Peer Mentoring, Learning Strategies Course, and Online Math Help Module to Increase Retention in School of Engineering

Prof. Corey Kiassat, Quinnipiac University

Dr. Corey Kiassat is an Associate Professor of Industrial Engineering, and the Associate Dean of the School of Engineering at Quinnipiac University. He has a BASc and a PhD degree in Industrial Engineering from the University of Toronto, and an MBA, majoring in Marketing and International Business, from York University. Corey is a Professional Engineer and has 11 years of industry experience in manufacturing engineering and operations management with General Motors in USA and Canada. He has also been involved with a start-up company in personalized preventive healthcare. Corey's research focus is on the role of people on performance of systems. His general research interest is the applications of Lean Six Sigma in the healthcare industry.

Prof. Ruby Elkharboutly, Quinnipiac University

Prof. Ruby ElKharboutly an Associate Professor of Software Engineering at Quinnipiac University. She has a PhD in Computer Science and Engineering from University of Connecticut and a MS in Computer Science from the American University in Cairo. She has over twelve years of experience teaching in public and private institutions. Here research focuses on social data analysis and modeling. Her general research includes pedagogical research that enhances students class experience and interdisciplinary research in which software engineering is used to empower other disciplines.

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Abstract

A considerable number of students leave engineering within the first year. At School of Engineering at Quinnipiac University, we have identified several factors that cause students to leave. We ran three initiatives in the Fall semester to help underprepared first-year students in transitioning from school to college. These initiatives are pilot for a First-year Academy (FA) program that we plan to offer starting next year to increase the school retention rate. The three initiatives target social, metacognitive and academic skills. The first initiative is a mentoring program; the second a metacognition course; and the third an online mathematics help module. This paper discusses each initiative, the lessons learned, and the plan for moving forward.

1. Introduction

1.1. Background

At the School of Engineering at Quinnipiac University, a private university in northeastern United States, we have set a short-term target rate of 90% for first-year students in making a successful transition through their first year. We plan to conduct the First-year Academy (FA) program to assist underprepared first-year students achieve this transition. Underprepared students are those who score a 3 or below on the Quinnipiac Math Placement Test or students with a low score on two pre-defined questions on the CSI Survey, The CSI survey (College Student Inventory) taken by all first-year students during a summer orientation. In the summer prior to their first Fall semester, participants of FA start to receive support on direct academic, metacognitive, and social areas. The support continues throughout the academic year.

The planned start date for FA is Summer 2020. During the 2019-20 academic year, we have been running pilots on three initiatives within FA. This allows us to evaluate these initiatives and work out any issues before offering them within the general framework of FA.

The first two of these initiatives are related to helping first-year student's transition from high school to college. The first initiative is on the social front; students are paired with a student

mentor, a senior in the major, for guidance and social support. The second initiative is metacognitive; students take a course on study habits, test-taking skills, resilience, and forming study groups. The third initiative is academic. Students who start in Pre-calculus have access to an online Math practice module. This module allows them to master prerequisite topics they have not mastered. It should be noted that among the Fall 2019 incoming class, 48% of the traditional first-year students did not start in Calculus I.

Similar programs exist around the country and have witnessed great success. California State University offers a course to prepare incoming students since 1996 [1]. Grace-Odeleye and Santiago [2] published a very recent study that reviews four models of Summer Bridge programs offered to first-generation students and at-risk in-coming students. The four program were designed to address personal and inhibiting institution factors including academic and non-academic barriers. This approach is much in line with our method for identifying initiatives to include in the FA program. The first program reviewed is a summer bridge program run by University of Arizona, Tucson. While the program is specifically aimed towards underrepresented minorities, similar to our FA program, it provides support to its students by allowing them to enroll in academic courses and receive social support through existing campus offices. This program is different since it targets all students in the university while ours is only limited to engineering students. The second program reviewed is a 5-weeks summer bridge program in an unidentified technical Southeastern University. This program is similar to ours as it provides non-credit courses such as calculus, math and computer science. It also employees senior students to serve as coaches and peer educators. The results of comparing participants of this program to non-participants showed a higher retention rates (about 3% difference). The third imitative under review is run by Rutgers University. This program is based on STEM course work as well as leadership and academic success training. Participating students are conditionally accepted in the university but are not admitted unless they pass the program course work. The students reported “cultivating valued experiences” during the program. No data on retention rates was reported in this study. The last program under study is a seven-week program run by Idaho State University [3]. The students admitted to the program were those with low test scores, low GPA as well as underrepresented minorities among other admission criteria. This program provides general educational courses as well as discipline specific courses that students take. Students receive social support though peer

mentors and academic coaches. The study reports that the program has positively impacted the GPAs of participating students.

We hypothesize that the treatment group, first-year students who engage in all or a subset of the three initiatives, have a higher success rate than the control group, students in none of the initiatives. Success is defined as completing the first year in the School of Engineering without transferring to another program or to another university. To test the hypothesis, we plan to compare historical retention rate data, as well as the retention rate of the control group, with that of the treatment group. We will do this analysis at the end of the academic year.

1.2. Motivation

Given the fact that Quinnipiac University is private, one of the aspects of the business model is to have small class sizes. As such, the School of Engineering only has about 400 students across the majors and cohorts. Each year, the incoming class is about 125. Almost all of the first-year students live on campus, with two-thirds spread across multiple dormitories, and the final third living in an Engineering Living-Learning Community.

Student retention in universities is a major concern in general [4]. It is more of a concern in undergraduate engineering programs [5, 6, 7, 8]. Retention rate of first year students at the School of Engineering at University X was 76.32% and 76.47% in 2018 and 2019, respectively. This rate lags the national retention rate of 85% at private universities. Closer monitoring of underprepared students and developing a significant support structure can improve the success rate of these underprepared students and improve the School's retention rate. The School of Engineering aims to achieve 90% retention rates for Engineering. Rather than aiming for the national average, and in light of the multiple initiatives pursued, a stretch goal, exceeding the national average by 5%, is pursued. Even if the multipronged retention efforts fall slightly short of the stretch goal, the realistic goal of 85% should be achieved.

Several studies analyzed factors affecting undergraduate student retention and attrition. A recent study [1] explored the role of SAT math score, first college math course, and first college math grade in predicting STEM undergraduate retention. The results supported our observations that student retention was influenced by student's experience in first year mathematics courses. Students who received lower than a C grade in first year math were

highly likely to drop out of their STEM majors. A case study by Central Queensland University [10] found out that personal pressure is among the main factors that negatively affect student's progression. The same study found that student interaction has a positive impact on student's progression. A study conducted by The American College Testing ACT [8] concluded that student's academic-related-skills, self-confidence, social support and social involvement have a positive relationship to retention. This evidence supports our selection of initiatives support student's socially and academically.

The three piloted initiatives identified this year are based on our observations of our student population and various findings from a preliminary analysis. Performance of students retained in the School of Engineering, compared to those who left the School, as well as verbal and written exit surveys, were the reasons for selecting the particular initiatives.

2. Method applied

2.1. Peer Mentoring

To provide guidance and social support for first-year students, a list of senior students' contacts was compiled and made available for first-year students to choose peer mentors. The peer mentors voluntarily choose to serve in the program. The list included 15 mentors from the five different majors offered by the School of Engineering. Each mentor shared her/his information including gender, hometown, hobbies, race, major and a fun fact. First year students were encouraged to sign-up for their mentor of choice to allow first-year students to connect with a mentor based on academic or non-academic criteria such as ethnicity, common hobbies or simply gender. The mentors held informal meeting with their mentees and were available to answer their questions through email, text or face-to-face.

2.2. Online Math Module

McGraw Hill offers an online math support module, ALEKS. The module is personalized for each student, covering the topics needed, and progressing at the pace chosen by the student. At the onset, the student completes a self-test. The questions cover all the topics to be covered in an upcoming math course. Once in the math course, the instructor would expect the student to know all the prerequisite topics. However, this theoretical expectation is not always matched in practice. Upon completion of the self-test, the student is aware of the percentage of

prerequisite topics s/he has mastered. ALEKS will then provide tutorials, along with quizzes, to ensure the student covers all the gaps that remain.

2.3. Learning Strategies Course

First-year students were given the option to enroll in a zero-credit course, Learning Strategies, ENR 199, that focuses on metacognition, study habits, transition from high school to college, and test-taking skills. The purpose of this course is to introduce students to evidence-based learning strategies and to help students become self-regulated learners, capable of achieving their full academic potential. In ENR 199, students reflect upon the fundamental nature of learning and what types of learning activities best facilitate their learning process. In addition, students explore topics related to achievement, motivation and a growth mindset. The goal of this course is to help students not only develop a deeper understanding of these topics but learn ways that the strategies and tools discussed in class readings and discussions can inform their personal study habits. Topics include, but are not limited to, time management, avoiding procrastination, and cognitive process of learning, exam taking and reducing test anxiety, growth and a growth mindset.

3. Pilot Results and Discussion

3.1. Peer Mentoring

The peer mentoring program did not go as well as anticipated. Only 25.7% of first-year students signed up even though 69.4% of first-year students had initially expressed interest during summer orientations. During the debriefing sessions with the peer mentors, they reported that several of the mentees who signed up had little to no communication throughout the Fall semester.

Lessons learned from this pilot program are the following:

1- Peer mentors should visit the core first-year classes to introduce themselves, state the role of a peer mentor, and the benefits a first-year student can gain by having a peer mentor.

2- The School should organize an at-large meet-and-greet event to allow peer mentors and their mentees to meet for the first time.
3- Mentees should sign-up by providing their phone numbers as a way of communication. During the Fall semester, we relied on email. First-year students partially or wholly miss information communicated by email.
4- Motivate the mentees to meet with their mentors through extra credit in first year classes.
5- Run the program in the Spring to provide social support for students who struggle in the Fall semester. First-year students may be more cognizant of what they do not know as well as the benefits they can realize by having a peer mentor.

3.2. Online Math Module

During the Fall semester, Department of Mathematics offered ALEKS to all students enrolled in College Algebra. College of Arts and Sciences had purchased ALEKS licenses, but only for the College Algebra sections. Very few students from the School of Engineering were in College Algebra though. However, there were a significant percentage of School of Engineering students who started in pre-Calculus. Due to budgetary issues, the School of Engineering could not purchase licenses for ALEKS last year. Only nine licenses were provided for free by McGraw Hill on a trial basis. Only eight students, all of whom were advisees of one of the authors of this manuscript, were strongly encouraged to enroll in ALEKS. Of these eight, one student received 93% on the pre-test and rightly opted to not participate in the module. Two never attempted the module, while the remaining five took the pre-test and received a score ranging between 56% and 78%. Two of these students never took any additional steps beyond the pre-test. Three students stayed with the module throughout the semester. By the end of the semester, the pre-calculus grade and the GPA of these three students ranged from to B- to A, and to 2.69 to 3.75, respectively. In future offerings of ALEKS, we must find better ways to motivate students to participate in ALEKS throughout the semester. We have started the discussions with the Math department to use ALEKS across all pre-calculus sections, like what they did last semester in the College Algebra courses.

3.3. Learning Strategies Course

At the end of the Fall semester, a comparison was performed between students who took the course and other first-year students who did not. The group who took the course had a higher mean GPA, with a smaller standard deviation, compared to the group who did not (3.15 and 0.63 vs. 2.99 and 0.87). While the results are certainly promising, no statistical analysis is performed due to the small sample size of students who took the course, n=13. However, given the initial success of the course, it is being offered again in the Spring semester and 14 first-year students are enrolled in it. Based on the Fall semester's student evaluations and the instructor course assessment, no content changes were deemed necessary in the new offering of the course.

For the Spring offering, the only difference was the approach we took for student recruitment. Participation in the Fall offering was completely voluntary and open to all first-year students. Three students in ENR 199 finished the Fall term with a 4.0 GPA. For the Spring offering, we targeted first- or second-year students with a GPA<2.5. This is more likely to affect the School's retention rate. It should be noted that the population in this course is self-selected, albeit with the strong encouragement of faculty advisors. Therefore, the participants may be inherently more motivated than those who did not participate. In this case, the results would be skewed. Simple performance comparison of participants and non-participants would not tell the whole story. One thought would be to make the course mandatory for all incoming students in the School

4. Conclusion and Future work

This paper describes the lessons learned and data collected after running three initiatives aimed at supporting underprepared first-year students and consequently increase retention rates at the School of Engineering. The first initiative is a peer-mentoring program where first year students are given the opportunity to pair with a senior student mentor. Surprisingly, only a small percentage of students signed up for this program. We plan to make numerous changes to encourage student engagement and participation. The second initiative is a pre-calculus online module to provide practice for students struggling in Math. Motivation seemed an issue for students who took this module. We would like to find ways to motivate students to finish this module once started by providing extra-credit or offering special badges.

The third initiative is a zero-credit learning strategies course that student could voluntarily enroll in. The GPA of first-year students who took the course is found to be higher than those who did not. The major change we are making this Spring semester is targeting first-, as well as second-year students with a GPA less than 2.5 and encouraging them to take the course. This is a work-in-progress as we launch the First-year Academy at the start of the next academic year to provide support to students during their first year.

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