. 20, students were introduced to general engineering concepts. The different fields of engineering were then presented with several activities in each area. Mathematics and physics concepts related to engineering problems were also presented. In the field of electrical and electronic engineering, there were two interesting activities that served as the platform to introduce many engineering concepts. The first one was the use of an electronic snap circuit kit. Students built many circuits in the manuals that accompanied the kit. Some concepts introduced were power and energy conservation, energy storage types of circuits, conductors and insulators, resistors, current, voltage, and electromagnetism. Figure 2 (a) shows some of the circuits built by the participants. Figure 2 (b) illustrates the students participating in a robot competition among themselves. The robotics platform used was Boe-Bot from Parallax. In this exercise, students learned the concepts of robotics, microcontrollers, hardware, software, motors, and sensors.

Figure 2 Science and Technology Activities: (a) Electronic Circuits and (b) Robotics Competition

Sports and Nutrition

During the week of Jul. 23 to Jul. 27, the subjects of sports and nutrition were presented. These areas served as an easy way, through fun activities, to present topics in food science, chemistry and biology. Presenters emphasized the importance of a good nutrition and regular exercise as related to learning, staying healthy and longevity. Hygiene was also introduced during this week with emphasis on microorganisms that cause different illnesses. Some of the sports activities included basketball, softball and running. Figure 3 shows some students practicing during the basketball activity.

Figure 3 Sports and Nutrition Activity

Multicultural Experience

The multicultural experience aimed to introduce the students to different cultures from around the world. Social skills were introduced during the week of Jul. 30 to Aug. 03. Students were taught how to deal with people from different backgrounds and to be receptive to others independent of their ethnicity.

Figure 4 Multicultural Experiences (Music and Food)

Music, dance, food, and religion of different countries around the world were introduced by volunteers and professors from different countries. The countries included the Cape Verde Islands, Ghana, Nigeria, Peru, Puerto Rico, China, and Jamaica. On Friday, a Potluck was organized where food and music from different cultures were presented. Figure 4 (on left side) shows African drummers playing and (on right-side) some of the food from different countries.

Performing Art and Celebration

The week of Aug. 06 to Aug. 10 was dedicated to performing arts, while the week of Aug. 13 to Aug. 17 committed to exposition and celebration. During the performance arts week, students were introduced to reading and writing techniques, poetry, singing, dancing and acting. Students used the performance arts week to write poems, songs, and practice acting and singing for the following week. During the last week, the students presented their work to the parents and the community. They danced, acted, recited poetry, presented research and demonstrated their work. Parents and guardians participation was at an 80% level.

Program Analysis and Conclusions

Implementing this summer program presented several challenges for the organizers, volunteers and participants. Offering a program such as this requires financial support. Unfortunately, the call for financial support from local businesses and institutions were not heeded. The program

was supported completely by contributions from the volunteers and professors. Contributions included volunteering time, and financial and material resources.

Apart from the financial constraints, there were inherent difficulties dealing with the community itself. It required extra effort to have parents participate and understand some of the guidelines required of the program to meet its goals. Secondly, there were also behavioral issues which caused additional tension with parents and guardians. For instance, when a student misbehaved repetitively, he or she was sent home with a note of the incident with the hope that the parent would talk to the student. Many times this did not work as planned. In some cases the parents stormed into the center demanding an explanation, in other cases they punished the kids. Lastly, the second goal of the program (support parents by providing them with technical skills necessary in the workforce) was not well received by the residents. The parents' willingness to change and the lack of infrastructure such as funds may be the causes of unsuccessfulness. A solution to this problem would be to build long-term relationships with the adults of the community and solicit financial as well as counseling support for the participants to increase the likelihood of successful results in all phases of the program. Furthermore, building community relations to build support for adult programs would make it easier for adults to participate as an environment would be set for them just as it was for the children.

In conclusion, the overall goals of the first phase was successfully implemented and achieved. All the students showed a lack of knowledge on the subjects prior to the activities. After the presentations and activities, student performance, whether oral or written, were substantially higher. Another obvious success was the introduction of STEM topics and terminologies that the youngsters had never been exposed to. The hands-on experience with the robots and circuits kit were some of the highlights of the program as the kids had never been exposed to such practical topics before. Furthermore, feedback data was collected for the third phase of the project, i.e., the learning garden phase of the project. This portion will be implemented in the future, possibly with an NSF or DOE grant.

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