2023 Annual Conference & Exposition
Baltimore Convention Center, MD | June 25 - 28, 2023
The Harbor of Engineering Education for 130 Years
ASEE
Paper ID #37121

# Work in Progress: A Correlation Analysis of Engagement of First-Generation College Students in Engineering

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# WIP: A Correlation Analysis of Engagement of First-Generation College Students in Engineering

## Introduction

In the college environment, students engage in a variety of educational activities. They ask questions in class, have discussions with peers and faculty, study in their preferred way, and do all of these with the goal of a degree in mind. These types of engagement, along with many others, are key components of students' education.

Previous research on first-generation college students shows that first-generation students across all majors engage less than their peers and perceive the college environment to be less supportive overall [1]. In terms of science, technology, engineering, and mathematics (STEM) majors, studies have also found that first-generation students are 6% less likely to complete a degree in these fields compared to their continuing-generation peers [2]. Research focusing on the engagement of first-generation college students in engineering is a topic that has not been widely explored up to this point. Because of the present battles that first-generation students face, more research on their engagement is essential to aid them in achieving their educational goals.

This work-in-progress (WIP) research utilizes the National Survey of Student Engagement (NSSE) as the main data collection instrument [3]. This survey is 40 questions in length and covers many types of student engagement. Within the survey items, creators of the NSSE have identified 10 Engagement Indicators (EIs). These engagement indicators have been further categorized into 4 themes: Academic Challenge, Learning with Peers, Experiences with Faculty, and Campus Environment.

The present WIP study focuses on the student engagement of first-generation college students in engineering majors. The overall research question of the present study was: Do four categories of student engagement correlate to one another for first-generation college students in engineering? If so, how?

Past research has not addressed this specific topic, which leaves a research gap that the current study will help to bridge. With the current struggles first-generation college students are facing both in STEM majors and overall [1]-[2], it is necessary to take steps to help aid this group of students. The current research looks to explore the engagement of first-generation college students in engineering and promote types of engagement that are helpful to this group of students.

## Literature Review

### *Student Engagement*

Student engagement happens in educational settings daily. One study, which utilizes the NSSE to look at the engagement of engineering students, describes student engagement to be students taking part in activities that are educationally effective [4]. This study found that the engagement of engineering majors and other majors was similar [4].

*First Generation Students*

Much of the current research on first-generation students focuses on persistence through college to graduation and ultimately obtaining a degree [5]-[7]. This is true for both STEM and non-STEM majors. Studies comparing first- and continuing-generation students are also common in this area of research [8]-[10]. The present study looks to focus only on first-generation college students in engineering, and the main area of interest will be student engagement.

*Engagement of First-Generation College Students in Engineering*

The current collection of research relating to the engagement activities of first-generation college students in engineering uses mostly qualitative methods, such as case studies and interviews to collect data. Studies look at different types of student engagement, but also often compare it to other variables or samples.

A recent study exploring the engagement of engineering students using classroom observational methods hypothesized that first- and continuing-generation students in a mechanical engineering course would not show a significant difference between their engagement levels and academic performance [10]. Findings disproved this hypothesis. This interesting result shows the growing gap between first- and continuing-generation students. Furthermore, this result opens the door for more research in this area. Research using different methods and an instrument that collects data on more engagement activities is the next step in this area.

Another study focused on out-of-class engagement of civil engineering students and made a comparison between first- and continuing-generation students, also finding significant differences between the two in all except one of the areas they tested for [11]. This study also found connections between out-of-class engagement, finding resources, and fostering relationships in an educational setting for first-generation students [11]. This result, like the previous study [10], shows a difference between first- and continuing-generation students.

The above results indicate that the difference exists; but leave it to future research to explore ways to help level the playing field for first-generation college students in engineering. The research outlined in this paper takes steps to fill the research gap and provides a picture of overall (in and out of the classroom) engagement for first-generation college students across multiple engineering disciplines. By seeing how first-generation college students in engineering engage in educational settings and activities, we can see what types of engagement are aiding students and helping them succeed.

## Methods

*Approach*

This WIP research utilizes a quantitative approach and employs surveys as the primary data collection tool. The main data for this research comes from the National Survey of Student Engagement (NSSE) [3][12]. The sample size of 28 students was verified to be sufficient for

quantitative analysis via calculations completed in excel [13]. The overall acceptable N was calculated using Equation 1.

$$N = \left[\frac{Z_{\propto}+Z_{\beta}}{C}\right]^2 + 3 \quad (1)$$

Values for alpha, beta, and r were 0.01, 0.20, and 0.6, respectively, and the calculated acceptable N was 27. The values of Z in equation 1 are related to standard deviations and C is related to the expected correlation coefficient (r). Values for C were calculated using equation 2.

$$C = 0.5 * \ln\left[\frac{(1+r)}{(1-r)}\right] \quad (2)$$

While this sample size is on the smaller side for quantitative research, results from the NSSE are generalizable to larger populations even with a smaller sample [14]. The sample was taken from the College of Engineering at the authors' institution Utah State University (USU) and looked to recruit sophomore, junior, and senior students with first-generation college status. These class levels were chosen because of the students' experience with engineering courses. At USU, freshman students often do not start right into engineering courses when starting college. The researchers of the present study, also the authors of this paper, wanted participants to have experience in engineering courses.

*Sampling*

An initial sample for this research was obtained using a pre-screening survey that was sent to all sophomore, junior, and senior students within the College of Engineering at USU via the students' school email. The pre-screening survey asked for potential participants' generational status, class level, and contact information. Students who were interested in participating in this research were asked to fill out the survey and wait to hear from the research team. Researchers received 42 responses to the pre-screening survey.

*Data Collection*

Researchers reviewed responses to the pre-screening survey. If a respondent was eligible to participate, they were sent another survey with an informed consent document via the contact email they provided in the pre-screening survey. Upon providing their informed consent, participants were sent a copy of their signed informed consent form, and a link to the primary data collection survey (the NSSE) via email. Of the 42 potential participants from the pre-screening survey, 30 were eligible and provided their informed consent to participate. Of these 30 eligible participants, 28 completed the NSSE and comprise the sample for this research. Participants who completed the NSSE were compensated with a $15 gift card.

*Participants*

This research has 28 participants who were all first-generation college students majoring in a field of engineering. Of the 28 participants, 8 were sophomores, 11 were juniors, and 9 were seniors. 75% of the sample was in the 18-23 age range. In terms of gender, 60.7% of the

participants identified as male, 35.7% identified as female, and 3.6% chose not to identify. In terms of different disciplines of engineering, there were 10 mechanical engineering students, 7 aerospace engineering students, 4 civil engineering students, 3 environmental engineering students, 2 computer engineering students, 1 biological engineering student, and 1 electrical engineering student. Students were enrolled at USU.

*Data Analysis*

Upon obtaining the survey responses, researchers used guidelines from the NSSE for data analysis. Data was analyzed using SPSS software. Within the NSSE, there are specific questions that contribute to 10 specific engagement indicators (EIs). These 10 EIs then contribute to 4 overall themes of engagement. Table 1 shows EIs and associated themes.

In order to calculate the EIs, the responses to each question contributing to a specific EI were coded on a scale of 0-60, with 60 indicating maximum engagement. As an example, for a question with response options of never, sometimes, often, and very often, never would be coded as 0, sometimes as 20, often as 40, and very often as 60. If the number of answer choices changed, the number of choices was divided into 60. These total scores for each question contributing to an EI were then averaged together, and that average was the overall EI score for each participant for each of the 10 EIs. These EI scores were then averaged to compute an overall score for each of the 4 themes. Therefore, for each of the 28 participants in the sample, 10 EI scores and 4 theme scores were calculated. EI scores and theme scores were also out of 60. Table 1 shows associated themes, engagement indicators, and survey questions.

**Table 1: EIs and Associated Themes**

| Engagement Indicators | Themes |
|---|---|
| Higher-Order Learning<br>Reflective and Integrative Learning<br>Learning Strategies<br>Quantitative Reasoning | Academic Challenge |
| Collaborative Learning<br>Discussions with Diverse Others | Learning with Peers |
| Student-Faculty Interaction<br>Effective Teaching Practices | Experiences with Faculty |
| Quality of Interactions<br>Supportive Environment | Campus Environment |

After EI scores and themes scores were calculated, normality tests were completed to determine if parametric or non-parametric analysis should be used. Depending on the results of the normality tests for each theme, Pearson or Spearman correlations were computed. Correlations were computed between all variables, and if a correlation was completed between a normal and non-normal variable, the correlation was a Spearman correlation.

## Results

*Normality Tests*

For each of the 4 themes, a Shapiro-Wilk normality test was used to determine the normality of variables. Normality test results are shown in Table 2. Variables with a significance value of less than 0.05 were identified as having a non-normal distribution.

**Table 2: Shapiro-Wilk Normality Test for Themes**

| Themes | Significance |
|---|---|
| Academic Challenge | 0.329 |
| Learning with Peers | 0.135 |
| Experiences with Faculty | 0.205 |
| Campus Environment | 0.293 |

*Correlational Analysis*

From the normality tests, appropriate correlations among themes were computed. Because all of the themes presented a normal distribution, Pearson correlations were used to look at the relationship between themes. These correlations are shown in Table 3.

**Table 3: Pearson Correlations Between Themes**

| | Academic Challenge | Learning with Peers | Experiences with Faculty | Campus Environment |
|---|---|---|---|---|
| Academic Challenge | 1.000 | 0.182 | 0.687** | 0.626** |
| Learning with Peers | | 1.000 | 0.229 | 0.041 |
| Experiences with Faculty | | | 1.000 | 0.690** |
| Campus Environment | | | | 1.000 |

**Correlation is significant at the 0.01 level.

## Discussion

Among the 4 themes of student engagement, the researchers found that 3 themes showed a significant positive correlation between them for first-generation college students in engineering. The academic challenge theme significantly correlated with both the experiences with faculty (0.687) and campus environment (0.626) themes. The campus environment and experiences with faculty themes also significantly correlated with one another (0.690). All correlations tested with

values significant at the 0.01 level. The learning with peers theme showed no significant correlations with other themes.

As we look at the significant correlations among themes from this research, we must also look at what engagement indicators and activities are contributing to these themes. For the academic challenge theme, the higher-order learning, reflective and integrative learning, learning strategies, and quantitative reasoning EIs were considered. These EIs are comprised of activities such as: applying and analyzing knowledge, connecting course material to outside sources, looking at different perspectives, analyzing problems with numerical means, and using time out of class to prepare or review concepts.

For the experiences with faculty theme, the student-faculty interaction and effective teaching practices EIs were considered. These EIs include activities such as: students having discussions with faculty outside of class or relating to non-course topics, and instructors utilizing different methods of teaching as well as providing feedback to students.

Lastly, for the campus environment theme, the quality of interactions and supportive environment EIs were considered. These EIs include activities such as: students having positive interactions with others associated with their institution, and institutions providing students with opportunities and support.

From the strong positive correlation between the academic challenge and experiences with faculty themes, we can conclude that the activities associated with these themes are also related. This is also the case with the strong positive correlations with campus environment theme. Students with higher levels of engagement in the activities associated with one theme will most likely also have higher levels of engagement in the activities of the others.

**Conclusions**

For first-generation college students in engineering, student engagement may be lower or look different than continuing-generation students for a number of factors. This research looked to explore possible correlations between student engagement themes for first-generation students in engineering using the NSSE and its defined themes for student engagement. Researchers found a strong positive correlation of 0.687 between the academic challenge and experiences with faculty themes. There was also a strong positive correlation of 0.626 between the academic challenge and campus environment themes. Researchers found a final strong positive correlation of 0.690 between the experiences with faculty and campus environment themes. These positive correlations indicate direct relationships between themes. As engagement in one theme increases, it also increases in the others correlated with it.

The main purpose of this research was to obtain an initial picture of student engagement for first-generation college students in engineering. With this initial picture, future research would look to compare these findings to continuing-generation college students in engineering. Future research could then promote or implement different types of student engagement for first-generation college students in engineering, in an effort to close the gap and level the playing field for this group of students.

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