

Workshop to Increase Women's Enrollment in Technology Discipline at the Community College

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Abstract - The enrollment of women in our Engineering Technology program at Queensborough Community College (QCC) is as low as 3 %. The challenge is that while technological change is rapidly expanding opportunities in every discipline today, the number of women entering technical studies remains low. The gender gap in academic technology could be due to the lack of opportunities for female students to be exposed to technology. Accordingly, female students rarely chose technology disciplines as their first choice in academic fields. The opportunity we are suggesting is that we can evoke and boost the women's interest in technology disciplines thru exposure to cutting-edge technologies including 3D printing and cloud computing. A workshop can be offered where students design a variety of products in CAD software and 3D print them. The workshop also includes exposure to cloud computing and machine learning. Students develop and host a website to chronicle their workshop experiences using HTML, CSS & JavaScript. The workshop exposes students to Design Thinking and leading-edge technologies while building their interest, involvement and personal confidence in technical domains. During the summer of 2018, we offered this practical, technical, project driven workshop and successfully provided technology-learning opportunities to 35 female QCC students.

Index Terms – Coding workshop, Project-based learning, Women in technology, 3D-printing,

BACKGROUND

The enrollment of women in Engineering Technology program in Queensborough Community College (QCC) is as low as 3 % according to the combined data of Fall 2013 and Fall 2016. Computer engineering was 7% of women and computer information was 14% of women for the same period. Degrees granted in STEM disciplines in City University New York (CUNY) from 2016-2017 represents only 20% and 23% of women in Technology (including Computer Science) and Engineering majors respectively compared to 62% of women in Science disciplines [1].

While the number of women enrollment in technology field remains low, the rate of job demands in technology fields is drastically increasing. [2] According to [3]-[4], the U.S. is

graduating only 52 % of the trained workforce in the technology related job demand. Filling the gender gap and job demand in technology field is challenging in its education.

The gender gap in academic technology field is due to many reasons. One of the reasons can be the cultural and social stereotypes of the gender role. Since young ages, the female students have fewer opportunities to be exposed in the technology. Therefore, technology disciplines are hardly chosen to be their first choice for female students in academic fields [4]. The author of the book, 'Girls Who Code' mentioned that "developing curriculum with girls' interests in mind and teaching in ways that girls prefer, such as project-based work, is needed to keep them engaged" [5]. Competitive environment in the technology-related classes may be other reason that the technology discipline is less attractive for the female students. Students feel distressed being a minority especially if the majority of the class is the opposite gender and when you have to compete with them [6].

Hence, innovative curriculum to get more young women started on their education and careers in technology discipline is necessary. So, we devised a summer pilot program that would engage women students with technology under the friendly environment. The program is a workshop type that applies a project-based learning pedagogy and focuses on two components, 3D printing makerspace and coding experience. Our summer program invited and offered priorities to the female freshmen students in all majors. This proposal, however, differs to those institutes where their classes are offered to only female students. The female students class model presumes that numerous female students already have interest and motivation of learning in technology discipline. In this program, we are proposing a specific intervention to evoke and boost the interest in technology from the students who were in lack of exposure in technology discipline.

Community college is the place where students explore their interest, potential and capacity that they could not discover it from high school. Community college offers a great opportunity for these students to decide their future academic and career goals through their experiences. Most of community college students transfer to the senior college to continue their desired study. Therefore, early positive technology experiences in community college through the proposed practical project are expected to increase the interest of technology discipline for young female students.

PROGRAM DESCRIPTION

The workshop was split into two groups. First group attended on August 6th -10th and the second group attended on August 13th -17th, 2018. By leveraging the QCC Advanced Manufacturing Lab (Figure I), the main objective of our program was to expose female students to the state-of-art technology.

I. Recruitment

The participants of the program were newly QCC enrolled women students in all majors for 2018 Fall semester. During the 2018 Fall admissions, QCC Admission Office cooperated to send out the invitations to all of the newly admitted women who start in the 2018 Fall semester. Since the objective of the program is only promoting interest in technology, there were no particular criteria to recruit the students. The program offered on a first-come (applied), first-served basis. Each session was fully registered with waiting listed students. We invited 20 first applied students per session, a total of 40 students were invited to the workshop, and 36 students completed full programs in the workshop.



FIGURE I

ADVANCED MANUFACTURING LAB AT ENGINEERING TECHNOLOGY
DEPARTMENT IN QUEENSBOROUGH COMMUNITY COLLEGE

II. Program Curriculum

The curriculum was focused on two components, 3D printing manufacturing technology and web development coding skills.

- **3D printing manufacturing technology:** The workshop curriculum exposed students to 3D computer design (CAD), additive manufacturing and metal casting by offering a course in 3D printed design. The students were trained to design a product in CAD software, print it on a 3D printer in wax, and then have their design cast into metal by the lost wax casting process. The students had a hands-on introduction to additive manufacturing, CAD design, Design Thinking, and metal casting. This introduction is designed to empower the student to further develop their proficiencies through self-study. All of the topics covered were prevalent in today's workforce and would extend to the students' enhanced employability. The students had their designed products 3D printed and we use these takeaways as transition tools to the next topic-web development.
- **Web development coding skills:** In this section, the students were exposed to coding experiences. We asked the students to develop and design a website as a showcase of their previously 3D printed products. This project-based learning curriculum boosted their

motivation and interest. The students experienced to build and host websites by implementing the fundamentals of front-end web design using GIT, atom, HTML5, CSS3, Angular JS, Zurb Foundation and Amazon Web Services (AWS). In addition to familiarized to web design and cloud computing, students were exposed AI (Artificial Intelligence), Machine Learning, and Natural Language Voice Processing.

ASSESSMENT

The metric to evaluate the project outcome is to measure the participants' technology related *CUNY Pathways* courses registrations in the following semesters. *CUNY Pathways* courses are general Common Core education requirements for students, which can be taken as elective courses. The benefit of *CUNY Pathways* courses is that these general education credits can be carried over to any other CUNY college when students transfer within the CUNY system.

We suggested three technology related *CUNY Pathways* courses from the Engineering Technology (ET) Department - Creating Smartphone Apps, Introduction to C++ Programming Design and Implementation, and Computer in Modern Society. These courses are open to the all-major students, there is no pre-requisite required, and regularly provided in the ET Department, QCC. The followings are the description of the suggested courses.

- *ET 570- Creating Smartphone Apps:* This course introduces the use and features of smartphones in modern life and how to create working applications. Students will create apps using existing modules and building blocks.
- *ET 575-Introduction to C++ Programming Design and Implementation:* This foundation course provides a general understanding of the use and development of computer software applications in fields such as science, mathematics, and business using a high-level computer language.
- *ET 821-Computers in Modern Society:* This course examines computer's effect on modern life. We look at how computer work, what they do, where they can be used, what they are capable of, what happens when they fail, and how they are used and misused. Topics included gaming, entertainment, communications and social networking, encryption and cryptography, data security, piracy, copyright, governmental regulation, and related issues.

The workshop participated students were informed and guided with priority, after sessions, to register any of the suggested courses upon their interest. Registering technology related courses, after participating summer program, would show the evidence of the interest expansion in technology discipline for students.

As of Fall 2018 semester, about 14% of the workshop participants registered and completed any of these courses. Spring 2019 registration is still open, thus final number of registrations are not yet counted. Figure II shows the majors among participated students that registered technology related

courses in Fall 2018. The chart shows that 40% of the participants were liberal art majored students who registered in the technology related courses. This evidences the effectiveness of the workshop that we provided positive exposure in technology to non-STEM majored students.

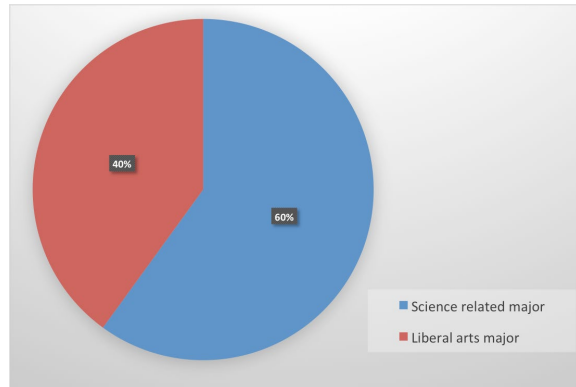


FIGURE II

MAJORS AMONG WORKSHOP PARTICIPATED STUDENTS THAT REGISTERED TECHNOLOGY RELATED COURSES IN THE FOLLOWING FALL 2018 SEMESTER

SUMMARY AND CONCLUSION

Reducing a gender gap in the academic field is necessary since current enrollement of women in the technology field is very low while job demand in tech is increasing drastically. Hence, we devised the workshop type of summer program to evoke and boost the interest in technology from the female students who were in lack of exposure in such discipline. The objective of the program is to expose students to the basic of science and technology, to build up students' confidence in their ability, to equip students with skills that help to further their knowledge, and to equip students with requisite knowledge for moving into third-level education. The contents of workshop focused on introduction to digital age, careers in technology fields, insight of future technology and inspiration to innovate. The workshop included 3D printing manufacturing technology, an exposure to cloud computing, and machine learning. Students also developed and hosted a website to chronicle their workshop experiences using HTML, CSS & JavaScript. We provided two sessions of full day workshops for five days in summer 2018 inviting 40 women freshmen students in all majors. A total of 36 students had early positive experiences in technology through the practical project and the college life. Students also explored careers in tech fields and insight the future in digital age. The enrollments of technology related *CUNY Pathways* courses among the participated students were suggested as an assessment tool. 14 % of participated students registered one of these courses which shows their interest expansion. Assessment analysis will be concluded one or two semesters later when the participated students graduate. Overall, we were able to, through the summer workshop program, facilitate, encourage and enable a significant increase in the participation of women in fields related to technology.

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REFERENCES

- [1] CUNY Student Data Book, Degrees Granted in science, Technology, Engineering and Math (STEM) Disciplines by Gender: 2016-2017 <http://www2.cuny.edu/about/administration/offices/oira/institutional/data/> Web. Accessed: May, 2018.
- [2] T. P. DiNapoli and K. B. Bleiwas. New York City's Growing High-Tech Industry Report 2-2015, <https://www.osc.state.ny.us/osdc/rpt2-2015.pdf> Web. Accessed: May, 2018.
- [3] Current Labor Statistics 2013, Bureau of Labor Statistics, United States Department of Labor. <https://www.bls.gov/opub/mlr/2013/> Web. Accessed: May, 2018.
- [4] National Center for Educational Statistics, 2014. Web. Accessed via <https://tech.cornell.edu/impact/witny/>
- [5] Reshima Saujani. "Girls Who Code." Penguin Books, August 2017.
- [6] Grant, Donna M., et al. "Fostering Technology Interest Among High School Girls." Encyclopedia of Gender and Information Technology, edited by Eileen M. Trauth, Idea Group Reference, 2006, pp. 349-354. Women and Gender Studies, http://link.galegroup.com.qbcc.ezproxy.cuny.edu/apps/doc/CX3467600069/GVRL.women?u=cuny_queensboro&sid=GVRL.women&xid=d aa840b3. Accessed 20 Nov. 2018.

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