Work in Progress: Education Beyond Borders – Efforts of a Student Chapter to Foster Education and Promote Academic Excellence in STEM Fields

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Her primary research interests include investigating students' understanding of difficult concepts in engineering sciences, especially for underrepresented populations. She also works in the development and evaluation of various engineering curriculum and courses at UPRM applying the outcome-based educational framework.

Work-in-Progress: Education Beyond Borders - Efforts of a Student Chapter to Foster Education and Promote Academic Excellence in STEM Fields

Abstract:

This paper describes the student chapter organization of the American Society for Engineering Education at the University of Puerto Rico, Mayagüez Campus (ASEE-UPRM), who serves primarily undergraduate Hispanic engineering students in the US. This chapter focuses primarily on promoting member's academic development and leadership skills, but also design and execute outreach experiences for high school students to increase their interest in STEM fields. Our goal in this paper is to share the different activities that were carried out and the impact on different student populations (college and high schools).

Background Information:

Our student chapter is hosted at the University of Puerto Rico, Mayagüez Campus (UPRM) which is the second largest enclosure of the public system in the island. UPRM was founded in 1903 as a land-grant institution and holds a total enrollment of 13,224 students for the academic year of 2018-2019. These numbers represents 12,321 undergraduate and 903 graduate's students who are pursing master and doctorate degrees. Also, overall 54% of the students were males and 46% were females. At the College of Engineering (CoE) there was a total enrollment of 4,732 undergraduate students, distributed into 9 academic programs. In addition, 27 % of the CoE undergraduate enrollment consists of female students.[2] According to the ASEE by Numbers for Undergraduate Enrollment publication[3], our institution is ranked first with respect to Hispanic Tenured/Tenure-Track Faculty by School; second place of Bachelor's Degrees Awarded to Hispanics by School and eighteen place on Percentage of Women Tenured/Tenure-Track Faculty by School. For the academic year of 2017-2018 the university had 150 organizations in general. Our chapter was the only that focused on promoting both engineering education and STEM careers on students around the university and the island.

Constitution of the ASEE-UPRM:

The ASEE-UPRM is a student organization that has served, since its establishment in 2016, as the premier multidisciplinary society for individuals and organizations committed to advancing excellence in all aspects of Engineering and Technology education (vision).[1] Our mission is to advance innovation, excellence, and access at all levels of education for the engineering profession.[1] When initially founded, our chapter only had 15 members from all engineering disciplines. By 2017, the chapter increased its membership to 72 students and for the year, 2018, we already have reached 116 members, all of them are undergraduate engineering students. This represents an increase of 131% and 47%, respectively. Out of those 116 members, 60 students (52%) are female.

Members of the ASEE-UPRM pay an annual subscription fee to be part of the organization and acquire benefits for all the exclusive events. The membership subscription is extended to all

students admitted to the institution regardless of their major. The organization holds bimonthly meetings which are open for all members and students at our institution that are interested in being part of the chapter.

In addition, the chapter has an executive board whose role is to organize and oversee all the activities during the academic year. The board's candidates are nominated by members and then selected by a process of interviews with the former board. The executive board's responsibilities and duties are determined by the organization's bylaws.[1] The board is divided into three main committees which are: (1) Executive committee (President, Vice-President, Secretary, Treasurer and Sub-Treasurer), (2) Development committee (Historian, Outreach Leader, School Oriented Leader, TISAM Leader and Vocals), and (3) the Marketing committee (Fundraiser Leader, Promotion Leader and Membership Leader) (Refer to Figure 1). The board meets once per week to inform, discuss, and take decisions about members duties and upcoming activities.[1] We also have the support of our faculty advisor, Dr. Aidsa I. Santiago-Román, and administrative support from the staff members appointed at the academic department that hosts the association, the Department of Engineering Sciences and Materials.[1] Together we work in tandem to achieve the chapter's established goals.

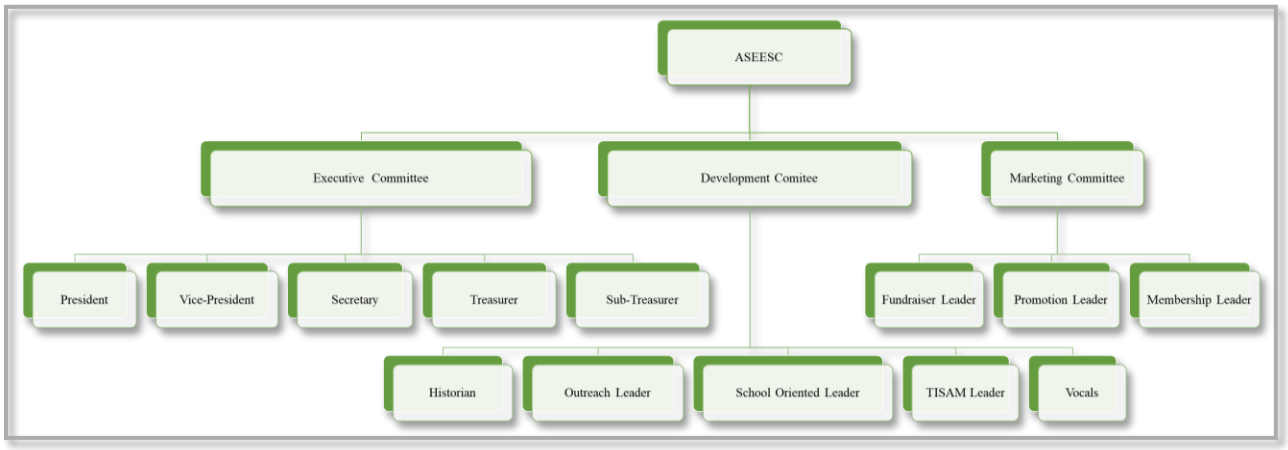

Figure 1 – ASEE-UPRM Organization

Our main objective is to work with educational institutions and industries to improve engineering education and promote student academic development and leadership skills. A secondary goal is to provide unique outreach experiences to high school students from around the island to increase their interest in pursuing a degree in STEM fields.[1] To complete these goals, a series of activities have been designed, planned, and executed through the academic year.

Members of the student chapter (all undergraduate engineering students) under the guidance of our academic counselor have established an ambitious plan for this academic year. Because there are no limits to education, we expect to expand our activities and impact more students, specifically in parts of the island where traditionally no students apply to STEM-field degrees. In this paper we provide a description of the activities that have been executed and the impact to not only the chapter members, but also members of the student population at our institution and abroad.

Organization's Committees and Planned Activities:

The activities organized by the association are divided in four main areas: (1) professional development, (2) community service, (3) outreach, and (4) fundraising. A committee has been established for each area to assure their effective planning and success. A description will be provided in the following sub-sections.

Professional Development: The activities are targeted to member and non-members of the association. They include offerings of a variety of workshops, info-sessions, and other professional development activities to help members improve their knowledge and leadership skills in different areas within engineering. The activities executed so far (for the current academic year) have impacted more than 215 students. The professional development committee is responsible to oversee, plan, and execute all of these activities within the university community and the communities of Puerto Rico. This committee provides professional and academic development to members through different workshops, seminars, and special projects. The workshops offered are in the topics of programming languages, design software, resume building, resume reviews, and professional development. These workshops are offered once every month. The seminars offer an opportunity for members to network with professionals from companies, such as Honeywell Aerospace and JC Automation, interns, professors, and research students. These interactions prepare participants to obtain new experiences and knowledge.

Community Service: The planned activities are targeted to the general community. Specifically, we host volunteer events to promote social awareness within members of our student chapter to improve their knowledge in their fields while serving targeted and under-served communities. It has been found that participation in volunteer work promoted interactions among peers.[3] Some of the activities organized by the committee include cleaning Puerto Rico's beaches and also help non-profit organizations that hosts foster children abused by parents by giving them hope and helping them with any needs they have. Finally, members also organize breakfast events for homeless. The most recent community project was created on November 2018, called "Semilla de Esperanza" (Seed of Hope in English), where members of the ASEE-UPRM visited one of the most affected communities by hurricanes Irma and María. In this visit members offered STEM toys to kids as Christmas gifts. This is an on-going project whose main purpose is to help and promote STEM education to citizens that were affected by these devastating hurricanes in September 2017. Many students from these communities had suffered difficulties not only in their personal lives but also in their education since many schools were closed for almost the entire 2017-2018 academic year. This project is about bringing joy, hope, happiness, and education to different children of the affected communities. With "Semilla de Esperanza" the community service committee has impacted more than 130 kids and their families and is looking forward to impacting more communities in the future.

Outreach Activities: These activities are targeted primarily to high school students from various public schools around the island. The outreach committee consists of members who are mainly alumnus from Puerto Rican public schools and would like to give back in appreciation of the education they acquired that allowed them to be academically successful at our institution.

In 2016 the association innovated with a new massive event call *Engineering Fun Day!* (EFD). The EFD event is performed once a year impacting high school students and their parents. The main objective is to explain parents and students the benefits, opportunities, and areas of emphasis that each engineering field offers at our campus; to provide students with real hands-on experience that represents the work of an engineer; and to help them answer questions about each engineering field. One of the students impacted by this activity said the following:

"I was determined to choose a career in engineering, but I did not know whether to choose electrical or computer engineering. Thanks to the activity I was able to choose computer engineering to obtain studies in hardware, but also in software. I would recommend it to all students, with or without uncertainty about which career to choose, so they can experience how engineering works and fall more in love with it."

Meanwhile, parents participated on an Informative Panel composed of representatives (deans, department heads, faculty, staff, and students) from different campus offices such as admissions, financial aid, academic affairs, student affairs, medical services, academic departments, etc. The objective was for parents to have the opportunity to learn more about the different opportunities available and ask questions about related topics. Also, we provided parents with a psychologist to give them tools to manage the transition from high school to college-life that their children (and them) will experience. During the first year, the program received 56 high school students and their parents. Last year, despite the devastation that occurred from the passing of the hurricanes, we had a participation of 105 students, which represented a 61% increase. This year we received 216 students and 130 parents, which represented a 69% increase. Also, we were able to impact 47 of the 78 municipalities of the island. One of the parents reacted to the EFD when asked about his experience as follows:

"This is a very well organized activity. I'm impressed with that these students are doing and their professionalism. I was able to answer many questions and clarify many concerns I had about my son coming to the "Colegio". I will recommend this activity to my friends for next year."

Other outreach programs that have been established are the School Visits and the Tutoring in Science and Mathematics (TISAM). The School Visits program focuses on giving high school students, from different levels and social status, orientations to help them gather a concrete vision of each one of the engineering fields offered at UPRM. The program promotes students' interest and engagement in their field of study but also fosters their creativity and sense of belonging that will result in a successful career. Since the approval of the program, it has impacted six of the seven educational regions of the island with a total of 520 students of elementary, middle, and high schools. On the average, we have impacted six schools each semester, over a period of five months. In the short term, our goal is to impact the last educational region which includes our two island municipalities were the number of students attending college is very low, especially in an engineering degree.

On the other hand, the TISAM Program, focuses on offering academic assistance and guide to high school students in the areas of science, math, and professional development. Academically talented students in math and science from selected schools are chosen by their teachers, to become peer tutors to their classmates and friends that have any deficiency in these areas. At each school,

the progress of those students is assessed at the beginning and at the end of the academic year. One of the high school leader said the following about the program:

"The most gratifying thing was to be able to help other students that had any struggles in the areas of mathematics and science and see how this helped them to get a better grade in their exams."

When asked, a teacher commented the following about the TISAM program:

"I'm very enthusiastic about this effort. Students are very excited to be working with college students they look up to. The efforts and dedication the students from the organizations are putting to this activity is admirable, even more since it is completely voluntary. I hope this project continues…"

In addition, each month members of the ASEE-UPRM prepare workshops to high school students with the goal to improve their knowledge in areas such as programming, professional development, etc. This program was founded in 2017 as a pilot program in a school located in the central part of the island and impacted approximated 130 students. This year, the program has been active with two schools in different municipalities, impacting approximately 310 students. Our members work jointly with the TISAM leader at the school, to develop different activities such as College Board Reviews and a Career Day. The Career Day is a yearly activity that includes Info Tables where college students from different STEM concentrations (bachelors and master's degrees) help high school students understand the differences between careers, and the opportunities that these fields offer. This project promotes the chapter mission, encourages high school students impacted to pursue STEM careers, and encourages interest in engineering education among our chapter members.

Fundraising Activities: The fundraising committee focuses on developing two or three activities per month in different buildings and places around or near campus. All chapter's members are invited to participate. Participants have the opportunity to acquire leadership skills that can be transferred into their professional environment. All the money raised in these activities is used to cover the expenses of the previously described activities and projects that the chapter hosts. So far, for this academic year, the chapter has raised around $2,500.

Also, this year the association implemented a system of points in which members are recognized at the end of each month with different prizes for their participation, donations, and commitment to the chapter and the activities organized. All of the committees, projects, programs or activities that the chapter sponsors allows members growth professionally. One of this year new member provided the following feedback:

"Being a member of the ASEE-UPRM has helped me professionally and personally. The workshops for resume and mock interviews were of great impact. Also, participating in the "Engineering Fun Day" influenced greatly on my decision to pursue a degree in engineering and in this institution. I would recommend others to enter the ASEE-UPRM, because members are always active helping others by offering tutoring, visiting schools, or giving community aid."

Conclusions:

The ASEE-UPRM seeks to continuously improve and expand the impact of their activities to students abroad. So far, we have already surpassed our proposed goals and we have become more ambitious. We also strive to influence more students around the island to choose a career in STEM. Our next steps will be to reach more cities across the island and influence twice as much students than we have impacted so far for each of our initiatives and projects. The chapter wishes to continue promoting education, and in the future and to be able to impact not only students, but also their teachers and academic counselors, since they are fundamental in the education process.

Acknowledgements:

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