



Work in Progress: Modeling a Tutoring Center to Improve Retention and Promote Student Success in Lower-level Engineering Classes

Dr. Hadil Mustafa, California State University, Chico

Dr. Mustafa received a Ph.D. in Electrical and Computer Engineering from the University of California at Irvine in 2012. In 2005, she received a M.S. in Electrical and Computer Engineering from California State University, Los Angeles. She is currently an Assistant Professor at California State University, Chico specializing in embedded systems design, cyber-physical systems, Computer architecture design, FPGA-based systems design, and Engineering educational innovation and research. Currently, she is a member of the McLeod Institution of Simulation Sciences at Chico state working on evaluating multi-FPGA communication protocols in high-speed real-time simulations and teaches courses in Embedded Systems Design, High-Performance Computing, and Digital Systems Design. She has been actively involved in implementing and evaluating new pedagogical approaches in her classes to promote students' success and improve retention rates.

WIP: Modeling a Tutoring Center to Improve Retention and Promote Student Success in Lower-Division Engineering Classes

Introduction

In recent years, engineering programs have experienced an increase in the number of students admitted due to the growing demand for young Engineering professionals. Lower division engineering classes, offered to students from multiple engineering disciplines, have been facing challenges to accommodate a large number of admitted students. Even though such courses may be offered in numerous sessions every semester, a ratio of one instructor to 100+ students is typical in these classes. The large class size and lack of support available to students in these classes contribute to high failure rate and significantly lower the retention rate. The CSU's "Graduation Initiative 2025", started 2015, has identified "student support services," such as tutoring and mentoring, as one of the leading elements that contribute to students' success [1], figure 1.

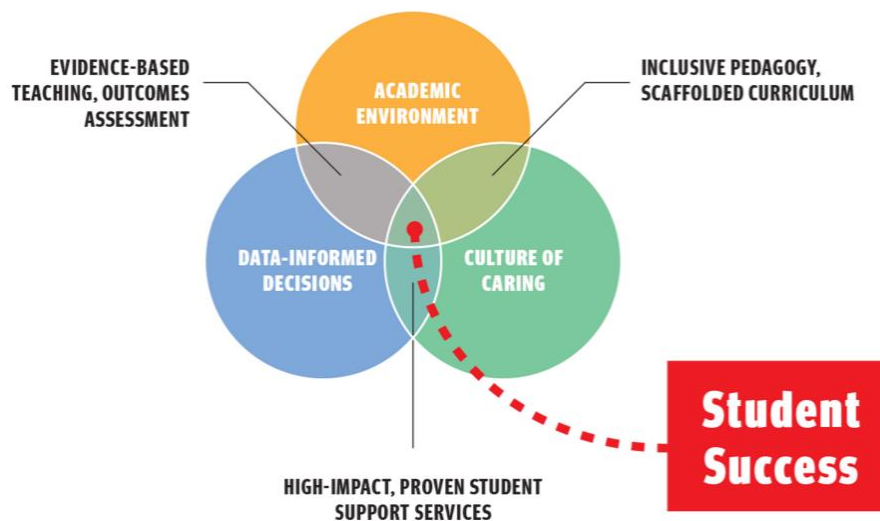


Figure 1: Elements of Students' Success [1]

In practice, peer tutoring has been utilized to support students in large introductory classes, such as math, chemistry, and biology, with little-to-no support in engineering classes. Tutoring services that target lower level engineering courses have been limited to individual attempts or club organizations, e.g., IEEE and HKN. Additionally, limited studies are evaluating general tutoring services in higher education [2].

In 2017, the Electrical and Computer Engineering department at California State University, Chico established a tutoring center to provide drop-in tutoring service to students in lower division engineering classes. Preliminary data has been collected to evaluate the center's impact on the success of our students, both tutors, and tutees. This Work-in-Progress paper represents an

up-to-date evaluation of the tutoring service along with suggestions for future improvement and assessment.

Motivation

While the retention rate in the school of engineering at Chico State has improved in the past ten years, it still lacks the national average. As shown in figure 2, the 4-years, 5-years and 6-years graduation rates for the First-time Full-time students have improved by 10% between the years 2005-2012. However, the average graduation rate, as of 2017, remains below national average [3].

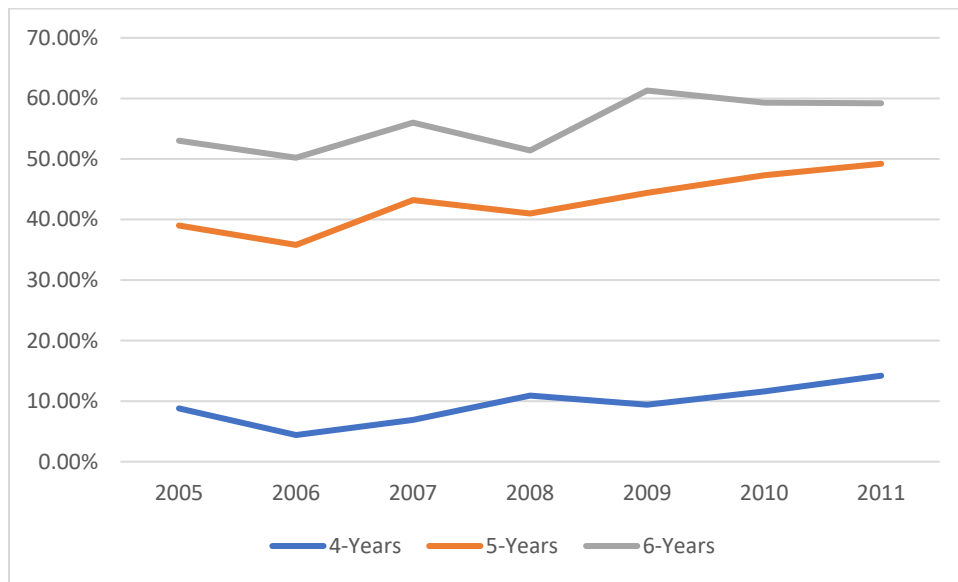


Figure 2: School of Engineering Graduation Rates 2005-2012

Moreover, the graduation rate in the College of Engineering was the lowest among all colleges in the university in the 2012-2015 cohort, as shown in figure 3.

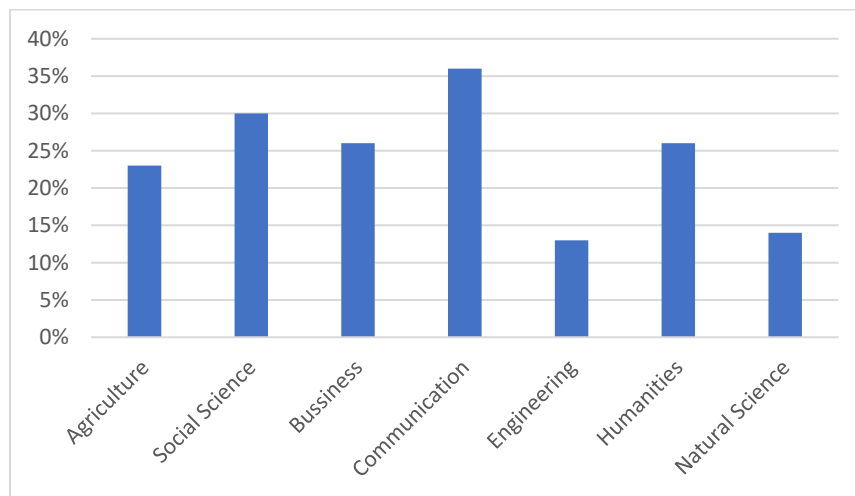


Figure 3: Graduation Rate 2012-2015 Cohort

Addressing the low graduation rate in California State Universities has been the focus of the CSU Chancellor's office for many years. In 2015, the Chancellor's office launched its second Graduation Initiative (GI 2025) with a goal of increasing the First-Time, Full-Time 4 and 6-year graduation rates in all its 23 campuses, table 1.

Table 1: CSU Graduation Initiative 2025

Completion Metric	2025 Target Campus Range
First-Time Freshmen: Four-Year Graduation Rate	30-71%
First-Time Freshmen: Six-Year Graduation Rate	55-92%

The Initiative identified many core strategies to meet the projected goal. One of the proposed approaches is to *“Increase student success rates in courses within the target time frame, especially in gateway and past high failure rate courses [4]”*. Additionally, the initiative proposes several key activities to support this strategy. One of the key activities was to offer additional support to students in *high failure rate courses* in the form of tutoring. High failure courses, referred to as "bottleneck course," are defined as courses with high DFW (students earning D, W or F grade) rate (>30%) and can delay students' graduation time. Offering extra support to students in these courses are sought to improve the graduation rate and increase retention rate.

For many years, tutoring has been promoted in higher education to improve academic achievement and encourage learning [5]. Research suggests that tutoring has many positive outcomes affecting both tutors and tutees, including [6][7]:

- a. Improve students' performance
- b. Improve the learning for both tutors and tutored students
- c. Improve overall performance in large mixed ability classes
- d. Help disadvantaged students academically and give them a sense of belonging to the school
- e. Help students develop a more positive attitude toward hard courses
- f. Increase social enhancement

Aside from its academic and social effect, Keerthana in [8] explained that "peer tutoring can provide more than twice as much achievement than computer aided instructions and three times more than reducing class size."

Despite its popularity in higher education, few studies were published in evaluating its effectiveness and impact on students' success [2]. This WIP paper focuses on assessing the impact a structured tutoring center has on all involved students, tutors, and tutees. The study evaluates a tutoring service, offered to students in lower-division engineering classes. All classes have been recognized as "bottleneck" classes and suffered from extensive enrollment due to the high failure rate.

Results and Data Analysis

In fall 2017, the Electrical Engineering department at Chico State established a specialized tutoring center to offer one-on-one tutoring to students in lower division Electrical Engineering classes. The center provided service to students in three bottleneck classes: "Logic Design Fundamentals," "Circuit Analysis," and "Embedded Systems Development" and will continue to do so in spring 2018. These courses are offered every semester in 2 or more sections. All enrollment ranges from 60-80 students per section. Students from 4 majors are required to take the courses during the first two years of their academic career. Tutors were hired after consultation and interviews with faculty members and were required to complete a "compliance training" before they start the service. In fall 2017, the department hired ten students as tutors, and due to high demands, this number is expected to increase in spring 18. The data presented in this section was collected using surveys, focus groups, and self-reflective essays.

In this section, we present an analysis of the collected data from tutors and tutees separately, as well as an overview of faculty roles and involvement in the program.

1. Impact on Tutors

In studying the effects, the service has on the tutors; we focus on the following aspects:

- The academic and social impact
- The advantages and disadvantages of participating as a tutor

As mentioned earlier, 10 tutors were involved in this study, all seniors, and juniors, with good academic standing. A focus group was held at the beginning of the semester to identify the students' vision of a successful tutoring service. Based on their prior experience as tutors, students were asked to provide suggestions to incorporate into the new tutoring center. Most students felt that instructors' involvement in the process was vital to the success of the program. They all requested to receive homework and lab assignments to prepare themselves for tutoring better. Also, students' comments and recommendations included: extend the tutoring hours, promote the center in classes, match tutors to courses based on preference, wear name tags identifying a specialized subject, and administer an evaluation at the end of the school year to determine areas for possible improvements.

At the end of the semester, all tutors were asked to write a self-reflective essay to reflect on their tutoring experience. A total of 7 essays were used for analysis in this paper. In their articles, students provided feedback on the effectiveness of the service as well as its impact on their personality and academic achievement.

In the realm of academic achievement, tutors stated that tutoring is not only beneficial for the tutees but the tutor as well. They indicated that it specifically helped them solidify their understanding of fundamental Engineering principles and allowed them to perform well in jobs' interviews. A couple of students felt their involvement in the center helped them improve their communication skills.

In their evaluation of the students' involvement and participation, all tutors agreed that the center was well received and had increased participation throughout the semester. Students indicated that tutored students' benefits were not limited to the academic aspects, but also included social involvement and moral support. For example, one of the students expressed his view on the importance of the tutoring center and its impact on peers through the following statement:

“These classes are by no means easy, and it is common to be discouraged from engineering when first starting and not doing as well as one had expected. I feel that is where the tutoring center helps immensely since students can receive the help and guidance they need, as well as being encouraged to continue with engineering....Students can also receive mentorship or advice from students that have recently taken the courses.”

None of the students outlined any disadvantages from their involvement in the tutoring service.

2. Impact on Tutees

The tutoring service was open to all students four days a week for 4 hours per day. A sign-in sheet was provided in all sessions to keep a record of participating students. A total of 25 students were randomly selected to participate in the study. A survey was given at the end of the semester to all participating students. The questionnaire consisted of two sections, a quality evaluation section and a free response section (sample of the essay in Appendix A). Students were directed to answer eight questions that addressed their experience with the tutoring service and how it affected their academic success. Also, they were asked to provide suggestions to improve the tutoring service.

Results from the first part of the survey were used to evaluate the effectiveness of the tutoring service based on attendance and overall satisfaction. The survey was administered both online and in person. The received responses showed that majority of the students visited the tutoring center more than five times during the semester, figure 4. As was confirmed by many tutors, the center had a sizable number of regular attendees, who was using the service on daily bases.

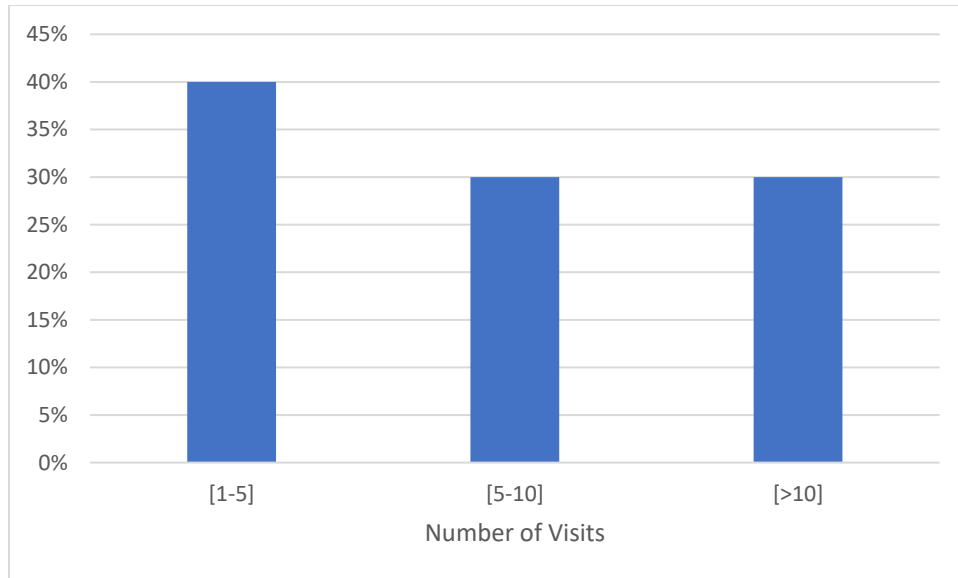


Figure 4: Fall 2017 Tutoring center visits

Concerning quality, the overall evaluation of the service was satisfying for the most part. Over 50% of the students felt the service was above average (Good and Very Good), while 29% indicated that it was exceptional. Only 7% ranked the service "Below Average," as shown in figure 5.

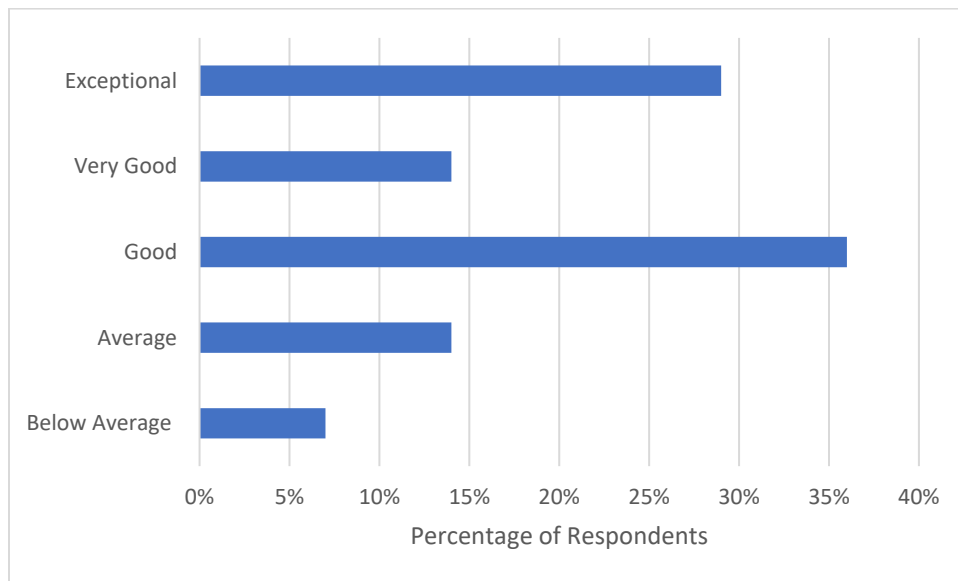


Figure 5: Student Evaluation of Service

The first question in the free response part of the survey asked the students to identify elements they appreciated the most about the service. Most of the answers commended the tutors for being "helpful," "patient," "knowledgeable," and "understanding." A student stated that he especially appreciated the fact that there is *"A place to go talk to peers about getting help in classes."*

Another student specified that what he liked most about the center was the fact that he could find individual help from students in the same major.

"It was easy you could just raise your hand, and someone will come over to help you out. Plus it was helpful to have a place that can specifically help you in your major."

On the other hand, students complained about the size of the room, the small number of tutors, and limited availability. Finally, a couple of students suggested that having an instructor visiting the tutoring center once a week may improve the productivity of the service in total.

As has been noted, the data presented in this section were collected from students in three different classes and during one semester only. Therefore, evaluating the effectiveness of the tutoring service based on the overall class performance was not feasible in this study. In the meantime, we conducted a preliminary evaluation of the tutored students' final grades in the serviced classes. The results presented in figure 6 summarizes the grade distribution for all 25 students involved in the survey. As shown in figure 6, 44% of the students achieved a B- or better grade, 32% received a grade in the C range, and 24% received (D-F) grade. We also noticed that students who achieved a B- or better grades had visited the center 10 times or more during the semester.

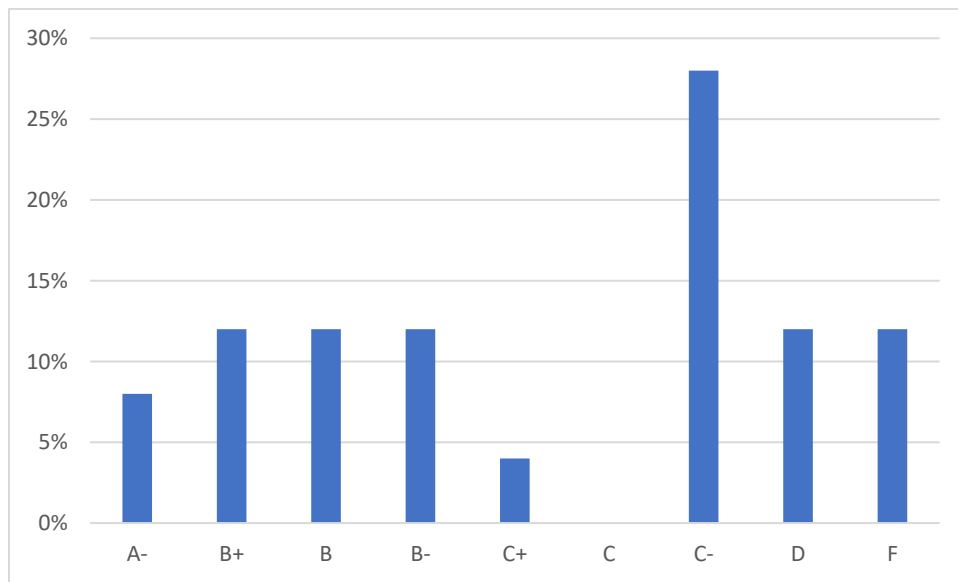


Figure 6: Surveyed students' final grade distribution in tutored classes

3. Faculty Involvement

As confirmed by both tutors and tutees, faculty involvement was a significant factor in the success of the tutoring center. Tutoring centers throughout campus have little to no faculty involvement in the process. Even though Research classifies administrating and overseeing the tutoring service by faculty members to be a significant drawback to peer tutoring programs [9], we managed to identify several strategies that helped in reducing the time spent by faculty

members in administering the program while maintaining a sufficient level of involvement. In our implementation, faculty contributions to the center were limited to:

- Recommending and interviewing tutors at the beginning of the academic year. This task was performed once a year and equally distributed among all faculty members teaching the courses.
- Adding hired tutors to the course management website (in Moodle, Blackboard, etc.). This allowed tutors to receive homework and lab assignments once posted directly.
- Administer tutor evaluation survey, at the end of the academic year. Evaluations can be conducted online with minimal time overhead.
- Meeting with tutors 2-3 times during the semester to address any concerns and get updates on the center's status.

Conclusion

According to our preliminary analysis, we can conclude that the tutoring service has managed to provide adequate help to students in the targeted courses. Students expressed great satisfaction with the service and indicated a need for such assistance in lower division engineering classes. It was also noted that the tutoring service had a positive impact on tutors regarding developing communication skills and solidifying their understanding of basic engineering concepts.

The collected feedback and suggestions from participating students enabled us to enumerate several adjustments to be incorporated in future implementations, including:

1. Increase the number of hours and tutors per session and upgrade the meeting facility to a larger room.
2. Assign a faculty member to oversee the tutoring center and conduct unannounced visits throughout the semester.
3. Collaborate with instructors to promote the center in their classes.

In the long run, the tutoring center is perceived to improve the success rate as it continues to help students in lower division engineering classes. Our preliminary evaluation showed that students who visited the center in regular bases passed their classes with a letter grade of C- or better. The long-term assessment of this study will track the success rate among tutored students in the targeted courses throughout the school year. We will also monitor the retention rate of students who have used the service in their freshman and sophomore years. Given that 60% of our admitted students drop out or change major during the first two years of their academic career [3], the service is expected to improve retention rate through offering support to students in their first engineering classes.

References:

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Appendix A

Tutoring Center Survey

1. Was fall 17 your first semester using a tutoring service?
 - a. Yes
 - b. No
2. Roughly, how many times did you participate in the EECE tutoring center?
 - a. 1-5
 - b. 5-10
 - c. More than 10
3. Rate your experience in using the service
 - a. Below average
 - b. Average
 - c. Good
 - d. Very good
 - e. Exceptional
4. If this was not your time to use a tutoring service, how did it compare to others?
 - a. Same
 - b. Slightly better
 - c. Better
 - d. A lot better
5. What did you like most about the EECE tutoring program?
6. What did you like least about the EECE tutoring program?
7. Describe an ideal tutoring service in your opinion
8. What changes would you suggest to improve the EECE tutoring center?