Interactions with Undergraduate Academic and Career Advisors in a Signals and Systems Base Course

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Abstract

The goal of this project is to develop an understanding of how student engagement in a Signals and Systems base course in Virginia Polytechnic Institute & State University, a large mid-Atlantic university, can be improved through email interactions with Undergraduate Academic and Career Advisors who are advising the undergraduates who are taking the course. These interactions related to graded events may introduce the possibility to improve student performance and engagement in the course. The Bradley Department of Electrical and Computer Engineering supplied the template to use in corresponding with the academic advisors. The weekly interactions were offered by one instructor of the base course for six semesters from Spring 2021 to Fall 2023 (and we aim to continue in future semesters). As part of the teaching, starting in Spring 2022, the department asked the base course instructors to send emails to students who did not complete graded events using a template, and to copy each student's undergraduate academic and career advisor on the emails. In this section, several hundred emails have been sent to date by the instructor. We aim to develop the course through these interactions with the students' Advisors, and we present results of a comparison of the results in "Intervention groups" (Spring 2022, Fall 2022, Spring 2023, and Fall 2023) with the results in "Control groups" (Spring 2021 and Fall 2021 sections that did not receive the emails). Preliminary results in Spring 2024 semester show that class attendance remains high; 100% of the students took Exam 1; approximately 10-20 students attend weekly Friday recitation sessions, and approximately 5-20 students attend weekly MATLAB recitation sessions. A major finding of this study is that the interactions have helped improve student attendance and quiz completion in subsequent weeks (after a missed quiz or class).

Introduction

This paper discusses interactions with students and career advisors in a sophomore-level signals and systems course in the Bradley Department of Electrical and Computer Engineering at Virginia Polytechnic Institute & State University, a large mid-Atlantic university, that is designated by the National Science Foundation as a minority-serving institution. The course has been offered each semester since Spring 2021 (Spring 2021, Fall 2021, Spring 2022, Fall 2022, Spring 2023, Fall 2023, and Spring 2024) [1]. This paper aims to describe interactions with students' academic advisors in a sophomore level Signals and Systems course and how asking the faculty instructor to send emails to the students and to their advisors is vital to student success in the Signals and Systems course. The paper also presents results of the analysis of the faculty's emails as a first step to quantify the care that the course is taking to help all students succeed in Signals and Systems course.

Collaboration between staff counselors and faculty is discussed in the literature [2]-[5] including in *The Chronicle of Higher Education* [2] in 2021. This latter article mentions that "the need for faculty-advisor exchanges rarely gets championed. Yet the quality of academic advising risks being compromised when staff counselors don't have access to faculty input. After all, it's faculty

members who witness how students do in class, and how they cope with course requirements" [2]. The article continues with the guidance that "If we are serious about student success – and about advising as a key way to achieve it – then academic counselors and faculty members must engage with one another about our students early and often" [2]. The article proposes that "The institution itself should advance ways to bring these two sets of colleagues together – with the dedicate time counted as 'service' for faculty members and acknowledged in staff advisors' annual evaluations" [2].

As part of a National Science Foundation (NSF) Revolutionizing Engineering Department (RED) grant, our department generated a document entitled "Engineering Care: The Vital Role of Academic Advisors in ECE Success" [6]. The document quantifies care for electrical and computer engineering (ECE) undergraduate students according to the number of student meetings, number of student concerns raised, and frequency of Academic Advising Topics [6]. The document also presented three themes that describe the value for care work. These three themes are "Reflect on and reevaluate the contributors to student success," "Mutual empowerment of expertise", and "Fostering a culture of collaboration, cooperation, and communication" [6].

The document "introduces the academic-career advisors, shows all that they do, and it answers a request from one of the advisors: `I feel there should be a stronger relationship between the faculty and the advisors. And I think that would be a direct correlation back to the students" [6]. Six reasons are listed to explain why advising matters: (1) student support; (2) happier students; (3) student retention; (4) increased diversity; (5) life preparation; and (6) confident students. Among the measures provided to quantify care provided by the advisors includes 1,699 student meetings (during COVID-19) and 2,495 student concerns.

To demonstrate the value of care work, the document provides three suggestions. The first suggestion is to "reflect on and reevaluate the contributors to student success". The second suggestion is "mutual empowerment of expertise". The third suggestion is "Fostering a culture of collaboration, cooperation, and communication" [6].

Background

Nel Noddings published a book "The Challenge to Care in Schools: An Alternative Approach to Education," discussing the topic of caring in schools in 1992 [7], and a second edition was published in 2005 [8]. In 2017, Kim Samuel discussed how to create "more caring university classrooms". Three components of a "caring university classroom" described in this article are "respect, recognition, and reciprocity" [9]. In 2021, Unwin *et al.* [10] published a study in *American Family Physician* discussing the "Care of the College Student". In 2023, Kim Samuel discusses how to create a caring campus [11].

At Virginia Tech, starting in August, 2022, Virginia Tech offers free 24-7 access to virtual care services [12, 13]. This is a partnership with TimelyMD. As part of the care services, students "will have access to: unlimited on-demand mental health support 24/7, available to all Virginia Tech students throughout the world, through TalkNow, [and] unlimited access to health coaching, available to all Virginia Tech students throughout the world, …."

Care and Faculty Emails to Students

In 2021, Carrell and Kurlaender published a study in the *American Economic Journal: Economic Policy* entitled "My Professor Cares: Experimental Evidence on the Role of Faculty Engagement" [14, 15]. In this study, Carrell and Kurlaender present interventions aimed to increase faculty engagement with undergraduate students in underrepresented groups. These interventions include "inducing a change in faculty *behavior* toward students" [14, page 115] in a 420-student introductory microeconomics course in 2014 [14, page 119] at University of California Davis, a large four-year institution of higher education. One intervention "consisted of two to three strategically timed personalized emails to students from the professor…" [14]. Benefits of this approach described in focus groups include students "[feeling] more connected to their instructor and when they understood class expectations" [14]. As described in this paper, the three components of the emails sent by the instructor are "(1) how they [the students] are progressing in the class; (2) how to be successful in the class moving forward; and (3) the availability of the professor and other supports" [14, page 117]. The study was scaled up in 2016 and 2017 to nearly 3,000 students taught by 22 faculty members in 20 different courses. As in the 2014 study, the studies in 2016 and 2017 involved emails sent by faculty to students containing the three previously-described components. The authors conclude that their "results suggest that a light-touch intervention that increased professor engagement significantly improved students' perceptions of the professor and course" [14, page 132].

Care and Belonging on Campuses

An increasing body of literature discusses caring for the student on university campuses. These include articles by Croley *et al*. in 2022 [16] and examples of institution discussions about care for students [17, 18, 19, 20]. Recent studies also discuss self-care for college students [21, 22, 23, 24, 25, 26]. Maithreyi Gopalan discusses three studies describing how students having a sense of belonging matters [27, 28, 29, 30, 31].

Good Practice in Undergraduate Education

We now discuss work published before the previous studies that address the sending of emails by faculty to students. In 1987, Chickering and Gamson published a list of "seven principles for good practice in undergraduate education" [32, 33]. Their list of good practice is the following "1. Encourages contact between students and faculty; 2. Develops reciprocity and cooperation among students; 3. Encourages active learning; 4. Gives prompt feedback; 5. Emphasizes time on task; 6. Communicates high expectations; 7. Respects diverse talents and ways of learning". Chickering and Gamson describe the contact between students and faculty in the following way,

> "*Frequent student-faculty contact in and out of classes is the most important factor in student motivation and involvement. Faculty concern helps students get through rough times and keep on working. Knowing a few faculty members well enhances students' intellectual commitment and encourages them to think about their own values and future plans*" [32].

The sending of emails by faculty to students, which is the focus of this paper, supports the first and sixth items in the list of Chickering and Gamson, namely " 'contact between students and faculty' and 'communicates high expectations' " [32].

Approach

The published Signals and Systems course description [34] is that the course covers "Mathematical methods for the analysis and design of continuous and discrete linear, time-invariant systems. Representation of signals using time-domain and frequency-domain methods and the application of Fourier transforms to linear system design and analysis. Descriptions of systems as signal transformations using block diagrams, differential equations, difference equations, convolution, and transfer functions. Applications to signal filtering, measurement, and control of the physical devices. Formal project documentation adhering to professional practices" [34].

The Signals and Systems course contains 24 distinct lectures in addition to two exams, two review classes, a review class for the final exam, and a final exam (See Table 1) [1]. Each lecture introduces a new topic called a "Topic Learning Objective" (TLO). The course setup, concept map, learner-centered teaching approach [35]-[39], and prior results are described in our 2023 ASEE paper [1]. The course uses the textbook by Alan Oppenheim and Alan Willsky entitled *Signals and Systems* [40].

Table 1. Topic Learning Objectives (TLOs) for the Course [1]

TLO Number	Topic Learning Objective (TLO) Number and Name
1	TLO 1: Course Introduction
2	TLO 2: Continuous-time (CT) signals
3	TLO 3: Discrete-time (DT) signals
4	TLO 4: CT systems as linear constant coefficient differential equations
5	TLO 5: DT systems as linear constant coefficient difference equations
6	TLO 6: Linear time invariant CT systems
7	TLO 7: Linear time invariant DT systems
8	TLO 8: CT convolution
9	TLO 9: DT convolution
10	TLO 10: CT block diagrams
11	TLO 11: DT block diagrams
12	TLO 12: Eigenfunctions of CT systems
13	TLO 13: Eigenfunctions of DT systems
14	TLO 14: CT Fourier Series representation of signals
15	TLO 15: DT Fourier Series representation of signals
16	TLO 16: CT Fourier Transform
17	TLO 17: DT Fourier Transform
18	TLO 18: CT Frequency Response
19	TLO 19: DT Frequency Response
20	TLO 20: Frequency Selective Filters in CT
21	TLO 21: Frequency Selective Filters in DT
22	TLO 22: The Discrete Fourier Transform
23	TLO 23: Sampling
24	TLO 24: Reconstruction

In Spring 2022, the department requested that instructors of all base courses, including the Signals and Systems course, reach out to students by sending emails to students who miss assignments. The department sent the faculty members a template to use in the faculty's emails to the students. The department also asked the faculty to send the emails and copy the student's advisors in the emails. The department-provided template is:

> *Dear Student (insert name here),*
> *I was reviewing the grades in ECE XXXX and noticed that you were not able to complete assignment XXX. Is there anything our support team for the class can do to help you keep on track in the class? I am happy to have you in this class and want to see you succeed. I understand that we all face demands outside of the classroom that can impact our class performance. If you would like to meet to discuss a plan moving forward in this course, please come to my office hours at your earliest opening or if they conflict with your schedule, please reach out to our assigned GTA for assistance.*

In this paper, the word "assignment" mentioned in the template above refers to a graded event such as class attendance, review session attendance, lab submission, exam taken, and quiz submission. The terms "assignment" and "graded event" in this paper are used interchangeably.

Following receipt of this template, the faculty instructor of this section of the course sends email to each student who misses a graded event (including but not limited to the following: weekly quizzes, missed classes, missed exam review sessions, missed exams). The department requests that the faculty member copy each student's Undergraduate Academic and Career Advisor.

In Spring 2022, a total of approximately 209 letters composed using this template were sent to students in this hybrid section who missed quizzes or labs by the instructor. Of these emails, approximately 181 emails were sent to students who remained in the course and who missed quizzes, and an additional twenty-eight letters were sent to students who dropped out or withdrew from the course. In Fall 2022, approximately 60 letters composed using this template were sent before the changes were made based on the Mid-Semester Feedback, and approximately 140 letters were sent after the changes made.

Since Spring 2022, the faculty instructor of this online/hybrid section of ECE2714 (first author of this paper) sent approximately 890 emails to 264 students who missed graded events (classes, quizzes, exams, exam reviews). Advisors were copied on the emails (Table 2). The data for the number of emails sent in Table 2 are approximate.

Table 2. Emails sent to students assigned to Academic Advisors, Attendance, and Grade for four semesters in Spring 2022, Fall 2022, Spring 2023, and Fall 2023

	Emails sent to students who miss an assignment (students are assigned to Academic Advisors)	**Class participation**	**Class Performance**
	All Advisors	**Attendance (%)**	**Grade (%) Confidence Interval**
Spring 2022	**190**	N/A (attendance not tracked)	(74.6 ± 20.1)
Fall 2022	**146**	77.4 (average in the part of the semester that was tracked)	(76.2 ± 16.3)
Spring 2023	**409**	76.5	(77.7 ± 11.7)
Fall 2023	**145**	82.1	(86.0 ± 8.5)
Total	**890**	--	--

Spring semesters tend to have higher enrollment compared with Fall semesters, although Spring 2023 and Fall 2023 enrollments were comparable with approximately 70 students each semester (the room is filled, and there are fire code restrictions that limit the number of students to 72 students).

Figure 1 shows the attendance percentage and the total number of emails sent to students in all four semesters, Spring 2022, Fall 2022, Spring 2023, and Fall 2023.

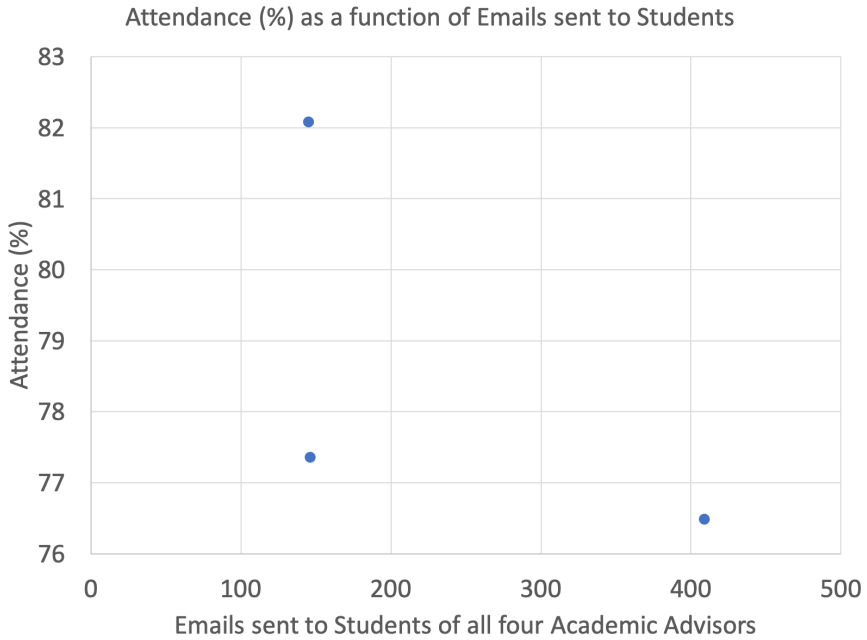

Figure 1. Attendance and total number of emails sent to students

Figure 2 shows grade as a function of attendance. The results show that the grade tends to be a bit higher when attendance is higher. This study will continue in future semesters to learn more about this trend.

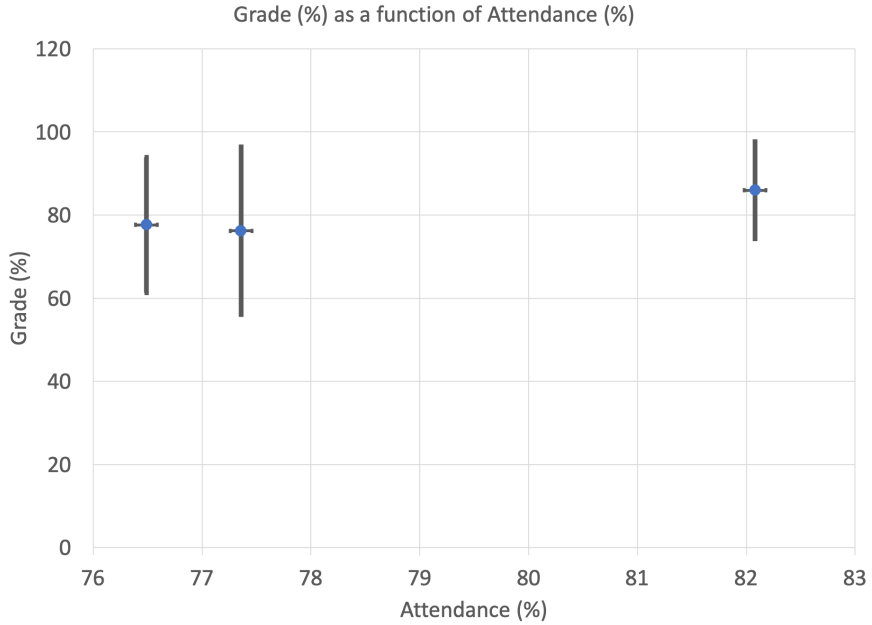

Figure 2. Grade as a function of Attendance

Figure 3 shows the grade percentage as a function of total number of emails sent to academic advisors. A higher average grade is observed when the number of emails is lower. This observation will be tracked in future semesters to see if the trend continues.

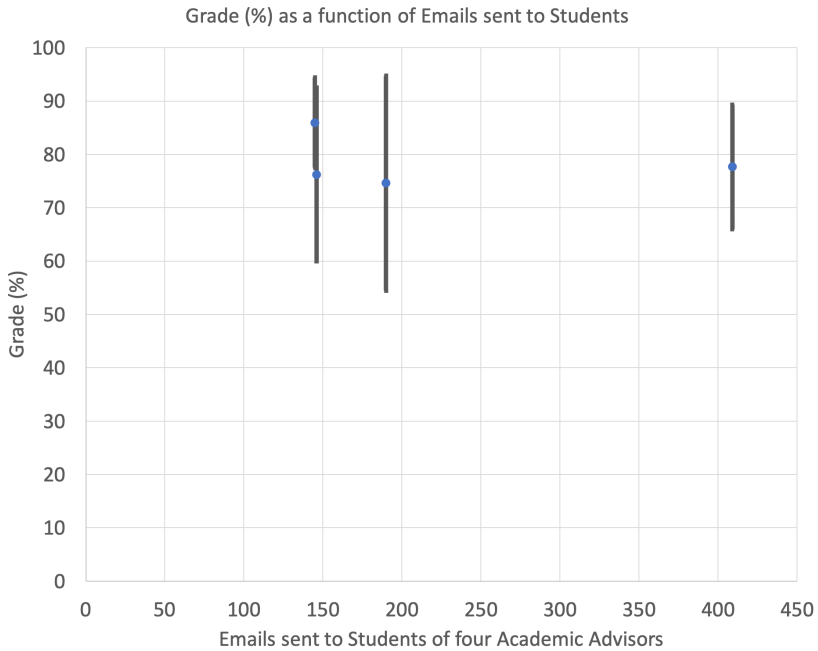

Figure 3. Grade as a function of total emails sent to Academic Advisors

Results: Attendance in Fall 2022, Spring 2023, and Fall 2023

Attendance was not tracked during the two control semesters (Spring 2021 and Fall 2021) or in Spring 2022, prior to about two-thirds into the semester (TLO17) in Fall 2022. Attendance was tracked during the entire Spring 2023 and Fall 2023 semesters (with points given for attendance as described in the companion paper at 2024 ASEE entitled "Further Strategies to Develop an Online/Hybrid Signals and Systems Course" [41]). Average attendance in Fall 2022, Spring 2023, and Fall 2023 semesters is 77%, 76%, and 82%, respectively, as shown in Figure 4.

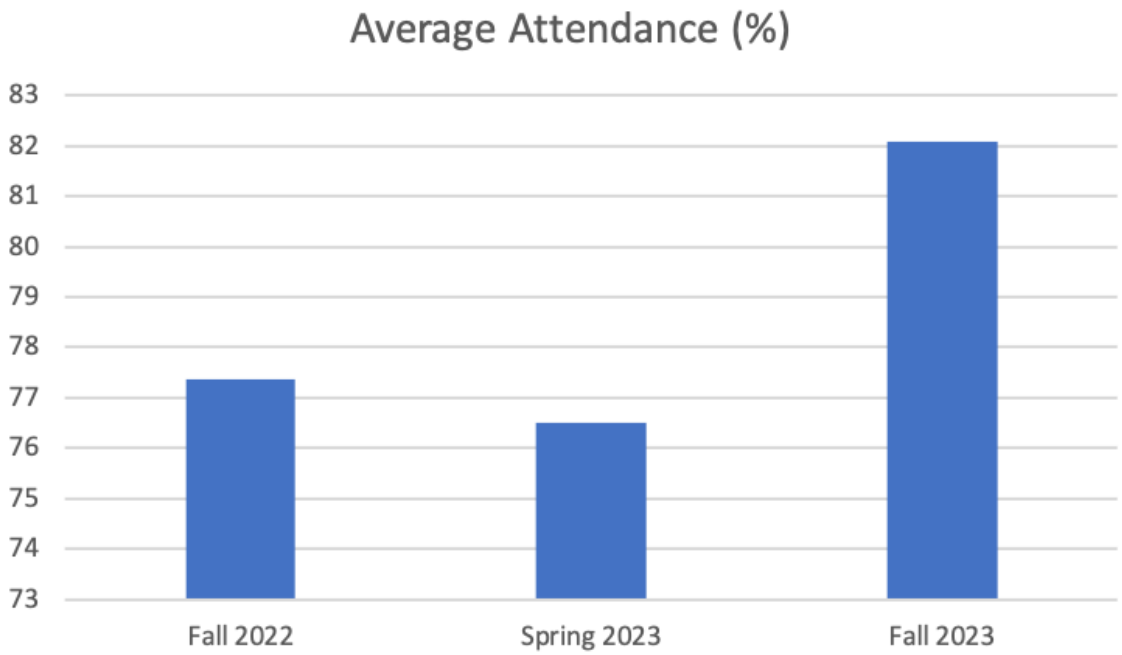

Figure 4. Average attendance in Fall 2022, Spring 2023, and Fall 2023. (Attendance was not tracked in Spring 2021, Fall 2021, and Spring 2022)

Results: Time histories of missed assignments

To understand more about the effect of sending many emails to students who miss assignments and exams, we first quantified the number of emails. The number of emails is approximate because the sending and counting of sent emails is done manually.

It appears that the sending of emails reduces the number of missed assignments in consecutive weeks. Emails also appear to reduce the total number of missed assignments, and one approximate measure of this is that it took the instructor only about 20-30 minutes in Fall 2023 to send emails each week (compared with prior semesters when it took the instructor about 1-2 hours per week to send emails about missed assignments). This time is estimated by the instructor who taught this section of the course. The amount of time is estimated because emails are typically sent after class or during the mornings before meetings. The department asked the instructor to send the emails to the students and advisors and to publish this paper for the ASEE Annual Conference.

A time history of missed assignments for students is now shown. This figure shows the number of missed assignments in each week since the start of the study. The number of missed assignments is obtained by binning assignments into weeks. Each semester is indicated at the range of weeks in the graph. Week 0 corresponds to the start of the semester in Spring 2022 (the zeroth week since the start of the study).

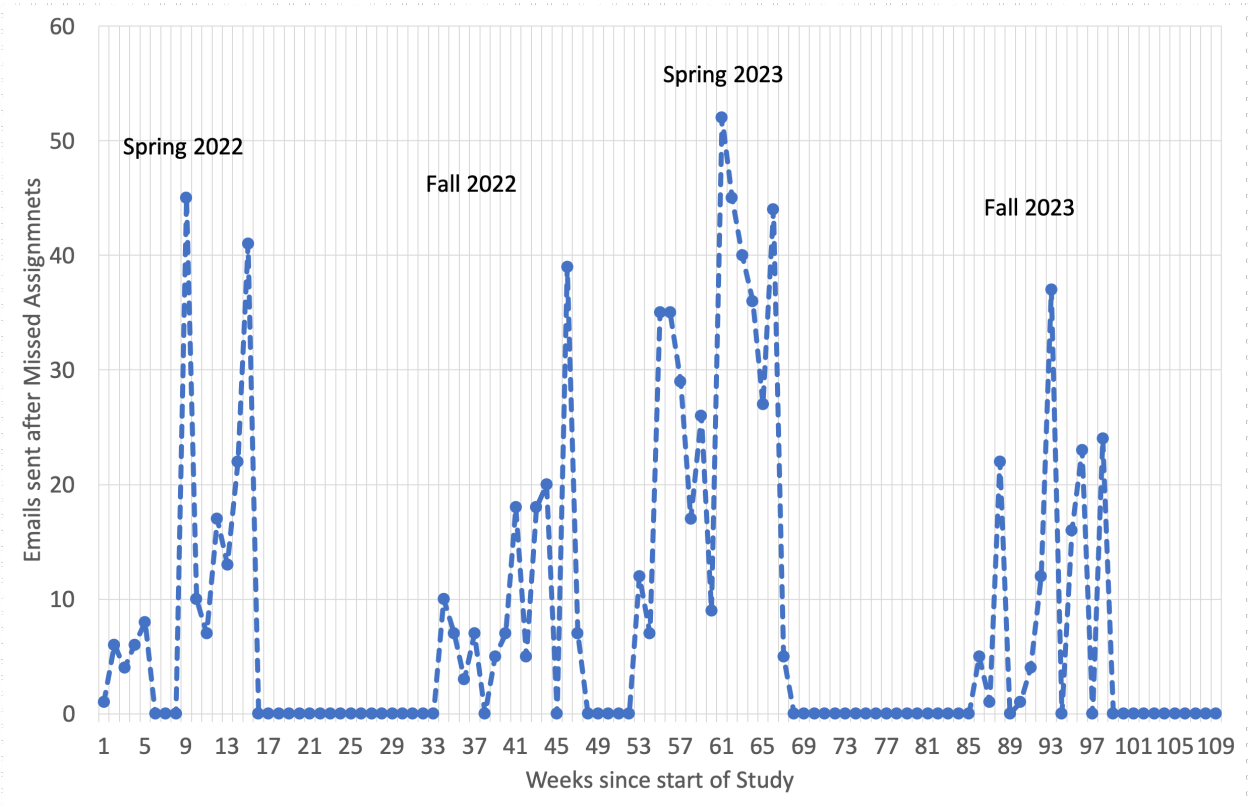

Figure 5. Time histories of emails sent after missed assignments each week since the start of the study

Results: Time history of missed assignments in successive weeks

After sending emails to the students about missed work, it was observed that students tend to complete the work in the following week. One question we had was whether the sending of emails in a given week was helpful in reducing the number of missed different assignments in the subsequent week (and therefore reducing the number of sent emails in the subsequent week).

The product of missed assignments in successive weeks (missed assignments in one week times missed assignments in the following week) is one important metric in this study. The product of missed assignments in successive weeks will be zero when assignments are completed in the following week. One measure of success of the sending of emails is that the product of missed graded events in successive weeks will be zero. We aim for success in reducing emails and for the metric to be zero in successive weeks.

Another way to think about this approach is that the goal is for the product of two consecutive missed graded events to be as low as possible (from one week to the next week). We record the number of students who have missed graded events and the date that they have missed that graded event. We construct a histogram of the number of students who have missed events in a given week by binning the missed events in a 7-day period starting from the first day of the semester in Spring 2022 (bin size is one week). We then construct a histogram of the number of students who were sent emails about missed events in a given week. From this histogram we construct another time history of the number of students who were sent emails the following week about missed graded events. Then we multiply the two histograms to obtain a measure of the product of missed events: That is, the product of the number of emails about missed events in a given week and the number of emails sent about other missed graded events in the following week.

Figure 6 shows the time history of the product of the number of missed assignments in each week and the number of missed assignments in the following week. As discussed above, an Academic Advisor is sent an email and is copied on the email sent to the student by the instructor, and the email informs the student when an assignment is missed. The missed assignments are connected to the Advisor because each student is assigned to an Academic Advisor, and that assigned Advisor is copied on the email to each student. An indicator that the sending of emails had an effect in reducing emails sent in successive weeks is that there are many 'zero' values in the figure. Enrollment in Fall semesters is typically lower than enrollment in Spring semesters, which could potentially explain why there are more missed assignments in Spring 2023.

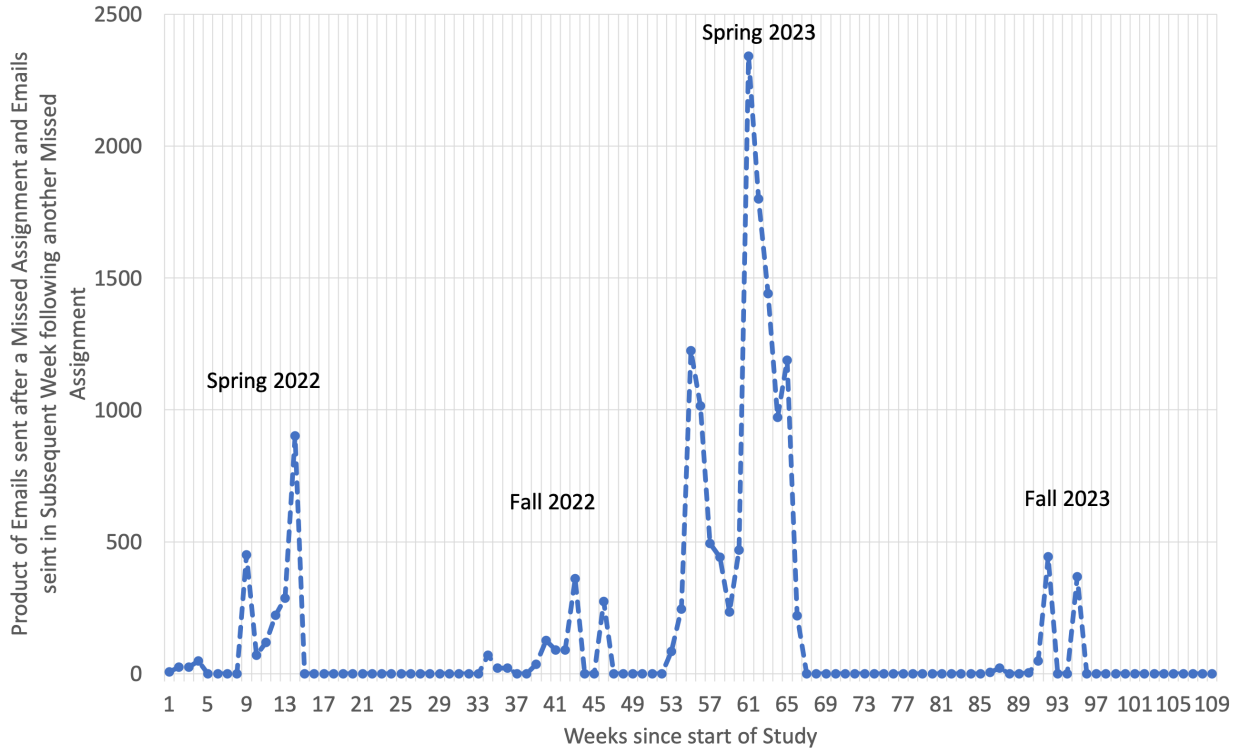

Figure 6. Time histories of the product of number of emails sent after missed assignments each week and the number of emails sent the following week since the start of the study

Comparison with Missed Assignments in Spring 2021 and Fall 2021 (prior to sending emails)

We tried to do a comparison with the control groups (Spring 2021, Fall 2021); however since the attendance was not tracked in the prior semesters, it is not possible to compare the missed assignments and product of missed assignments (discussed in the previous section) with Spring 2021 and Fall 2021 semester. In the semesters (Spring 2021, Fall 2021) prior to Fall 2022, attendance was not tracked. We sought a comparison with the impact of sending emails after missing assignments, such as attendance, to the students. The closest type of daily assignment that was done in prior semesters (Spring 2021, Fall 2022, Spring 2022) is the daily Active Reading Worksheet (ARW, due by start of class each day) and Engagement Questions (EQ, due by the end of the class day).

We first calculated the number of missed assignments that followed another missed assignment, for the entire class. Then we calculated the product of the number of missed assignments (that followed another missed assignment) and the number of missed subsequent assignments (that themselves followed another assignment (again, for the entire class). The results for Spring 2021 and Fall 2021 show that very few missed assignments (ARWs, EQs). I think that I let the students complete these assignments before the end of the semester for full credit, unless I am completely mistaken. In Spring 2021, the section was held entirely online including online exams during COVID. Few students missed two assignments in a row. In Fall 2021, the section was held online with in-person exams, also during COVID. Again, few assignments were missed.

Results: Course Performance and Grade Distributions

The letter grade distribution percentages in Spring 2021, Fall 2021, Spring 2022, Fall 2022, Spring 2023, and Fall 2023 are shown in Table 4 (rounded to the nearest percentage). The results in Table 4 show that the grade distribution and C-/D/F rate for the sections that did not receive emails in Spring 2021 and Fall 2021 are 16% and 25%, respectively. These distributions and C-/D/F rates improve in sections that did receive emails and improve in subsequent semesters to 21%, 9%, 14%, and 0% in Spring 2022, Fall 2022, Spring 2023, and Fall 2023, respectively. In Fall 2023, no students who completed the course failed the course with a grade of C- or lower.

Table 4. Letter grade distributions each semester for Spring 2021, Fall 2021, Spring 2022, Fall 2022, Spring 2023, and Fall 2023. The grey cells indicate the "control" (students did not receive emails in Spring 2021, Fall 2021).

	Semester					
Grade	**Spring 2021**	**Fall 2021**	**Spring 2022**	**Fall 2022**	**Spring 2023**	**Fall 2023**
A	13%	8%	16%	16%	6%	44%
B	49%	25%	26%	44%	40%	55%
C	22%	43%	36%	31%	40%	2%
C-, D, F	16%	25%	21%	9%	14%	0

Numerical grade distributions are shown in Figure 7 and Figure 8. The figures show that there are few students with grades at the lower end of the distribution, and most students have grades at the higher end of the distribution. The grade distributions for the section that received emails (Figure 8) appear to shift to higher grades, especially for the Fall 2023 section, compared with the section that did not receive emails (Figure 7).

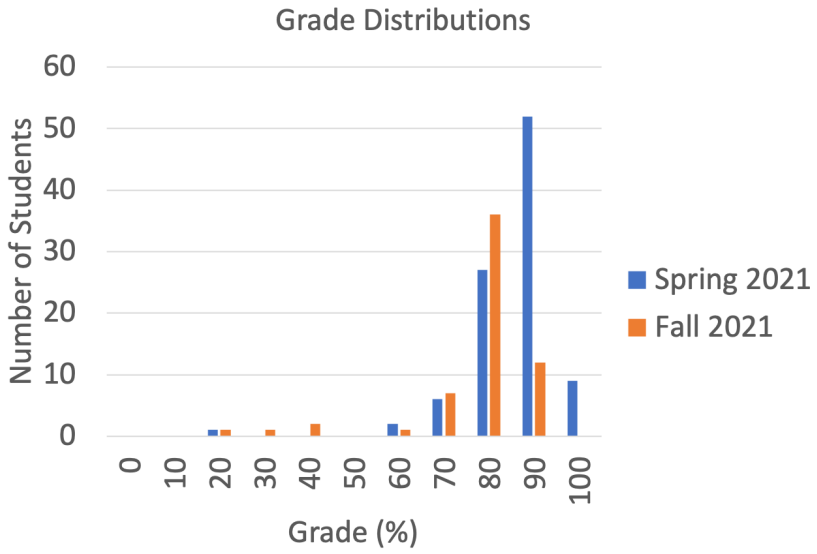

Figure 7. Grade distributions in Spring 2021 and Fall 2021 (the Control sections)

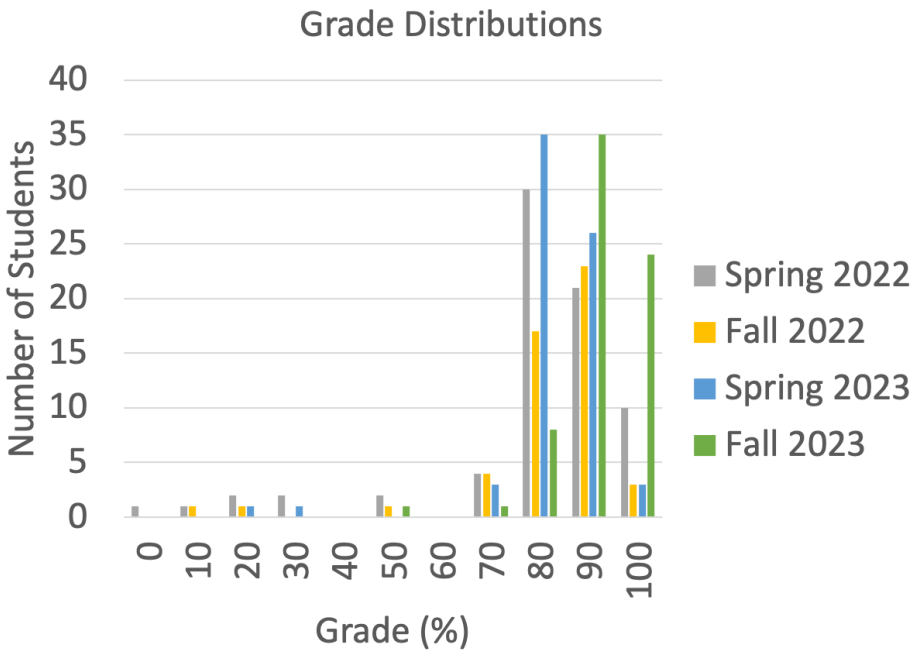

Figure 8. Grade distributions in Spring 2022, Fall 2022, Spring 2023, Fall 2023 (the sections that received emails when assignments were missed)

Comparison of "Control Groups" (Spring 2021, Fall 2021) with "Intervention Groups" receiving Emails (Spring 2022, Fall 2022, Spring 2023, Fall 2023)

In this section, we compare the results of the students in Intervention sections in Spring 2022, Fall 2022, Spring 2023, and Fall 2023 with students in the "control groups" (students in Spring 2021 and Fall 2021 sections). This analysis starts with obtaining a list of the grades in each section. There is one grade for each student in the section.

We first perform an F-test between the grades in the **Spring 2021** Control section and grades in the four Intervention sections (Spring 2022, Fall 2022, Spring 2023, Fall 2023) to determine if the variances are equal or not. The null hypothesis is that the variances are equal. Next we perform a T-test with the grades in the Spring 2021 section and each of the intervention sections to determine if the mean grade in the Spring 2021 section is the same as the mean grade in each intervention section. The null hypothesis is that the mean grades are equal. We next perform an F-test between the variances in the grade of the **Fall 2021** Control section and the variances in the grade in the four Intervention sections (Spring 2022, Fall 2022, Spring 2023, Fall 2023) to determine if the variances are equal or not. The null hypothesis is that the variances are equal. Next we perform a T-test with the grades in the Fall 2021 section and the grades in each intervention section to determine if the mean grade of the Fall 2021 section is the same as the mean grade of each the four intervention sections . The null hypothesis is that the mean grades are equal.

Table 5 shows a comparison of the mean grade in each Control Group and each Intervention Group. In this table, the **red** shaded cells indicate significantly lower mean grade in the intervention groups compared with the mean grade in the control groups. The **green** shaded cells indicate significantly higher mean grade in the intervention groups compared with the mean grade in the control groups. The white cells indicate no significant difference between the mean grade in the control group and the mean grade in the intervention group.

Table 5. Comparison of Mean Grade in Control Groups (Spring 2021, Fall 2021) and Intervention Groups (Spring 2022, Fall 2022, Spring 2023, Fall 2023). The **red** (**green**) shaded cells indicate significantly lower (higher) mean grade in the intervention groups compared with the mean grade in the control groups. The white cells indicate no significant difference.

	Control Groups (no emails)			
	Spring 2021 (online)		**Fall 2021 (online; in-person exams)**	
Intervention Groups	***M* = 80.9**	$V = 105.5$	***M* = 72.4**	$V = 178.9$
Spring 2022 (online; in-person exams) ***M* = 74.6**; V = 405.7	$F_{72,96} = 3.9$, $p = 6.2E\text{-}10$; $t(100) = -2.44$, $p = 0.0082$		$F_{72,59} = 2.3$, p = 0.00071; $t(126) = 0.76$, $p = 0.22$	
Fall 2022 (in-person) ***M* = 76.2**; $V = 265.0$	$F_{49,96} = 2.5$, $p = 5.9E\text{-}05$; $t(102) = -4.2$, $p = 2.6E\text{-}05$		$F_{49,59} = 1.5$, $p = 0.075$; $t(95) = 1.3$, $p = 0.094$	
Spring 2023 (in-person) ***M* = 77.6**, $V = 136.4$	$F_{68,96} = 1.3$, $p = 0.12$; $t(164) = -1.9$, $p = 0.029$		$F_{59,68} = 1.3$, $p = 0.14$; $t(127) = -2.4$, $p = 0.0095$	
Fall 2023 (in-person) ***M* = 86.0**, $V = 71.6$	$F_{96,68} = 1.5$, $p = 0.046$; $t(160) = -3.5$, $p = 0.00034$		$F_{59,68} = 2.5$, $p = 0.00015$; $t(97) = -6.8$, $p = 5.0E\text{-}10$	

Comparison of Spring 2021 "Control Group" with "Intervention Groups" receiving Emails (Spring 2022, Fall 2022, Spring 2023, Fall 2023)

We start by considering the control group in Spring 2021. This group did not receive emails about missed graded events and assignments. The mean Spring 2021 grade for 97 students is $M = 80.9$, $V = 105.5$. We now compare this control group to the four groups that did receive emails (Spring 2022, Fall 2022, Spring 2023, and Fall 2023). The results in Table 5 show that the mean grade in Fall 2023 is significantly higher compared with the mean grade in Spring 2021.

We summarize the results in Table 5. First, the mean Spring 2022 grade for 73 students is significantly lower than ($M = 74.6$, $V = 405.7$) the mean Spring 2021 grade, $t(100) = -2.44$, $p = 0.0082$ ($F_{72,96} = 3.85$, $p = 6.24\text{E-}10$). Second, the mean Fall 2022 grade for 50 students is significantly lower than ($M = 76.2$, $V = 265.0$) the mean Spring 2021 grade, $t(102) = -4.22$, $p = 2.63\text{E-}05$ ($F_{49,96} = 2.51$, $p = 5.92\text{E-}05$). Third, the mean Spring 2023 grade for 69 students is significantly lower than ($M = 77.6$, $V = 136.4$) the mean Spring 2021 grade $t(164) = -1.91$, $p = 0.029$ ($F_{68,96} = 1.29$, $p = 0.12$). Fourth, the mean Fall 2023 grade for 69 students is significantly greater than ($M = 86.0$, $V = 71.6$) the mean Spring 2021 grade, $t(160) = -3.46$, $p = 0.00034$ ($F_{96,68} = 1.47$, $p = 0.046$).

Comparison of Fall 2021 "Control Group" with "Intervention Groups" receiving Emails (Spring 2022, Fall 2022, Spring 2023, Fall 2023)

We next consider the control group in Fall 2021. This group also did not receive emails about missed graded events and assignments. The mean Fall 2021 grade for 60 students is $M = 72.4$, $V = 178.9$. We also compare this control group to the four groups that did receive emails: Spring 2022, Fall 2022, Spring 2023, and Fall 2023. The results in Table 5 show that the mean grades in Fall 2022, Spring 2023, and Fall 2023 are significantly higher compared with the mean grade in Fall 2021.

We summarize the rest of the results in Table 5. First, the mean Spring 2022 grade for 73 students is not significantly different from ($M = 74.6$, $V = 405.7$) the mean Fall 2021 grade, $t(126) = 0.76$, $p = 0.22$ ($F_{72,59} = 2.27$, p = 0.00071). Second, the mean Fall 2022 grade for 50 students is significantly higher than ($M = 76.2$, $V = 265.0$) the mean Fall 2021 grade, $t(95) = 1.32$, $p = 0.094$ ($F_{49,59} = 1.48$, $p = 0.075$). Third, the mean Spring 2023 grade for 69 students is significantly higher than ($M = 77.6$, $V = 136.4$) the mean Fall 2021 grade, $t(127) = -2.38$, $p = 0.0095$ ($F_{59,68} = 1.312$, $p = 0.14$). Fourth, the mean Fall 2023 grade for 69 students is significantly higher than ($M = 86.0$, $V = 71.6$) the mean Fall 2021 grade, $t(97) = -6.77$, $p = 5.02\text{E-}10$ ($F_{59,68} = 2.5006$, $p = 0.00015$).

Reflection on the Email Strategy from the Instructor who was asked to send the Emails

This section presents a reflection on the email strategy from the instructor of this section who was asked by the department to send the emails. This reflection was suggested to include by a reviewer of this paper. Assigning points to the course events such as attendance led to an increase in the number of emails because some students do not attend class. Second, grading Quizzes the day after

they were due and then sending emails directly after grading the Quizzes appears to reduce the time spent in sending emails the following week because students are reminded to please complete the Quizzes after missing one or two Quizzes. Third, sending emails about missed classes on the Friday (the day after both class days in the week) appears to help increase student attendance in the following week for most students because students are receiving a timely reminder about missed attendance and then tend to attend class. While it appears that attendance and quizzes participation may decrease for the class, the emails tends to take less time. It also appears that students who miss a quiz or class tend to complete the subsequent quiz and attend the following class. I am grateful to the students for their positive responses to the emails, for attending class, and for participating in graded events.

Discussion

This paper contributes to the literature in the area of care for students and increasing student-faculty interactions in a large institution of higher education. There are several relationships among the data presented in the paper. First, the sending of emails has increased student-faculty interactions. Second, the sending of emails expresses encouragement and confidence in the students that by submitting assignments, the students will succeed in the course.

The department requested that the emails be sent to the students and the advisors by the instructor in the course when students miss graded events. The instructor therefore sends the emails about missed quizzes, attendance, and exams. It is important to send the emails to the students before the next graded events are due; therefore some students receive a couple of emails per week since one email is sent after the two classes per week, and another email is sent after the quizzes are due. With this set of reminders, it is hoped that the students complete the upcoming week's assignments which also has the beneficial result that the instructor sends fewer emails. It takes about an hour to send emails twice per week. Some students miss multiple assignments in a row, and for these students, the product of missed assignments in successive weeks is nonzero in successive weeks. In the long term, these results will continue to be investigated to understand relationships among the missing assignments and student performance. Informal feedback from students throughout the semesters after class, during office hours, and in email indicates that the students respond positively to the emails. Some students explain why the graded event was missed and discuss how they will participate in future graded events.

Conclusions

This paper describes interactions with students' academic advisors in a sophomore level Signals and Systems course for four semesters starting in Spring 2022 (Spring 2022, Fall 2022, Spring 2023, Fall 2023). A major finding of this study is that the sending of emails has helped improve student attendance and completion of quizzes in subsequent weeks (after a missed quiz or class).

This paper also discusses how sending fewer emails to the students and to their advisors is observed during the same semesters in which attendance and grades are observed to be higher (see the companion paper at 2024 ASEE that describes "Further Strategies to Develop an Online/Hybrid

Signals and Systems Course") [39]. The results also show that there is a decreased number of emails sent to students in successive weeks in Fall 2023. The data shows that this leads to better student performance in the course. The care demonstrated to the students is helping all students succeed in Signals and Systems course.

Future Work

Future work will continue the department-requested interactions with the students and academic advisors when students miss graded events. The future work will also include further analysis of the interactions with students and the academic advisors.

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Glossary

ECE Electrical and Computer Engineering
SPOT Student Perception of Teaching
TLO Topic Learning Objective

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