AC 2011-1223: CHARACTERISTICS OF SUCCESSFUL STUDENT-FACULTY INTERACTION OUTSIDE THE CLASSROOM

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Characteristics of successful student-faculty interaction outside the classroom

Abstract

Student-faculty interaction, including contact outside the classroom, is one of the most important factors in undergraduate student motivation and performance. In engineering, both students and faculty have limited time due to rigorous curricula and research expectation, and so may not prioritize contact outside the classroom. However, particularly in multidisciplinary courses, this contact may be critical to help students with various backgrounds learn the course material. Fusani[3], through an applied communication approach, studied the salient characteristics of out-of-class student-faculty interaction. We build upon this framework by investigating the impact of student-faculty interaction outside the classroom in a variety of courses in a multidisciplinary engineering program. Our purpose is to identify qualities of successful student-faculty interaction to help both students and faculty optimize their contact outside the classroom.

Our study focused on three courses within the general engineering curriculum: Statics, Physics III, and Signals and Systems. Total enrollment in these courses is about 50 students, with each course spanning various engineering disciplines (mechanical, electrical, computer). We kept a detailed log of student-faculty interaction outside the classroom, including the frequency and duration of each contact. We also classified the nature of each interaction according to certain distinguishing characteristics, such as whether the students visited individually or in a group, whether the student sat down or stood at the door, whether there was any work done on the board, and whether the interaction took place within schedule office hours. We then examined the relationship between these characteristics and the students' performance in the class, as measured by their grade.

Students engaging in more than 10 visits during the 15-week semester had significantly higher grades than students engaging in 5-10 visits ($p=0.011$) or less than 5 visits ($p<0.001$). Of the top students (grades more than 0.5 standard deviations above the mean), 80% interacted with faculty outside the classroom more than once, with 37% interacting more than five times. This interaction was characterized by an average frequency of 7.6 visits (about 1 visit every 2 weeks), an average length of 10 minutes, an average total time of 80 minutes during the semester, about 6 emails during the semester, with written work about 30% of the time, group visits 40% of the time, with visits occurring an average of 1.3 days before an assignment is due, and outside scheduled office hours 70% of the time. For the struggling students (grades more than 0.5 standard deviations below the mean), only 14% interacted with faculty outside the classroom more than five times. The factor that best correlated with students' performance was frequency of contact, followed by total interaction time. Factors not correlated with student performance were average length of visit, number of emails, and number of days before the assignment due date. With respect to discipline, the undecided students were less likely to have contact. With respect to gender, female students appeared to have a greater increase in grade with more interaction. With respect to year, the youngest students (sophomores) were the least likely to visit, with more than 50% having only one or fewer visits outside the classroom. These results can help tailor student-faculty interaction outside of class.

Introduction

Student-faculty interaction, including contact outside the classroom, is one of the most important factors in undergraduate student motivation and performance.[1,2] In engineering, both students and faculty have limited time due to rigorous curricula and research expectation, and so may not prioritize contact outside the classroom. However, particularly in multidisciplinary courses, this contact may be critical to help students with various backgrounds learn the course material.

Multidisciplinary courses have become increasingly popular in recent years. As engineering programs around the world seek to address changing global issues in the 21st century, there has been a marked growth of interdisciplinary fields such as bioengineering, sustainability, and entrepreneurship. Tied to this growth, the engineering landscape has highlighted the need to develop professionals who possess an interdisciplinary skill set and work effectively in multidisciplinary teams. ABET directly emphasizes this need in one of their main program outcome criteria: 3d) an ability to function on multidisciplinary teams.[4] However, in effectively designing and teaching multidisciplinary courses, faculty are met with various intrinsic challenges, such as the need to account for the differences in the technical background of the students. Student-faculty interaction outside the classroom may play a particularly important role in effectively meeting these challenges in multidisciplinary courses.

To this end, we build upon an applied communications framework developed by Fusani[3] to investigate the impact of student-faculty interaction outside the classroom in a variety of courses in a multidisciplinary engineering program. Our purpose is to identify qualities of successful student-faculty interaction to help both students and faculty optimize their contact outside the classroom.

Methods

Our study focused on three courses within the ABET-accredited general engineering curriculum at a small (less than 2,000) regional liberal arts college. The courses were: Statics, Signals and Systems, and Physics III (introductory waves, optics, fluids, and thermodynamics). These courses are required of all engineering majors and span various engineering disciplines and years. Each course had between 22 and 33 students, with a total enrollment in all courses of 48 distinct students (some students were enrolled in more than one course).

Of the 48 total students, there were 37 men and 11 women, with 21 sophomores, 19 juniors, and 8 seniors. For declared concentrations in a specific discipline, there were 25 mechanical engineering, 6 computer engineering, 4 electrical engineering, 3 applied physics, and 10 undecided. For analysis purposes, the students were classified as either mechanical, computer and electrical, other, or undecided.

The three courses included three lectures (each meeting two or three times per week) and two lab sections (for the Physics III course). They were taught by two assistant professors that offered 8 and 4 scheduled office hours each week, respectively, in addition to an open door policy.

Throughout the semester, we kept a detailed log of student-faculty interaction outside the classroom by filling in a questionnaire after the student exited. The information included:

- the student's identifier
- the date
- the time
- the approximate length of the visit (2, 5, 10, 15, 20, 30, 60 minutes)
- individual or group
- seated or standing
- written work (on a white board or blank piece of paper) or none

At the end of the semester we also recorded the number of emails exchanged with the student, as well as any significant time spent with the student doing other activities, such as student clubs, department events, advising, additional projects or research, or sports. The college's Institutional Review Board approved all data collection and protocols for protecting student's identities. All students gave their informed consent to participate in the study.

First we examined the characteristics of all the student-faculty interaction, and compared the interaction characteristics for the top students (grades more than 0.5 standard deviations above the mean) to those of the struggling students (grades more than 0.5 standard deviations below the mean). Then we examined the relationship between these characteristics and the students' performance in the class, as measured by their grade relative to the course average. We looked at the strength of the effect of: frequency, length of visit, total visit time, the number of days before an assignment was due, and the number of emails. We then determined if these effects differed depending on year, discipline, or gender of the student. We also compared the results for the first third of the semester to the entire semester to determine if the beginning of the semester is a particularly critical time to establish interaction.

Results

Average characteristics of student-faculty interaction for the entire cohort over the semester included: interaction 5.5 times (about once every three weeks), lasting for 10 minutes, total interaction time of about 61 minutes, 4.5 emails sent, written work 30% of the time, group visits 30% of the time, outside of office hours 70% of the time, and 1.35 days before an assignment was due. Statistical details including standard deviations, maxima, and minima are included in Table 1.

The factor that best correlated with students' performance was the frequency of contact (number of visits during the semester), followed by the total interaction time (Figure 1). Factors not correlated with student performance were the length of the visit, the number of emails sent by the student, and the number of days before the assignment was due.

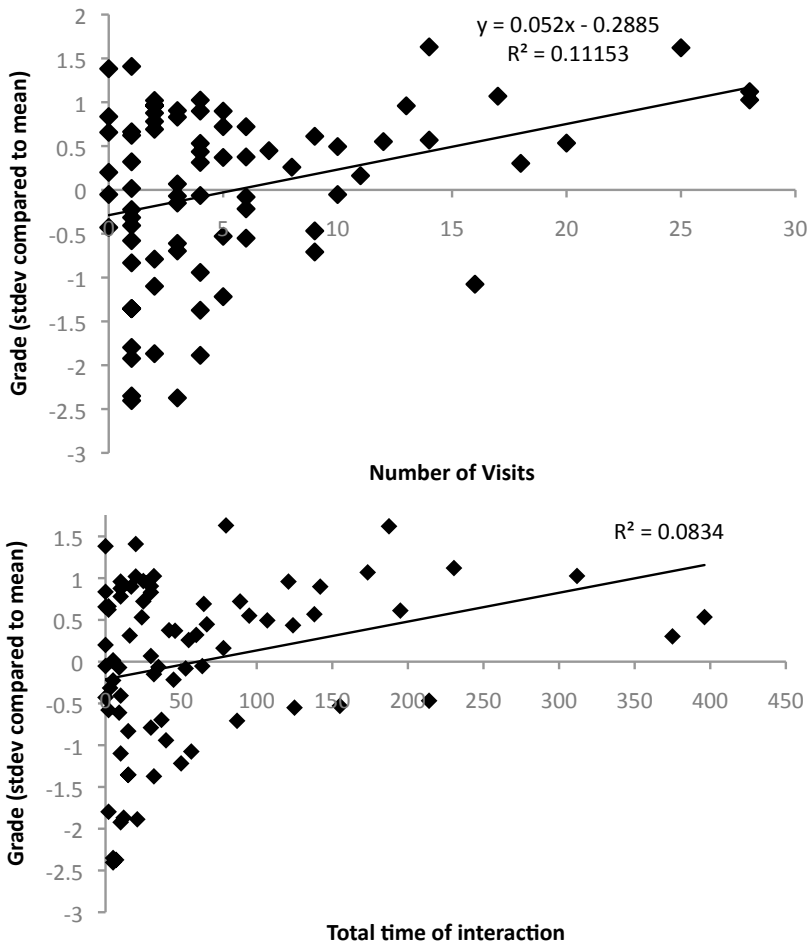

Figure 1. The frequency of contact (number of visits) and the total interaction time were the characteristics best correlated with student grade in the course.

Students engaging in more than 10 visits during the 15-week semester had significantly higher grades than students engaging in 5-10 visits ($p=0.011$) or less than 5 visits ($p<0.001$). The top students as a group appeared to benefit the least from interaction, while the struggling students appeared to benefit the most. However, struggling students were also the least likely to have interaction (Figure 2).

Of the top students (grades more than 0.5 standard deviations above the mean), 80% interacted with faculty outside the classroom more than once, with 37% interacting more than five times. This interaction was characterized by an average frequency of 7.6 visits (about 1 visit every 2 weeks), an average length of 10 minutes, a total average time of 80 minutes during the semester, about 6 emails during the semester, with written work about 30% of the time, group visits 40% of the time, with visits occurring an average of 1.3 days before an assignment is due, and outside scheduled office hours 70% of the time (Table 1).

For the struggling students (grades more than 0.5 standard deviations below the mean), 64% interacted with faculty outside the classroom more than once, but only 14% interacted more than five times. The interaction for struggling students occurred an average of 3.4 times during the semester (about 1 visit every 5 weeks), lasted 9 minutes for an average total time of only 28 minutes during the semester, about 4 emails during the semester, with written work about 30% of the time, group visits about 17% of the time, with visits occurring an average of 1.4 days before as assignment is due, and outside of scheduled office hours 70% of the time (Table 1).

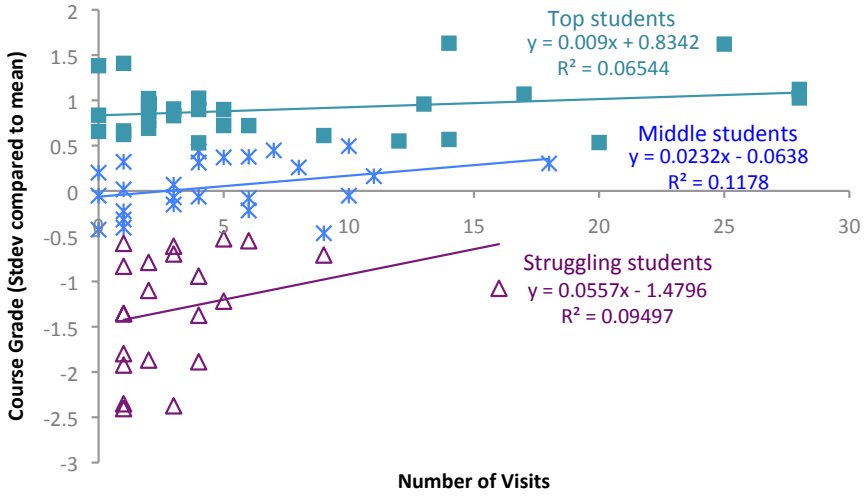

Figure 2. Top students appeared to benefit the least from frequent interaction, while struggling students appeared to benefit the most. Struggling students were also least likely to interact.

With respect to gender, women appeared to have a greater increase in grade with more interaction (Figure 3) and spent significantly more time engaged in additional non-course related activity with the faculty. There were no other differences in interaction between women and men (Table 1).

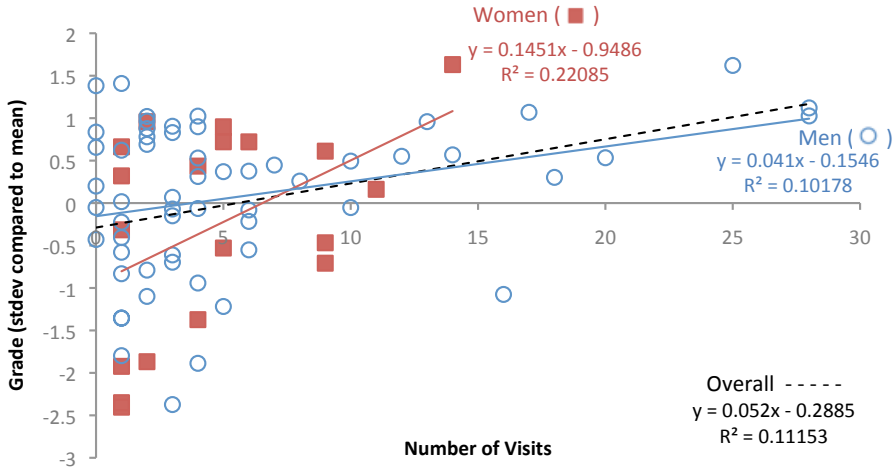

Figure 3. Women appeared to benefit more from an increased number of visits.

With respect to discipline, undecided students were least likely to have contact (Figure 4), while computer and electrical concentrations interacted for a significantly shorter time per visit and total time, occurring significantly more outside office hours. Undecided students were significantly less likely to engage in written work and group work during interaction (Table 1).

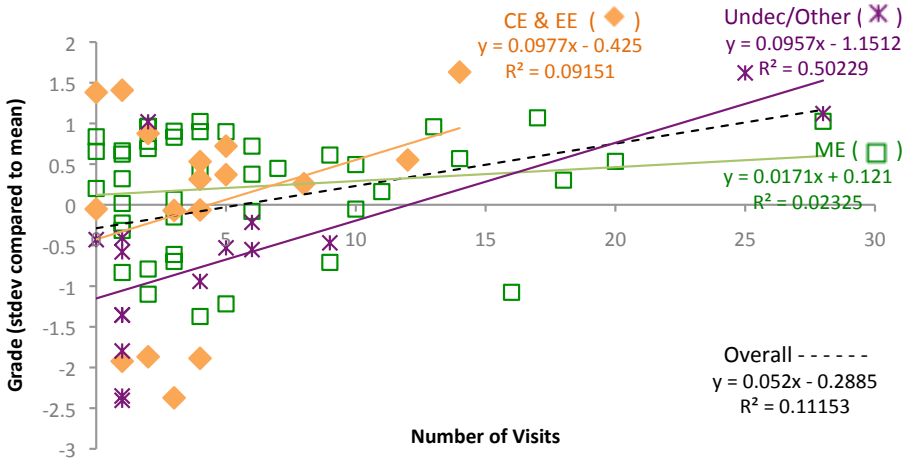

Figure 4. With one exception (one student in two courses), undecided students were less likely to have contact outside the classroom than other disciplines.

With respect to year, the youngest students (sophomores) were the least likely to visit, with more than 50% interacting with faculty only once outside the classroom, and more than 75% visiting less than five times (Figure 5). Sophomores also send significantly fewer emails and stood rather than sitting during the interaction significantly more often (Table 1). Seniors appeared to benefit the most from interaction, and had significantly shorter visits with significantly more written work (Figure 5, Table 1).

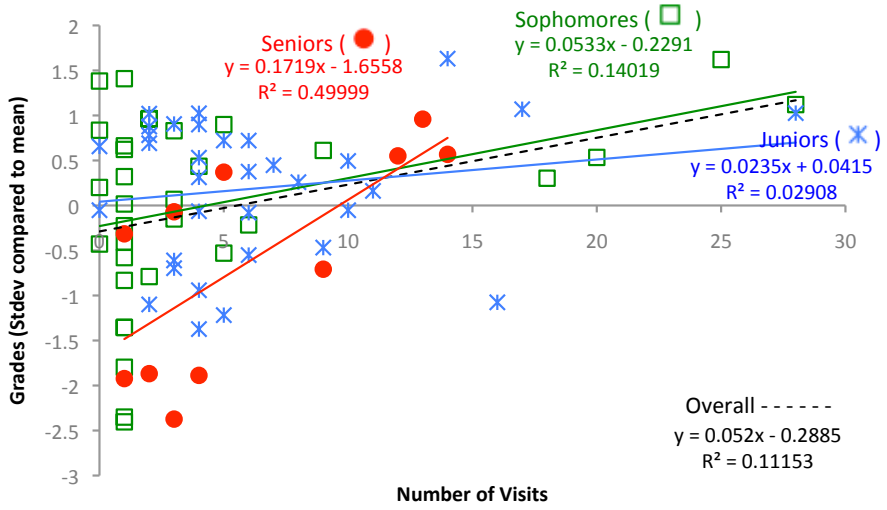

Figure 5. Sophomores were the least likely to visit, with more than 50% interacting with faculty only once outside the classroom. Seniors appeared to benefit the most from increased interaction.

We also analyzed data on the first third of the semester (the first five weeks) to determine if the beginning of the semester is a critical time to initiate contact. Results were similar in the first five weeks: the factor that best correlated with students' performance was frequency of contact, followed by total interaction time. Factors not correlated with student performance were average length of visit and number of days before the assignment due date. Another similar result was that students engaging in more than four visits in a 5-week period had significantly higher grades than students engaging in one to three visits ($p=0.069$) or zero visits ($p<0.001$). Characteristics of the interaction for the top students were similar to the final results: an average length of 16 minutes, board work about 50% of the time, group visits 37% of the time, with visits occurring an average of 1.5 days before an assignment is due, and outside scheduled office hours 65% of the time. Most strikingly, 76% of the top students interacted with faculty outside the classroom during the first five weeks, while only 23% of the struggling students had any contact.

Conclusions

From the previous results, we as faculty members can learn valuable insight to incorporate into our interaction with students for a more successful experience. We observed that most of the interaction occurred outside of scheduled office hours (70% of the time), so it might be beneficial to steer away from rigidly scheduling a high number of office hours, in favor of, for example, an open door policy. Most of the interaction for all groups of students occurred about 1-2 days before an assignment was due, so being available during that time may be most efficient. It may also be necessary to take special care in encouraging younger students or those of undecided majors to visit the faculty member, as these students were the least likely to do so on their own.

Students may also learn from our results and identify habits that may be conducive to their academic success. The highly performing students visited and emailed most often, and generally worked in writing and with a group more than other cohorts (although the most exceptionally-performing students visited more often alone). Highly performing students also took the initiative to visit the faculty member during the first few weeks of the semester, while very few struggling students had early interaction. It also appears that by the time students reach their senior year they benefit most from their interaction, but their interaction is shorter and involves more written work. It is likely that senior level students are able to identify a key aspect of a topic they are struggling with and come to the faculty member with a directed, written question, after which they are able to master the material.

Our findings may also be of interest to engineering departments and college administration personnel. Because of their very nature, multidisciplinary courses may require more time outside the classroom for a successful experience; we found that increased number of visits and total time with the faculty outside the classroom best correlated with student performance. Also, it may be a positive step for departments to incorporate into their curriculum a program where they encourage or require students in their freshmen and sophomore years to actively seek out interaction with faculty members. Furthermore, women appeared to benefit more from increased interaction and had significantly more extra-curricular time with faculty. This is likely due to departmental programming for the women, and may be important to introduce women to the faculty and encourage them to visit with course questions.

	Number visits	Average length	Total time	Number emails	Days before hw due	Official office hours	Written work	Group	Standing	Extra activity together
	#	*min*	*min*	#	*days*	%	%	%	%	*min*
Overall										
average	5.55	10.01	61.00	4.48	1.35	0.29	0.32	0.31	0.32	20.71
stdev	6.33	9.36	82.55	6.35	0.94	0.35	0.33	0.43	0.35	26.98
max	28.00	60.00	396.19	51.00	3.80	1.00	1.00	3.00	1.00	90.00
min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grade										
"+1.00 or more	*13.22	8.97	*117.2	*10.89	1.45	0.17	0.34	0.18	0.41	15.00
"+0.50 to +0.99	5.24	10.05	67.92	3.67	1.24	0.33	0.28	0.45	0.32	32.86
"-0.49 to +0.49	4.88	10.73	59.00	3.56	1.29	0.29	0.39	0.33	0.22	21.80
"-0.50 to -1.00	3.78	13.20	55.56	4.33	1.78	0.39	0.29	0.23	0.35	8.33
"-1.00 or less	3.23	7.09	*18.52	3.23	1.31	0.27	0.27	0.16	0.43	11.54
(stdev vs mean)										
Gender										
women	4.83	15.23	71.98	3.17	1.32	0.44	0.41	0.43	*0.15	*46.11
men	5.76	8.42	57.65	4.88	1.36	0.25	0.29	0.27	0.37	*12.97
Discipline										
CE&EE	4.24	*6.20	*27.34	3.76	1.07	*0.10	0.46	0.36	0.42	14.12
ME	5.98	11.21	71.85	4.95	1.42	0.35	0.33	0.35	0.31	25.57
Undecided/other	5.75	10.80	66.94	3.94	1.48	0.33	*0.16	*0.13	0.24	14.38
Year										
Sophomores	4.52	12.19	65.76	*2.67	1.29	0.39	0.21	0.32	*0.17	27.27
Juniors	6.39	8.89	59.93	6.64	1.41	0.26	0.34	0.28	*0.46	16.97
Seniors	6.09	*6.87	49.92	3.45	1.32	*0.13	*0.60	0.32	0.34	12.27

Table 1. Average interaction characteristics for various groups of students. * Indicates a significant t-test compared to the entire cohort at a level of $p<0.05$.

In spite of the insight we have gained from our results, there were limitations to our study. The primary limitation was that the number of students was relatively small, weakening our statistical power. In particular, as we grouped the data into subsets, some of the cohorts ended up with on the order of ten students, thus limiting the statistical significance of our findings. Additionally, there were certain factors that may have confounded the data. For example, the students whose major was undecided consisted exclusively of sophomores, while many of the electrical and computer engineers happened to be seniors.

Future studies could extend this approach to a larger cohort so that a more thorough statistical analysis, such as a linear regression model, may be applied. There are other important pieces of information that could be tracked as well, such as whether the student's intent during contact is to ask a specific question, to acquire a more general sense of comfort regarding the course, or to speak informally with the faculty member. It may also be of interest to study the characteristics and success of out-of-office interaction in the context of a larger program where students interact with both faculty members and teaching assistants. Finally, we did not find a correlation between student performance and the number of emails exchanged with the student, while there was a correlation with face-to-face contact. However, the exceptionally performing students sent the most emails. This inconclusive evidence opens the door for future studies to determine if electronic communication common to online courses is as effective as face-to-face interaction.

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