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Teaching and Learning: Challenges and Successes with First-Year Program at Regional Campuses

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Abstract

This complete paper presents teaching and learning approaches to offering First-Year Engineering Experience at a regional campus of a large midwestern university. Challenges faced by students and faculty will also be presented in this paper along with some guidance and best practices. Many universities invest their resources to explore teaching pedagogies that best fit the needs of their students. Universities that offer programs at regional campuses ensure consistency of the curriculum, however, there are challenges associated with offering programs with different demographics represented at the regional campuses. The purpose of this paper is to: a) present some of the challenges faced by instructors in teaching the first two years of engineering courses, b) share student attitudes and performance in core courses, and c) share some of the best practices adopted by the instructors to ensure rigor and consistency of the coursework at the regional campus.

The curriculum for the two courses covers the fundamental concepts and provides an opportunity for students to explore the applications of circuits in the real world. In a normal learning environment, these courses tend to be difficult due to higher expectations for problem-solving, math, and scientific concepts, and adding external factors such as the pandemic adds more complications. The focus of this research work is to study the first- and second-year engineering courses and present the challenges associated with the delivery of the course content, teaching engineering concepts and applications and laboratory experimentation. This paper also presents an assessment of student attitudes and their performance in engineering courses. With the learning assessment comes the lessons learned and evaluation of teaching strategies that have been investigated by the instructors to facilitate learning.

The courses are two-credit-hour and introduce problem-solving, analysis techniques, testing, troubleshooting techniques, and teamwork. Teaching strategies include the identification and evaluation of flipped classrooms and active learning to support teaching in various modes, restructuring the content, and utilizing alternative methods to assess course goals will be discussed in this paper. This paper provides an opportunity to learn from the unique experience, develop skills to address the various skill levels of the students at regional campuses and support students and faculty with a variety of academic needs.

Introduction

Traditionally, First-Year Engineering Experience involves two semesters' worth of coursework. During these two years, students explore a variety of engineering disciplines in order to make informed decisions about the field they are interested in pursuing their Bachelor's degree. Engineering is considered a practical and challenging degree that involves applied math and science coursework. In addition, there are hands-on labs and open-ended projects in the first-year curriculum that provide students with critical thinking, problem-solving, and project management

skills. Undergraduate introductory courses cover a wide variety of fundamental topics such as electrical circuits, electronics, logic design, computer programming, statics and dynamics, material science, biomedical and industrial systems, etc. Students in their first-year face challenges due to several factors related to the transition from high school to college. Although there are resources available for high school graduates to explore the campus such as open-house, freshmen orientations, and advisor meetings, students struggle with the thought of a college environment and higher expectations. Several teaching pedagogies such as active learning, flipped classrooms, online discussion groups, and peer mentoring [1-6] have been studied in the past to help alleviate anxiety among freshmen. Higher academic expectations, time management, and peer pressure are some of the factors that cause anxiety among engineering freshmen. Due to the wide variety of classes offered in college, the class schedules do not always have to align with the student's preferences which causes students to change their work schedules. All of the noise and stress due to this transition results in a lack of concentration and feelings of withdrawal.

During the pandemic, learning was disrupted, and educators were impelled to devise strategies and innovative ways to deliver the course content [7]. Students were also taught to adapt to the quick changes to the teaching modes in order to restrict public interactions. Although remote instruction has been proven to be effective for teaching theoretical knowledge [8], teaching laboratory courses require hands-on learning which were difficult to execute in a remote setting. In addition, project-based learning also suffered since students could not meet to brainstorm ideas and test their concepts and prototypes. Several research studies have been conducted in the past three years about the impact of the pandemic on teaching and learning [9-10]. Studies showed that first-year students reported lower connections with their instructors. And female students reported statistically higher effects of online learning on their sense of belonging in engineering compared to male students [11]. Studies from the pandemic have also provided some guidance as to how to navigate through adverse situations like the pandemic and continue with teaching and learning practices [12]. More research is warranted to provide a coping mechanism for instructors and students to overcome the challenges presented due to continuously changing global conditions.

Other than the pandemic, there are many factors that affect teaching and learning at the regional campuses. Traditionally, the regional campuses were built to serve the communities in rural communities while central campuses served the communities in the cities and towns. Due to the unique characteristics of these communities, there is always a difference in the teaching and learning perspectives. Even though there are several hurdles to teaching and learning at the regional campuses, there are many positive experiences shared by instructors and students. This paper presents some of the challenges and successes of offering the First-Year Experience at a regional campus with small class sizes. An indirect assessment of students' behavior and attitudes will also be included in this paper. With this paper, the author hopes to offer a unique perspective of teaching and learning at the regional campuses which was not brought to the forefront before.

The paper is divided into the following sections: I. Campus Culture, II. Overview of First-Year Courses, III. Challenges in Teaching and Learning, IV. Successes with Teaching and Learning, V. Student Performance and Attitudes, VI. Conclusion and Future Work.

II. Campus Offerings and Culture

The regional campuses of this research institution are located in rural areas to provide higher education opportunities for place-bound students. These regional campuses can be positioned as leaders in educating a new generation of college students. Campuses are developing innovative approaches to support students financially and academically. The state legislation is turning towards regional campus models to educate students at multiple levels in an inexpensive and effective way due to which regional campuses are seen as exemplars for fulfilling the land grant mission. All the regional campuses are located at a distance of 40 to 60 miles from each other and serve rural communities. The majority of the students served are either first-generation or under-represented. The campuses conduct an enrollment data collection on the 15th day of each semester, and it was found that fewer than five hundred incoming freshmen students registered at each campus. Figure 1 shows the enrollment data from central and regional campuses. It can be noted that there is only 9-10% of the population represented rural areas of the state and attended regional campuses.

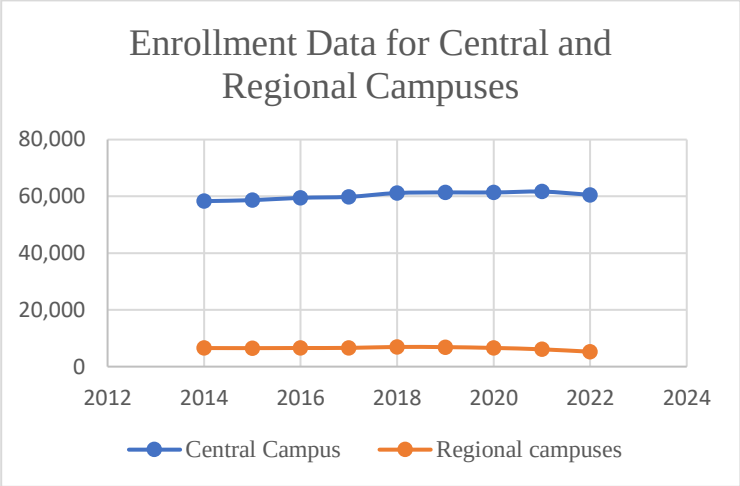

Figure 1. Student Enrollment Data from AU 2022

This study was conducted at one of these regional campuses and will focus on the enrollment data from that specific location. In Autumn 2022, a total of 900 students are registered out of which 311 are new incoming freshmen and 37 transfer students. There are about 463 male and 437 female students. Of the 348 students comprising the incoming freshmen class, there are about 52% male, 45% female, 2% unknown/did not respond, 21% are from underrepresented groups, 31% are first-generation; about 30% are eligible for federal student aid. Communications were also sent out to students about the university offering grants in addition to federal grants.

The regional campuses offer the first two years of coursework in engineering after which students have to transition to the central campus. The program offered at this regional campus is the first full year of coursework in engineering and select second-year course offerings in the areas of computer science engineering, electrical engineering, and mechanical engineering, in addition to growing the general education curriculum for engineering. Students may complete the following degrees in their entirety at this regional campus: Biology, Business, Education, Engineering Technology, English, History, Psychology, RN-BSN, Social Work, and Associate of Arts.

Faculty and Staff work collaboratively for the success of the students. There are academic resources available for students such as the academic success center, health, and wellness counseling center, student center, student club organizations, etc. Faculty also provides an academic alert to the office of student retention. Identifying a student as "At Risk" early in the semester allows faculty and advisors to provide remedial approaches to help support student learning. Most of the time, students need that push from their support system to get back on track and perform better. The engineering faculty hold a position in the department and coordinates with peers on the central campus for curriculum updates, revisions, and assessment of learning outcomes. Although not all second-year courses are offered in engineering, some core courses are part of the outcomes assessment plan.

First-Year Engineering Experience courses are offered in the Autumn and Spring semesters. The first course in the sequence is primarily offered in Autumn since the majority of the students from high school take it in Autumn to get on the fast track to graduation. There are no prerequisites for the first course. In the next section, these courses will be discussed in detail.

II. Overview of First-Year Courses

This section provides an overview of the curriculum for the two engineering courses titled Fundamental of Engineering I and Fundamentals of Engineering II. Both courses are lab-based and highly regulated by the Department of Engineering Education. These courses are 2 credit hours each and are offered at the central and regional campuses, however, this study only focuses on the regional campus course offering. These courses are required for all Engineering disciplines within the College of Engineering.

First Semester Course - Fundamentals of Engineering I

Curriculum: Topics in this course include engineering problem-solving, introductory programming, technical communication, engineering ethics, and teamwork. Utilizing engineering tools to analyze data and solve real-world problems is an important aspect of the course. Data analysis involved arrays, logical and relational operators, and graphing techniques for single or multiple datasets in Microsoft Office Excel. Basics of programming, referencing and memory addressing are taught in this course using MATLAB to enhance students' ability to code and develop algorithms. As a comprehensive exercise, a design project is assigned to assess learning. In addition to analytical skills, the First-Year programs cover a wide variety of tasks that teach students about team building, leadership, and communication skills. The course is taught in a flipped classroom setting providing reading material, demonstrations, and practice problems to prepare students for lectures.

Laboratories: A variety of topics are covered under the laboratory component including electrical circuits, stress and strain, computation of moment of inertia, Young's modulus, power generation through wind turbines, and the significance of lean and six sigma in industrial systems engineering. There are 8 labs in total that students have to complete during a semester. Laboratory instructions, manuals, and video presentations have been made available to the students via learning management systems (LMS). Teams are randomly formed at the beginning of the semester using Purdue's CATME Team-Maker tool [11]. Simulation tools such as

LTSpice, TinkerCad, and MATLAB Simulink Toolbox were used to elaborate on the circuit design principles and measurement techniques.

Assessments: Due to the nature of this course, application assignments are assigned each week and students are supposed to utilize MS Office and MATLAB to complete those assignments. There are weekly lab quizzes, two midterms, and a comprehensive final exam. Lab assignments are predominantly assessed for technical writing goals. Students are required to deliver executive summaries, lab reports, lab memos, and project notebooks. Participation grades are given to encourage attendance and class discussions and interaction with the instructors.

Second Semester Course - Fundamentals of Engineering II

Curriculum: Students continue to explore engineering disciplines in this course by learning about graphic design, 3D modeling, and spatial visualization. Topics include the engineering design process with an entrepreneurial mindset, problem-solving, conceptualization of ideas, prototyping, technical communication, and teamwork. Lectures cover graphic design techniques, 2D to 3D conversions, and isometric and orthographic views. SolidWorks is introduced as a computer-aided 3D design tool for creating sketches and building assemblies that help learn the importance of dimensioning and confirming constraints of individual parts in an assembly. Students select open-ended problems to address any real-world problem. Students work in teams and learn about project management, Lean, and Six Sigma principles while developing a business model. Course material includes reading exercises, demonstration videos, PowerPoint lectures, and practice problems.

Laboratories: The laboratory component of the course involves a semester-long team design project which is divided into three phases – problem definition, conceptual design, and final design. Research projects are led by curiosity to solve real-world problems by understanding user needs, and limitations of the system, prototyping solutions, testing, and assessing the impact of the solution on society. The project is driven by the Engineering Mindset Learning model where students chase their curiosity and pursue their entrepreneurial goals. Weekly laboratory instructions, manuals, and video presentations are made available to the students. Teams are formed depending on the class sizes.

Assessments: Weekly graphics assignments, quizzes, and four midterm exams exist. For the project, students are required to develop conceptual and technical design reviews. Weekly activities include discussion posts on technical and communication topics related to the design project. Peer evaluations are conducted via Purdue's CATME Peer-Evaluation tool three times during a semester and serve as a measure of teamwork. Technical writing is considered a critical piece of project documentation. Project deliverables such as oral presentations, design reviews, peer evaluations, and prototype testing are used to assess student learning objectives.

III. Challenges in Teaching and Learning at the regional campus

Higher Education institutions especially land grant institutions have relied upon the traditional student population admitted to the central campus. With the goal of serving the rural population, many land grant institutions opened campuses in the regions where there is a need for higher

education facilities. The dynamics of evolving social, economic, and academic status of the rural population, the regional campuses served them well. Since the degree earned will be the same no matter if the student started at the central campus or regional campus, it facilitated the students in rural areas to live locally and complete their degree requirements. Even though the regional campuses serve the population well, some challenges are associated with how the campuses function. There are federal funds available for regional campuses, however, there are constraints on how those funds get distributed among all campuses. With the benefits come the challenges associated with regional campus teaching and learning. These challenges are discussed below:

1. *Limited Resources*: The regional campuses have limited resources when it comes to offering engineering or engineering technology courses. These courses are lab-based courses and must have all the resources to ensure consistency in the type of project being offered. Course coordinators from the central campus are assigned the task to form regional campus teams and discuss the availability of resources to offer the first-year engineering courses. The first-year courses are revised often which requires the pilot to be studied before they are delivered to the regional campuses. Sometimes regional campuses fall behind on the revisions due to limited resources. It is recommended that the central campus implements the revision and after the successful execution of the revised curriculum, the regional campuses will move forward with the implementation. Delivery of the hardware and availability of all parts required for the projects and proper training to run those labs take time. Especially when there are curriculum revisions, the regional campus faculty would have to spend the summer break preparing the hardware and training on the new technology to be able to teach the following year. After the regional campuses revise their curriculum, there has to be maintenance support for these labs. With the delay in shipping and handling, it is not convenient to order broken parts, sensors, or development boards during the course of a semester. Therefore, there have to be extra kits available for backup which requires planning for the budget accordingly.
   There are maker spaces available on the central campus where students can work on their open-ended projects. For the second semester course (Fundamentals of Engineering II), the project requires brainstorming and conceptualization of the design and creation of the prototypes. Students need to master these skills, however, there are no maker spaces at the regional campuses which limits their ability to build and test their prototypes.

2. *Teaching Pedagogies:* As much as it is difficult for engineering students, it is equally challenging for regional campus faculty to facilitate these courses with limited resources. Faculty are trained to teach the same content as offered at the central campus to ensure rigor and consistency. However, due to limited resources, faculty need to adjust the timeline or the deliverables without compromising the quality of the outcomes. Instructors teaching the labs for Fundamentals of Engineering I are less challenged since the coursework is based on M.S. Excel and MATLAB programming. Although there are some labs that require hardware, the design project is software based. Instructors teaching the labs for Fundamentals of Engineering II have to be proactive in order to ensure the lab equipment is provided in a timely manner so students can work on their open-ended projects. Teaching methods differ from instructor to instructor, hence the course

coordinators from the central campus meet with the regional campus faculty at the beginning of the semester to explain the content and the flow of the topics. During a regular semester, students learn to adapt to the instructor's teaching method which helps establish a connection with the instructor that lasts the entire semester. Students transitioning from Fundamentals of Engineering I to Fundamentals of Engineering II might have the same instructor for both courses since there are only two instructors teaching these courses at the regional campuses. Situations like the pandemic break that bond which causes confusion and lack of concentration and cognitive distress among students. The disruption in learning urges students to explore alternative learning approaches such as virtual or spatial learning, gamification, and even solitary learning which are different from traditional teaching methods used in the classroom. Higher education institutions are equipped with learning management systems (LMS) that facilitate the synchronous or asynchronous delivery of coursework. Due to the pandemic, many instructors were impelled to adapt to online teaching. However, there were several instructors who had to be trained in order to teach their classes remotely.

3. *Lack of Support:* The first-year engineering experience courses require a tremendous amount of work in class as well as outside the class. Even though these courses are two credits, the courseload is equivalent to a three-credit hour course. The amount of grading is exceptional with homework assignments, exams, and project documentation that requires manual grading. At this institution, Canvas LMS is used for content delivery for the majority of classes. All engineering courses were taught using Canvas LMS which has the capability of auto-graded quizzes. However, there were some challenges with regard to grading technical problems. Instructors have to review the technical problems or open-ended problems manually in order to effectively assess student work. On the central campus, teaching assistants teach the lab sessions and graders handle all the grading work for these first-year courses. The regional campus faculty do not have that support; hence they spend considerably more time grading than teaching.

4. *Assessment of course goals:* With courses taught at the regional campuses, the course goals and expectations are the same as those taught at the central campus. The course goals are not assessed at the regional campuses, nor are they reported to the central campus. The objective of the first-year engineering curriculum is to provide an opportunity for students to explore engineering disciplines so that students can make informed decisions about their careers. So, these two courses achieve the goal of training these students for their second year of the degree program.

5. *Role of Administration:* It was noted earlier that the regional campuses get limited funding to run the campus businesses. However, there is a process of submitting a budget to the central campus. Engineering coordinators submit the budget each year to the fiscal office. The purchases made for the lab supplies and equipment have to go through the university procurement process. Ordering the supplies also has to be done by the faculty since there is limited personnel on the regional campuses to prepare the orders. They have to be

proactive in ordering supplies for their labs, otherwise, there will be a delay in teaching the labs. In order to avoid this situation, the administration should assign roles for staff to handle ordering and procurement so the faculty can focus on teaching.

IV. Successes in teaching and learning at the regional campus

1. *Academic Integrity:* University has a strict academic misconduct policy and there is zero percent tolerance for cheating and plagiarism. Hence, the regional campus courses abide by the same policies and hold academic integrity as paramount. Instructors are required to insert the policy on academic misconduct on their syllabi and communicate the policy with the students in their first week of classes. Instructors always remind students not to cheat or copy others' work and to submit their own work. Students in these first-year engineering courses are diligent and focus on the rules while submitting their work. The majority of the assignments in first-year engineering courses are team-based or group assignments. For group assignments, teams are formed on Canvas LMS and only one student per team is required to upload the assignment which makes it convenient for students as well as instructors to grade their work.

2. *Small Class Sizes*: Regional campuses offer small class sizes with a maximum of 24-25 students per class. Although the classroom space can accommodate more students, there is a limit to the lab equipment and supplies that can be provided. It also helps with logistics and scheduling. Due to the pandemic, enrollments in engineering have dropped across the U.S. and it has affected the regional campuses significantly. The small class sizes help the instructors manage the classes effectively and have limited students per team. Instructors are able to recognize their names and students are able to connect with their instructors. It is a win-win for both instructors and students.

3. *One-on-One Interactions:* As mentioned earlier, small class sizes allow instructors and students to get to know each other. It allows students to have one-on-one interactions with their instructors and ask questions during class without any hesitation or embarrassment. In a class with 100-200 students, it is difficult to have one-on-one interactions with the instructors, and the students have to utilize office hours. At regional campuses due to the small class sizes, students have the flexibility to meet the instructor after class and clarify any doubts. The office hours are usually not filled, and students get most of their questions addressed during or after class.

4. *Teaching Evaluations*: There are mid-semester and end-of-semester teaching evaluations. The mid-semester evaluation helps to address any concerns with the pace of the class, teaching approach, conflict with schedules, difficulty understanding the material, need for additional help, etc. Instructors are able to review the results of the anonymous surveys and offer additional support.

5. *Lower Tuition Rates and Scholarships*: Students attending regional campuses are expected to pay lower tuition as compared to students at the central campus. Due to this reason, the

majority of students from counties closer to the central campus prefer to attend the first-year at the regional campus. In addition to the lower tuition costs, regional campuses offer scholarships to students based on their class rank in high school. Class rank is determined by their high school transcript, or if your school does not provide a rank, based on your academic information and your school profile. The regional campus where the author teaches provides eligible students with a variety of sources for college funding, including nearly $1.2 million annually in campus-based scholarships. The scholarship program is funded by the generous support of many area residents and organizations.

6. *Convenience:* Regional campuses offer more convenience with regard to serving their students, faculty, and staff. Usually, these campuses are built in the neighboring city so that it is convenient to find restaurants and cafes. Another benefit is the availability of parking spaces for vehicles. There is no charge or parking pass needed for faculty, staff, and students. There are other benefits that are offered at these regional campuses which help serve the community such as local events and programs.

Analyzing student performance and attitudes

The first-year engineering courses studied in this paper are offered at a regional campus of the Ohio State University. The course content and laboratory work are consistent with the central campus offering and therefore these courses are highly regulated by the offering department. To assess student performance, student grades in those sections (AU2020, AU2021, AU2022) were presented.

The two courses (Fundamentals of Engineering I and Fundamentals of Engineering II) were taught by the author at the regional campus. Data was collected based on the grade distributions presented in Tables 1. and 2. below.

Fundamentals of Engineering I: In AU2020, 60% of the lectures and labs were taught in person and 40% were taught online using Zoom and online MATLAB platforms. The Software Design Project was completed in MATLAB and testing and troubleshooting were done remotely. In AU2021 and AU2022, 100% of the lectures and labs were taught in person.

Fundamentals of Engineering II: In AU2020, 100% of the lectures were taught remotely using Zoom and RemoteLabs platform implemented by the institution to grant remote access to labs for students, and 100% of the labs were taught in person. Students and instructors followed mask and social distancing guidelines. In AU2021 and AU2022, 100% of lectures and labs were taught in person.

Overall grades and the laboratory-only and project-only grades are provided in the tables below for the two courses. It is noted from Table 1. that the number of students failing the courses (D, E, F or W) was less than 10% for AU2021 and AU2022 semesters and those that passed the courses (A, B or C) are more than 90%. This explains that the majority of the students are passing the courses and have a good understanding of the subject matter. The results from AU2020 were slightly different due to the pandemic. Several students withdrew from courses due to the anxiety from social distancing.

Term	Overall Grades				
	A	B	C	D, E, F, W	Total
AU 2020	11	9	2	8	30
AU 2021	8	2	0	1	11
AU 2022	9	12	0	2	23

Term	Laboratory Grades				
	90- 100%	80-90%	70-80%	< 70%	Total
AU 2020	17	8	0	5	30
AU 2021	8	1	2	0	11
AU 2022	13	7	1	2	23

Table 1. *Overall (final) and Laboratory grades in Fundamentals of Engineering I for the three observed terms*

Term	Overall Grades				
	A	B	C	D, E, F, W	Total
SP 2020	6	11	2	2	21
SP 2021	8	7	0	2	17
SP 2022	7	9	3	5	24

Term	Laboratory Grades				
	90- 100%	80-90%	70-80%	< 70%	Total
SP 2020	13	8	0	0	21
SP 2021	17	0	0	0	17
SP 2022	18	2	1	3	24

Table 2. *Overall (final) and Laboratory grades in Fundamentals of Engineering II for the three observed terms*

It is noted from Table 2. that the number of students failing the courses (D, E, F or W) was about 10% for SP2022 and SP2021, however, it was about 20% for the SP2022 semesters. The spring courses were taught by another faculty member, hence the reason for the higher failing percentage is unclear. The method used for assessing the student attitudes was to analyze attendance and class participation. Based on the observations in the classroom and online via the Zoom participant

roster, the instructor observed that there were no significant differences in attendance in the 2020, 2021, and 2022 sections. However, the instructor has identified minor differences in student participation in online classes. Since the online classes are conducted via Zoom in Spring 2020, there were no requirements for a camera or microphone since the majority of the students come from rural backgrounds, and the university chose not to mandate the high-speed requirement for online classes. Therefore, this warrants more studies to be conducted to investigate student attitudes and behavior in an online learning environment. Although there were significant differences in motivation, students made all efforts to be respectful of each other's ideas and prompts during the sessions.

Other significant factors impacting the results could be the class size, different teaching methods, and different instructors. More data need to be collected in the future to provide statistically significant results over a broad group of student populations.

Best Practices

The author believes that this study could provide some guidance to the instructors teaching first-year engineering courses at the regional campuses. Some of the best practices are discussed below:

- *Preparation*: Preparation is critical in ensuring that the regional campus classes are taught in harmony with the central campus offerings. Therefore, preparing new instructors on the content of the course, the hardware necessary for the course and other aspects is important for a successful semester. Students should also be informed of the curricular synchronization within the campuses so that they are on the same page when communicating with their peers at other campuses.
- *Availability of Resources and Staff*: Due to the lack of resources and staff to support the laboratory components for these first-year engineering courses, it is important to make sure the supplies are ordered in a timely manner. It also allows for effective training of the new instructors. In addition to lab supplies, there is a specific need for additional staff to support the labs to ensure that students are able to complete the labs successfully understanding the concepts and applications rather than trying to finish the exercises. Having some lab assistants would help instructors navigate through the exercises more effectively.
- *Administrative Support*: Offering student positions to help with the labs would be necessary due to the limited budget for regional campuses. Rather than hiring full-time lab assistants, student workers could be trained to help support the labs. It also allows for some flexibility for students as they will become comfortable with the student workers. Student workers can also become peer mentors for their technical writing exercises and provide feedback.
- *Learning Resource Center:* The Academic Success Center (ASC) is a collaborative learning resource available to students at this regional campus. During the pandemic, the center was overwhelmed with the number of requests failing to address all the concerns since the tutors or mentees were also unavailable. With planning and proper coordination of tutors and peer mentors, it is possible to organize tutoring sessions geared toward first-year engineering students.

Future Work

The goal of this paper was to present some of the challenges and successes in teaching and learning during the first two years of engineering courses and share student attitudes and performance in those courses. With this paper, the author believes that the state of the regional campus teaching and learning was presented which would provide some guidance to the course coordinators and administrative support groups. More work across a wider sample is needed to understand the degree to which the teaching modalities and learning environments affect student performance. Also, the author realizes that the work presented in this paper is qualitative and in the future direct assessment of student skills and knowledge will be conducted. Similar studies with quantitative results will help in proposing strategies to address the challenges. In the future, it would be helpful to conduct qualitative student surveys or interviews as part of a comparative case study among all regional campuses which will serve the communities at large. More work is warranted to study student attitudes, engineering belongingness, and performance in higher-level courses offered at regional campuses.

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