Work-In-Progress – First Year Engineering Experience of Under-prepared Students at The University of Akron

Dr. Julie Zhao and Dr. Donald Visco Jr.
The University of Akron, zhao1@uakron.edu, dviscoj@uakron.edu

Abstract - **At The University of Akron, about 12% of the first-year engineering students are considered underprepared in math in that they must take their first mathematics at a level below Pre-Calculus. During the past five years, the first-year retention rate of this cohort at The University of Akron is about 52%, compared to the first-year retention rate of about 80% for the first-year engineering students placed into Pre-Calculus and above. Low student retention rates have a great impact on both student success and institutional strategic planning. Based on a successful program at University of Colorado at Boulder (GoldShirt Program), the Engineering Redshirt Learning Community was developed in 2014 at The University of Akron as a part of the First Year Engineering Experience (FYEE). This paper discusses the context of creating this first-year engineering experience in easing students' transition from high school to college, enhancing their study habits and equipping them for success in engineering and beyond. Student feedback and assessment results are presented to guide further development of the program and academic support of all first-year students.**

Index Terms – FYEE, Learning Community, Under-prepared.

INTRODUCTION

The University of Akron (UA) is a public, 4-year institute in Ohio. There are about 12% (about 100 students) of engineering freshmen who are placed into the first mathematics class that was below Pre-Calculus and this cohort are commonly referred as under-prepared students. During the past five years, the average first-year retention rate of engineering students who were placed into College Algebra (a pre-requisite for Pre-Calculus) is about 52%, compared to the first-year retention rate of about 80% for the first-year engineering students placed into Pre-Calculus and above. In order to increase the retention rate of engineering students, especially to enhance academic success of underprepared engineering students, the College of Engineering at The University of Akron is redesigning its first year engineering experience.

In 2012, to respond to the commitment of *President Obama's Council on Jobs and Competiveness*, the American Society for Engineering Education (ASEE) declared the mission of retaining and graduating those talented students who gained admissions [1]. According to engineering schools' reports and studies [1]-[3], the factors that students self-reported for transferring out of engineering include poor teaching, poor advising, difficulty of the engineering curriculum and lack of belong in engineering. One of UA's internal studies [4] reported that lack of preparation in mathematics was an important factor for underrepresented students leaving engineering.

Multiple promising practices and strategies for retaining students in engineering were presented, including tutoring, mentoring, learning centers, programs specifically developed for at-risk students, programs specifically for first-year students, academic advising and career awareness [1], [2]. This demonstrates the need of designing a "holistic" approach and pursuing multiple strategies to improve first-year retention through faculty-student interaction.

ENGINEERING REDSHIRT LEARNING COMMUNITY

One of the FYEE initiatives at UA was the formation of an Engineering Redshirt Learning Community. Initialized in the 2014 fall semester, this learning community was modeled after the GoldShirt Program at the University of Colorado [5] and the STAR Program in Washington State [6], and structured by applying the methods of student engagement through learning communities [7]. The term "redshirt" means delaying participation to increase readiness for engineering studies. This year-long learning community is offered to incoming engineering students who are placed in College Algebra and majored in any engineering discipline. Students co-enroll in College Algebra, English Composition I and Effective Oral Communication in the fall semester, linked by a 2-credit Akron Experience (University 101) course, while taking Pre-Calculus, Chemistry I and a discipline-specific Engineering freshman course in the spring semester. Students are provided with mentoring, tutoring and a study table hosted by the College of Engineering. In addition, engineering faculty advisors and

academic specialists will meet with students regularly through learning community study hours.

The theme of "Innovation" for the learning community has been chosen since innovation is often the key deciding factor in the utility of a design. Indeed, Akron (the home of the "Inventors Hall of Fame") has a long-standing culture of innovation and entrepreneurship. In the Redshirt Learning Community, the theme of transformation, change, development and entrepreneurship, in short, "innovation", is integrated throughout the courses the students take as part of this learning community. Certain homework assignments and projects in Effective Oral Communication, English Composition I and the Akron Experience are related to the theme. And the theme does not only apply to external engineering innovation (parts, processes, approaches, etc.), but also internal and personal innovation. Students in the learning community are expected to become innovative in designing strategies for their success as engineering students – inside the classroom and outside the classroom.

Since students were placed into this learning community at the freshman orientations by their academic advisors based on their availability and class capacity (25), many students did not know what to expect from this experience. Therefore, Akron Experience course becomes the common course of the learning community. Students are introduced to engineering studies and engineering careers, along with contents to enhance study skills as well as institutional culture. The course is taught by dedicated engineering professionals who are willing to adopt effective and active teaching-learning techniques. Besides general lectures, workshops that require student involvement in classroom are heavily adopted and a service-learning project is carefully selected to improve teamwork, engineering hands-on and communication skills. Both instructors from English Composition I and Effective Oral Communication collaborate with the instructor of Akron Experience to assign project reports and/or in-class presentations related to the service learning project. The College of Engineering Dean's Office takes ownership of this version of the Akron Experience course, through rapid instructor feedback, midterm student survey and focus groups. The main contents of Akron Experience include

- Freshman Hall Meetings: institute history, student conduct and campus safety;
- Lectures: engineering studies, engineering careers, engineering ethics and engineering safety;
- Workshops: goal setting, time management, learning styles, note-taking and stress management;
- Guest Speakers: resume writing, job interviews, and diversity training;
- Hands-on project: service-learning projects;
- Student panels: academics success, extra engineering curricular activities and engineering careers.

An internal study at UA also showed that "*students are not necessarily leaving engineering because they cannot do the work*" [3]. However, many of the students may not grasp fundamental mathematical skills in order to overcome tough hurdles. Therefore, careful attention needs to be paid early through accessible and approachable faculty-student interaction [1]. In this learning community, the instructor of College Algebra plays an important role by accepting a shared responsibility for students' success in mathematics and by encouraging this cohort of students to develop good study skills with high academic standard.

As a coordinator of the Engineering Redshirt learning community, the instructor of the Akron Experience course keeps running records of student academic performance and arranges other services. Good mentoring helps students feel that they belong in engineering and good tutoring assists students to develop good study methods, in addition to regular meetings with advisors. Both in-class and outside-classroom activities help students increase their confidence in completing an engineering degree, thus, to enhance their sense of belonging [3].

ASSESSMENT RESULTS AND FUTURE WORK

The UA Institutional Research provides the first-year retention rates of the first two cohorts of underrepresented engineering students, as shown in Table 1.

TABLE I
RETENTION RATES OF ENGINEERING REDSHIRT LEARNING COMMUNITY

	# of students	1st year retention
2014-15 LC	15	86.7% (13 STUDENTS)
2015-16 LC^	21	81.0% (17 STUDENTS)
2010-2011 Comparison Group*	37	48.6% (18 STUDENTS)
2011-2012 Comparison Group*	45	51.1% (23 STUDENTS)
2012-2013 Comparison Group*	61	47.5% (29 STUDENTS)
2013-2014 Comparison Group*	57	59.6% (34 STUDENTS)
2014-2015 Comparison Group*	41	48.8% (20 STUDENTS)

"*"The comparison groups include freshmen engineering students who were placed in College Algebra, but not in the Engineering Redshirt LC.

"^"The retention rate for the 2015-2016 cohort is based on the fall registration data before May 18, 2016. The number might be higher after several students pay off fees. Other retention rates are based on the 14th day of the fall semester enrollment.

It is seen that underprepared engineering students who participated in the Engineering Redshirt Learning Community at The University of Akron are retained at UA at a higher rate for their second year. Some explanations for the improved retention include the management through the College of Engineering, effective teaching-learning, faculty collaboration and integration of academic support. The findings provide encouragement to implement same/similar first-year experiences to broader student populations in engineering.

Student evaluation and focus groups also showed high satisfaction from students. Some sample feedbacks are

- *"Being in the LC allows me to build close relationship with my friends, since we all have the same classes. It makes it a lot easier for us to study together and help each other with our goals."*
- *"Akron Experience Class gave me a general idea of what college will be and the rest of my college career. I got to hear from various speakers. It provides so many resources to help me with academics and careers."*
- *"I suggest more learning about engineering and more focus on mathematics."*

In response to the positive initial results, the program will be expanded for the 2016-2017 academic year to include an additional section of the learning community. Per students' choices, the names will be changed into Engineering Gold-shirt Learning Community and Engineering Blue-shirt Learning Community, reflecting the school colors.

In the spring semester of 2016, a Zip to Success Program was developed as an application of best practices learned from the Engineering Redshirt Learning Community. This program targets freshman engineering students who are directly admitted into the College of Engineering and do not show good academic stands/performance in the first semester in college. Managed by the Engineering Dean's Office, the Zip to Success Program consists of six interactive workshops during the first six weeks in the spring semester, including Goal Setting, Keys to Success in Mathematics, Time Management 1&2, Test Anxiety, Self-Assessment and engineering resources. Weekly tutorial study tables were also available. Though there were 35 students who were on the probation list (first semester GPA less than 2.0), only six of them were able to participate in Zip to Success Program. The comparison of semester GPAs of students who participated in the Zip to Success Program to students who were not willing or not available to participate in the program is shown in Table 2. The data provide encouragement that this intervention had value to the cohort who self-selected to participate. Further discussion is needed to determine if the program should go from optional to mandatory.

TABLE II
ZIP TO SUCCESS PROGRAM STUDENT GRADE REPORT

	Zip To Success Program	Comparison Group
# of students	6	29
Fall semester average GPA	1.721	1.191
Spring semester average GPA	2.510	1.650
# of students whose GOA is above 2.0 in 2016 Spring	4 (66.7%)	14 (48.3%)

The structure and contents of FYEE at The University of Akron will be revised as needed to ensure the program meets the needs of all freshmen. Additionally, the effective teaching techniques and contents of student success will be highlighted in other engineering freshman courses, with expectation to improve overall course effectiveness and student learning outcomes.

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AUTHOR INFORMATION

Dr. Julie Zhao Assistant to the Dean for Diversity, Director of Increasing Diversity in Engineering Academics Program, College of Engineering, The University of Akron, zhao1@uakron.edu.

Dr. Donald Visco Jr. Associate Dean for Undergraduate Studies, Professor Chemical Engineering, The University of Akron, dviscoj@uakron.edu.