

Work in Progress: Using First Year Engineering Laboratory to Improve a Student's Readiness to Pursue an Engineering Degree.

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Dr. Charmane V. Caldwell is the Director of Student Access at the FAMU-FSU College of Engineering (COE). As Director, Charmane leads a comprehensive effort to increase the number of underrepresented undergraduate minorities and women in engineering. She has developed and managed several retention programs at the college: Engineering Concepts Institute (ECI) Summer Bridge; Engineering Living Learning Community (LLC), Educating Engineering Students Innovatively (EESI) and Peer-Assisted Study Sessions (PASS). Dr. Caldwell also serves as the activity director for the Title III program Engineering Learning Community. Those collective programs have nearly doubled the first-year retention of underrepresented minorities at the college. Additionally, Dr. Caldwell serves as a teaching professor for the First-Year Engineering Lab (FYEL), which is part of the pre-engineering program.

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Dr. Melodee Moore received her Bachelor of Science degree in Chemical Engineering from Howard University, and her PhD in Biomedical Engineering from Northwestern University. She has been an instructor at the FAMU-FSU College of Engineering since 2005, where she teaches First Year Engineering Laboratory and other general engineering courses. Her research efforts focus primarily on engineering education.

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Ken Tellis is a doctoral candidate in the College of Education at Florida A&M University

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Introduction

An Introduction to Engineering course serves in many universities as a first-year college success course for engineering majors [1]. College success courses assist students in developing the skills that they need to be successful in college [2]. At the joint Florida A&M University-Florida State University College of Engineering (FAMU-FSU COE), we have found that the final grade a student receives in our introductory engineering course is a strong indicator of a student successfully completing a degree program [3].

Although the technical content of the course is not relatively complex compared to an upper-level engineering course, we find that some students are unable to complete it with a satisfactory grade. This paper presents preliminary findings on examining the relative performance of students on a recent midterm examination given in the class. Questions on the exam were analyzed based on a revised Bloom's taxonomy [4], instructional method, and learning environment. The primary purpose of this work is to develop strategies and interventions designed to close the readiness "gap" in a student's pursuit of an engineering degree.

Student Success and Introduction to Engineering Courses

Introductory engineering courses have their origins in the early retention studies of a number of researchers who suggested that student retention is influenced by academic and institutional integration [5],[6]. In 1990, the ASEE Engineering Deans Council Pipeline Implementation Committee put forth a charge for programs to expand access and introduce students to the spectrum of opportunities across engineering disciplines[7]. This caused many institutions to develop a traditional Introduction to Engineering course. Later, it was suggested that there was a need for engineering programs to become more hands-on as opposed to the traditional didactic method of lecture delivery[8]. Although the modern iteration of the course may vary slightly from institution to institution in terms of objectives, credit hours and approaches, the salient theme of informing students about the nature of engineering and improving retention, particularly among women and underrepresented minorities, has helped campuses experience positive results.

First-Year Engineering Laboratory at the FAMU-FSU College of Engineering

The introduction to engineering course offered at the Florida A&M University and Florida State University College of Engineering is *EGN-1004L First-Year Engineering Laboratory*. This is a one (1) credit hour laboratory and is required for all pre-engineering students. Its only prerequisite is "a passion to be an engineer." A student must obtain a grade of "C" or better in the course to continue in the engineering program.

The major goals of the course include:

1. Familiarizing students with the engineering degree programs offered at the college and the course requirements of their intended engineering major.
2. Orienting students with academic policies, procedures, and support resources available to engineering students.
3. Introducing students to the technical and social skills which are needed to successfully complete an engineering degree program at the college.

The class meets for two hours, once per week on the COE campus, in a standard classroom setting. It is taught in a combination of seminar-style discussions based on textbook readings and other topics raised by the instructors (~50% course meetings), in-class activities/workshops, and three to five team-based, hands-on projects offered during the semester (~50% course meetings). Teaching and Learning Assistants are employed in each section to assist with in-class activities and hands-on projects.

A student's final course grade consists of a midterm exam (20%), class participation (10%), online reading quizzes (10%), team-based projects (30%), and homework or in-class assignments (30%).

Analysis and Findings

During the fall 2017 semester, the course was offered in four distinct sections and taught by three instructors. For this analysis, a midterm exam consisting of 55 multiple choice questions which was administered to each section is examined. Exam questions generally fall into one of four different categories. They include: (1) policy and procedure questions which are unique to being a student at the COE, (2) questions regarding the engineering profession, (3) questions related to team-based projects, homework, or in-class assignments, and (4) current event questions which are for extra credit. A total of 15 questions were common across all four exams. A sample of these questions is shown in Table II along with their revised Bloom's classification, the instruction method used to teach the answer to the question, and the learning environment used when the material was covered.

Table II: A sample of the 15 Common Questions used in the Fall 2017 Midterm Exam.

#	Question	Revised Bloom's Classification	Instructional Method	Learning Environment
1	Your ILS results indicate that you are a strong "active" learner this indicates to be a successful student you should generally	Understand	Homework Assignment	Individual
3	What is the main idiosyncrasy of the CCS print quota system?	Remember	Lecture	Individual
5	A student earned a 2.75 GPA during her fall semester, with 15 credits. In her spring semester, she is registered for a total of 17 credits. What is the minimum GPA she will need to have a 3.0 cumulative GPA at the end of the spring semester?	Apply	Lecture	Group

8	If a 20,000 cm ³ bucket has a diameter of 10 cm, how tall (in cm) is the bucket?	Apply	Activity	Group
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Table III provides a summary analysis of the average normalized mean for students in the first (i.e., “A” students, N=88) and fifth quintiles (i.e., below “C” students, N=96) on all 15 common questions based on the three factors given in Table II. For most categories, the normalized mean of students in the 5th quintile is approximately 50% of those in the first quintile. However, there is a statistically significant difference (at p=0.05) between questions classified at the lowest Revised Bloom’s Taxonomy level “Remember” to those classified as “Evaluate.”

Table III: Normalize mean score and Pct between top and bottom quintiles by category

Category	Remember	Understand	Evaluate	Apply	Individual	Group	Lecture	HW	Activity
1 st Quintile	0.93	0.86	0.89	0.93	0.94	0.92	0.92	0.86	0.94
5 th Quintile	0.50*	0.41	0.35	0.44	0.44	0.47	0.47	0.41	0.47
Pct of 5 th to 1 st	54%	48%	39%	47%	47%	51%	51%	48%	50%

* statistically significant at p=0.05 to problems classified as Evaluate.

Summary

This paper describes a preliminary analysis in identifying factors which encompass the academic performance of students in an introduction to engineering course. The performance difference found between students in the various categories suggests there are many areas of opportunity to engage students. The next step in this research is to expand the analysis to include additional semesters, include non-common questions which have similar classifications, examine non-academic factors (e.g., level of class participation) which may also impact performance, and to ultimately develop intervening protocols to improve the overall performance of all students.

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