

Paper: Overcoming Comfort Zones to Better the Self-Efficacy of Undergraduate Engineering Students (Tricks of the Trade) (WIP)

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Overcoming Comfort Zones to Better the Self-Efficacy of Undergraduate Engineering Students (Tricks of the Trade) (WIP)

INTRODUCTION

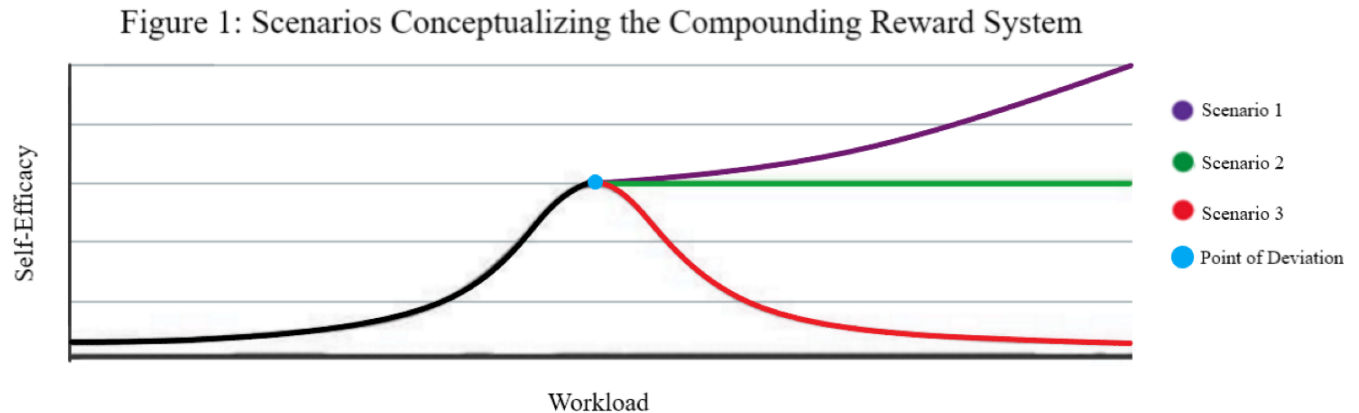
Community College Success

Involvement in co-curricular activities, including participation in student and professional organizations, can significantly enhance the overall educational experience [1]. Engineering programs in community colleges strive to reinforce student engagement that increases student academic and extracurricular success. [2-5] One factor that reduces engagement amongst students in co-curricular activities is low self-efficacy. [6] Students believe that participation in co-curricular activities will take time from their academics [7] regardless of the potential benefits that organizations can offer. In addition to extra time commitment, other factors such as an inferior sense of belonging repel students from participating. Students reported a low sense of belonging resulting from a lack of support and a non-inclusive campus environment. [8] At a particular institution, engineering student interviews highlighted individual success stories in a campus environment with subpar inclusion. [9] Without ethnic and minority organizations such as the National Society of Black Engineers (NSBE), the Society of Hispanic Professional Engineers (SHPE), the Society of Asian Scientists and Engineers (SASE), or the Society of Women Engineers (SWE), students found it challenging to enter organizations with pre-existing cliques. Ethnic and minority organizations can provide a greater sense of belonging, making it easier for students to make the first step to join and initiate the compounding reward system. [10] With ethnic organizations, students expand their comfort zones to fit in and make connections among members who share the same attributes. Furthermore, a student trying to belong in out-of-class activities at a nonresidential college campus such as community colleges has their own set of challenges, including financial barriers. Students at a community college often need to work, which adds pressure that could undermine the academic experience. [11] After taking the primary step to join these organizations, it is anticipated that students will be encouraged to engage in more activities resulting in greater self-efficacy.

Organizations also help develop communication, teamwork, leadership, networking, time management, and many other professional skills necessary inside and outside the classroom. [12] Student organizations such as the American Society of Civil Engineers (ASCE), American Concrete Institute, Institute of Transportation Engineers, SHPE, SWE, and many others help produce better engineers who are more prepared and in demand for entry-level positions upon graduation. [13,14] Student-led and faculty-advised groups provide opportunities for students to take on a leadership role in an organization, develop study groups with other members, connect with industry professionals, and participate in a design team. The responsibilities of each position help to develop soft skills that are necessary for engineering practice upon graduation. [14] Not only do these organizations provide necessary skills and networks for student success, but a higher level of student involvement through out-of-class experiences, in general, promotes the development of a better-quality learning environment, an essential aspect of promoting

student success in engineering. [1] Moreover, a viable student organization can foster cohesion that benefits the program and institution at large while at the same time accommodating the nontraditional student's challenging time constraints. [15]

We hypothesize that increased participation in co-curricular activities, especially engineering student organizations, will provide positive experiences that will be a driving force to pursue more activities and more responsibilities. The more students experience positive outcomes when performing responsibilities could lead to increased self-efficacy and increased academic success. [16] The compounding reward system proposes that participation in co-curricular activities increases self-efficacy and academic success in college. Student GPA, time to degree completion, and internships will be used to measure student success. A survey and case study interview will be used to assess self-efficacy. Figure 1 shows the possible scenarios between self-efficacy and active participation in co-curricular activities, defined as workload.



Three scenarios are depicted in purple, green, and red (Figure 1), representing a possible correlation between self-efficacy vs. workload. We only include three possible outcomes of student participation. (The model will be changed depending on the results of this research). We hypothesize that increased workload on the student will increase self-efficacy while maintaining consistent academic performance (represented by the black curve). However, personal and non-scholastic factors of the student, including family context, could be a barrier after a certain point (the point of deviation). The predicted increase of self-efficacy and success could be reversed depending on the student's individual situation. According to Tinto et al. [17], “knowing about the role of family context may help institutions more effectively configure their support programs for differing student situations and populations.” Therefore, after the “point of deviation,” several scenarios may occur: 1) continuously increase, 2) plateau, or 3) decrease. Since each student is unique, non-scholastic factors should be considered to construct the model.

We predict these non-scholastic responsibilities may act as barriers that can negatively impact the students' ability to participate in academics and co-curriculars by diverting focus after the point of deviation. Considering students' diverse personal situations, scenarios may vary. *Scenario 1:* Highly motivated students with less workload outside school as well as a lot of familial support will continue to have increased success rates as they add more workload to their schedule. *Scenario 2:* Highly motivated students with more outside workload and less familial support will

reach a plateau with more co-curricular activities. *Scenario 3*: Increased co-curricular activities could potentially be overtaxing and decrease student success for students who do not have ideal personal situations. The point of deviation could also vary depending on the individual situation. Knowledge of students' unique situations will provide institutions guidance to customize support and interventions to maintain success, especially for students in scenario 3.

The current research is only in its developmental stages. It will be conducted primarily at Wright College, a Hispanic Serving Institution (HSI) in a multi-college urban setting with a very successful engineering program. Wright College has a diverse student population with respect to academics, race, ethnicity, gender, and socioeconomic backgrounds that is successful in navigating the college experience. To equitably serve these students, Wright College developed contextualized practices to further increase diversity and student success. [4] The contextualized practices emphasize increasing opportunities for student participation and increasing the number of academic and ethnic organizations. These interventions are instrumental for the unprecedented success rate of the Wright College's Engineering Program. [18] The current research aims to determine whether the compounding reward system will serve as the driving force behind student success in both academics and co-curricular activities and to determine other factors that could potentially affect student success. To achieve this goal, we will survey current and graduated student organization chapter leaders, active members, and students without co-curricular involvement. The results of this research are expected to help increase co-curricular participation and increase academic achievement through greater self-efficacy and belonging while also providing the Wright College Engineering Program with guidance to create more effective interventions.

This paper should be valuable in creating more successful engineering programs at other institutions by providing insight into increasing student involvement and other factors that could affect self-efficacy and belonging. It will also help faculty and administrators to support the incorporation of co-curricular opportunities in developing their engineering programs while providing intentional support to increase the point of deviation for every student. [19] The success of this research will not only advance engineering programs but also STEM education, including other disciplines, especially for diverse students with varying talents and needs [20], and will be critical in developing a more resilient and skilled workforce.

METHODS

This research project is a part of the current Wright College Engineering, NSF-HSI funded research. The survey and case student protocols are approved by Wright College's Institutional Review Board (IRB). The survey will be used to gather student participation and self-efficacy data as well as understand barriers. The case study interviews will gather self-efficacy data through the Appreciative Inquiry (AI) method. [21] Students' identifiable information such as emails and phone numbers will be gathered for longitudinal studies.

I. Assessment Instruments

1. Survey

The belonging and self-efficacy survey designed by MUSE consulting and the PI of the NSF-HSI project “Building Bridges into Engineering and Computer Science” was modified for compounding reward system research. The modified survey contains questions regarding participation in co-curricular activities, internships, and non-scholastic factors and barriers. The survey aims to gauge how participation in an organization affects self-efficacy, belonging, and academic and professional success. The survey contains the elements listed below:

- a. Self-efficacy
- b. Belonging
- c. Amount of other responsibilities outside school and co-curricular participation
- d. Ease of getting internship(s) as a result of co-curricular participation

2. Case Study Interview

The case study will use the AI method. [21] Individual interviews will also assess the self-efficacy and belonging of engineering students, and their interview responses will be correlated with academic success and professional success. The interview will reference the participants’ survey responses.

II. Data Collection and Analysis

1. Academic Data (GPA and time to degree completion)

GPA and time to degree completion will be collected and provided by the Wright College Engineering Program and the Wright College Institutional researcher.

2. Survey and Case Study Interview Participants

Participants will be recruited from four groups:

- A) Current students at Wright College who actively participate in co-curricular activities
- B) Current students at Wright College who do not participate in co-curricular activities
- C) Wright College alumni who are currently at 4-year institutions
- D) Wright College alumni who graduated from a 4-year and are already in the workforce or graduate program

3. Data Collection through different organizations

Different organizations will also contribute to data collection by providing the researchers with student attendance and participation in their organization-sponsored events. All data collected will be correlated to self-efficacy and student success.

4. Analysis

All data collected will be deposited and managed according to the Data Management Plan of the NSF-HSI project. The data will also be analyzed while correlation studies are evaluated using Microsoft Excel. At the end of the Spring Semester, we expect to have enough data to generate a preliminary model, which will be further enhanced by Fall data collection.

III. Continuous Improvement

The data collected will be utilized to refine our model for a more accurate representation of the scenarios. Findings will be used to continuously improve the research and the processes at the Wright College Engineering Program.

PRELIMINARY RESULTS AND DISCUSSION

The survey and the case study interview will be administered throughout the Spring and Fall of 2021. We started gathering data from the alumni group (Group 4) who visited Wright College in the Fall. Participants were speakers in the Wright College Engineering Success Seminar. The Engineering Success Seminar is a first-year course that introduces engineering students to Engineering disciplines and helps students develop design thinking and professional skills.

The preliminary case study interviews conducted with two of Wright College's engineering program alumni support our hypothesis that participation in co-curricular activities helped them focus and provided them the skills to get internships. Joe Doe (pseudonym) highlighted that his participation in engineering student organizations helped him study and solidify knowledge necessary for academic success. Similarly, Steve Smith (pseudonym) understands the need for students to be more involved in activities outside of class. He resonated with Joe's experience where extracurriculars provided enforcement of what he learned from the classrooms. Both participants support our hypothesis that involvement in student organizations has increased their sense of self-efficacy.

To date, we carefully designed the survey and case study interviews. These instruments are IRB-approved and ready for administration by the end of Spring 2021. We expect enough data to be collected at the end of Fall 2021 to construct and modify the hypothetical model presented in Figure 1.

The alumni case study interviews, although very preliminary, are promising.

LIMITATIONS

Although we do not anticipate problems with collecting data to correlate self-efficacy with workload, the current research will be limited by the willingness of the participants to share personal, non-scholastic situations to identify the "point of deviation." Depending on the outcomes, modification of the research design might be necessary.

FUTURE WORK

We will continue to administer the survey, conduct case study interviews, and increase our data size. We will correlate the data with self-efficacy and student success, and identify the point of deviation. Depending on the outcomes, we will modify Figure 1 and redesign the methods. We are also adding a diversity study within the organizations. We will extend our research to identify best practices and activities that should be implemented to support the student organization

members' academic success. The research will also be extended to other community colleges that do not provide opportunities for engineering organizations, and we will compare them to 4-year institutions that yield plenty of opportunities for student participation.

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Wright College IRB protocol # 108007

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