

## Correlating Freshman Engineers' Performance in a General Chemistry Course to Their Use of Supplemental Instruction

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# Correlating Freshman Engineers' Performance in a General Chemistry Course to Their Use of Supplemental Instruction

## Abstract

This study examines the correlation between first year engineering students' use of supplemental instruction and their performance in a required general chemistry course at Northeastern University. Research has shown that supplemental instruction is positively correlated with measurable factors, such as higher grade point averages and timely graduation rates, as well as less-easily measured factors, such as long-term retention of course material, teamwork, communication skills, information processing skills, and motivation. Previously we examined what grade level triggered students to seek out supplemental instruction in a required general chemistry course and what factors affected whether a student used a form of supplemental instruction.<sup>1</sup> However, data were unavailable to correlate with grades.

In order to understand a student's pre-disposition and ultimate choice to participate in supplemental instruction as well as to determine correlations with grade distribution, honors and non-honors students in a required general chemistry course were given pre-surveys at the beginning and post-surveys at the end of the semester. Analysis of pre-surveys allowed identification of a student's predisposed "trigger point" at which s/he decides to seek extra help upon entering college. The availability of data for different types of course assessments, including exams, homework, and class participation, enabled correlation among individual trigger points, grades, and the use of different forms of supplemental instruction. Previously we had investigated how important convenience factors are to students in their decision to use supplemental instruction. This year's study examined this question further to determine what factors deter students from using specific resources for supplemental instruction. An overarching intent of our study was to identify how females and males differ in their use and attitudes towards supplemental instruction.

Using this study based on a freshman general chemistry class as a model for student behavior in freshman courses, this paper presents the survey results, methodology used, conclusions, and recommendations for increasing the usage of supplemental instruction by first year engineering students.

## Background

The overall focus of this paper is identifying the correlation between the performance of freshmen engineering students and their use of supplemental instruction in a required general chemistry course. General chemistry is a subject commonly taken by first year students seeking to major in a discipline of engineering. The majority of such students have taken one or more courses in chemistry in high school, and often students who choose not to go on to major in chemical engineering have formed strong opinions regarding the difficulty and utility of further study in chemistry. Retaining these students in engineering during the freshman year is a major priority. Successful programs designed to support these students should have potential impact beyond just courses in general chemistry for engineers, including developing freshmen skills in

time management, studying at the college level, and problem solving necessary for subsequent success in their college studies.

Supplemental instruction is a common instructional technique used at many universities to help freshman adjust to and succeed in college courses. Supplemental instruction in general consists of peer tutoring, instructor office hours, review sessions, study groups, and other programs that assist students outside of the classroom. Students who use supplemental instruction have been shown to earn higher term and cumulative grade point averages (GPAs) as well as more timely graduation rates than their peers who do not utilize supplemental instruction.<sup>2,3</sup> Moreover, it has been found that less-easily measured factors such as long-term retention of course information, teamwork, communication skills, information processing skills, and motivation are improved when students engage in supplemental instruction.<sup>2</sup> With so many positive outcomes resulting from the utilization of supplemental instruction, it could be assumed that many students during their course of study would seek out and utilize these additional resources. Yet, there are significant numbers of students who do not participate in supplemental instruction. Given limited resources, what forms of supplemental instruction have the greatest impact on grades? What forms of extra help reach the greatest number of struggling yet motivated students? How should programs in supplemental instruction be structured to promote best retention? We address these research questions in the context of supporting freshmen enrolled in a required course in general chemistry through the evaluation of the impact of different forms of supplemental instruction.

A primary research question for our present study is identifying what specific factors or qualities lead students to engage in supplemental instruction. Previous studies reported conflicting results about the differences between attendees and non-attendees. For example, although some studies found “no inherent preexisting differences” between the groups, other studies found “inherently less able” students and those with “low self-efficacy” were more likely to attend supplemental instruction.<sup>2,4</sup> It has been shown that students who are not confident in their ability to perform well in a course are more likely to seek help than their more confident peers.<sup>5</sup> Self-confidence is a factor in seeking out extra help, as often the act of seeking out extra help can be demoralizing as students realize that they cannot master the material on their own.<sup>6</sup>

Our study also examines what current factors deter students from utilizing supplemental instruction resources. A paper published in 2010 hypothesized that not finding a particular method appealing, poor scheduling, and conflicting activities are reasons why students wouldn't use supplemental resources.<sup>7</sup> In addition to the aforementioned reasons, we aim to understand what other particular qualities may make a resource unappealing to a student. For example, Ning and Downing reported that students feel more comfortable approaching upper-class students than established faculty members.<sup>8</sup> In last year's study, we also found that both males and females were most comfortable with friends as extra help resources and that almost all students used group studying throughout the semester. Both males and females previously were found to be least comfortable with an unfamiliar faculty member. These results suggested that the closer in educational background a supplemental instructor was to the student, the more comfortable the student felt using that person as a resource. Results from last year's survey also indicated that students felt being able to explain the material well was the most important quality for a tutor to have, with the depth of understanding as the second most important quality. The least important

quality reported by both male and female students before and after taking the course was empathy. Availability and friendliness, both before and after taking the course, had similar levels of importance. In addition, we found previously that both males and females ranked time, frequency, and location the most important factors, and friends and food the least important factors when seeking extra help. A student's experiences prior to college may also influence their use of supplemental instruction in college.

A longstanding goal of our research has been identifying how gender differences impact the use and effects of supplemental instruction. The gender distribution in engineering is very skewed towards males at most universities and nationally. Of engineering bachelor's degrees awarded in 2012, only 18.9% were received by women<sup>9</sup>. Fewer women enroll in engineering initially, and it has been shown that more women leave engineering in their freshman year of college to pursue other fields than men. Women who continue to study engineering beyond the first year, however, perform comparably to the men in their classes.<sup>10</sup> Thus, it is a priority for schools to retain women in their first year engineering programs. At Northeastern University efforts have been on-going to increase the numbers of women entering the College of Engineering and to increase the effectiveness of programs to retain them through graduation. Slow but steady progress has been made in both areas. The Fall 2013 entering freshmen class was 28% female.

Previous studies have found that females had a more positive attitude towards seeking help outside the classroom and were more likely to use supplemental instruction than their male counterparts.<sup>5,11</sup> These findings are supported by our previous research from the fall 2012 semester, when 76% of females and 60% of males used some form of extra help during the semester. These aforementioned studies indicate that females not only seem to have more positive attitudes but are also more intrinsically interested in learning.<sup>11</sup> In contrast, male freshmen felt a greater threat to their self-confidence if they required additional help to succeed and master course material. Although there were gender differences in attitudes towards supplemental instruction, it has been reported that both male and female students benefit equally from supplemental instruction.<sup>12</sup> To explore such issues further we have examined what "trigger points" lead the student to take advantage of the resources and how these trigger points correlate with grades. Last year, females on average sought out extra help when they had a grade of B. This threshold was a lower than for males, who on average sought out extra help with a grade of C. Based on this previous research we expected females to have a higher trigger threshold of A/B compared to B/C for males for seeking out additional help. However, we previously did not have data available regarding scores on assessments or overall course averages for these students.

In our previous studies we have focused solely on how supplemental instruction can be applied to support students enrolled in non-honors sections of general chemistry. However, at Northeastern University an increasing percentage of engineering students are admitted to an honors program based on their records of outstanding achievement in high school. These students may have encountered relatively fewer challenges in their previous studies and enter college with expectations of continued success. Further, often such students may not have developed skills in overcoming academic challenges and can be overwhelmed when encountering poor grades. In this present study we have expanded our assessment of the impact of supplemental instruction in general chemistry on students enrolled in honors section for this

course. In particular, we have examined the hypothesis that honors students would seek out supplemental instruction at a higher trigger threshold but utilize less supplemental instruction than their non-honors peers.

In this study we assess the use of supplemental instruction by engineering students enrolled in a required course in General Chemistry for Engineers during the fall of their freshman year. This course met three times weekly for 65-minute lectures and once weekly for 100-minute recitations. During lectures the professor introduced new concepts and skills and sometimes offered active-learning exercises in which students could practice the new material and receive feedback. Recitations of typically 20 to 30 students were led by graduate teaching assistants (TAs) and offered students the opportunity to review more difficult subject matter introduced the previous week and receive help on their weekly on-line homework assignments. Three 65-minute exams were administered during the semester along with a two-hour final exam. Students were enrolled in either an honors or non-honors section, with honors lectures having ~50 students each and non-honors lectures ~100 students each. Students are placed in the honors section based on their enrollment in the Honors College at the university, with students admitted to the Honors College based on their high school records of high achievement.

Several forms of supplemental instruction were available for enrolled students. Instructors held office hours several times weekly outside of scheduled lecture times. During these hours the instructor was available for students, either individually or in small groups, to come and receive help. Instructors also held 60-90 minute reviews prior to each of exam. Weekly review sessions were offered for non-honors students by the "Connections Chemistry Review" program run by three upper-class female tutors majoring in chemical engineering. These tutors led students through a review of the key concepts and skills and helped students work through challenging homework problems. Additional forms of supplemental instruction offered by Northeastern University included:

- “Chem Central,” where at least one chemistry professor and/or TA was present weekdays from 10 am to 4 pm to assist students in this and other general chemistry classes on a walk-in basis;
- A free-of-charge tutoring center staffed by graduate and upper-class undergraduate engineering students by the College of Engineering for freshmen to receive extra help in all of their common courses;
- One-on-one peer tutoring services offered by the university, where an upper-class undergraduate student was paired with a freshman student in chemistry for hourly tutoring instruction once per week.

In addition, engineering students were encouraged to form study groups with peers also taking the course, a strategy, which is facilitated by the College of Engineering’s cohort method of grouping students throughout their classes.

## Methods

The data for our study was based on feedback from freshmen enrolled in General Chemistry for Engineers during the Fall 2013 semester and grades for individual exams and overall grades

provided by instructors for these students. Students consisted of two populations: a honors group registered in one of two special honors lecture sections, and a non-honors group registered in one of four regular lecture sections. Students were invited to participate in the Honors program at time of Admissions (top 15%, based on academic credentials such as GPA, SAT). A pre-survey was administered during recitations accompanying lectures the first week of fall semester classes to both the non-honors and honors sections of general chemistry. The pre-survey (see Appendix A) asked questions to determine what students expected from the course and when they expected to seek out supplemental instruction. A post-survey was administered during recitations the final week of fall semester classes to both the non-honors and honors sections of general chemistry. The post-survey (see Appendix B) asked questions to decipher when students felt the need to seek extra help, why they did not use some forms of supplemental instruction, and their attitudes towards chemistry. Student ID's were used to match individual pre- and post-surveys with grade data provided by instructors. All surveys were conducted confidentially. Only data for students who completed both a pre- and a post-survey were included in our analysis (*e.g.*, data for a student who withdrew due to poor grades prior to the end of the semester was not included in our analysis).

As both the pre- and post-surveys were extensive in the data sought from students, we focused our analysis on identifying and evaluating the trigger point at which students sought supplemental instruction based on their grade, the main factors that determined whether students chose to use additional resources, and the main factors that deterred students from using supplemental instruction. Analysis of surveys included assessment of statistical significance of the results. The Z-Test was used to determine at a 95% confidence level if male and female averages for both non-honors and honors students were statistically different for exams 1, 2, and 3, the final exam, and overall course grades.

## **Results and Discussion**

A total of 367 freshman engineering students completed both the pre- and post-surveys out of an overall class of 488 students (75% response rate). This response rate was significantly higher than for our previous two studies, with response rates of 54% and 55% in 2012 and 2011, respectively. The increased response rate was due in part to the use this year of student IDs to correlate pre- and post-surveys (verses an arbitrary code made up by the students) and in part to the provision of very minor grade incentives (equal to less than 0.5% of their overall grade) to encourage students to attend end-of-semester recitations during which post-surveys were administered. Of the 367 students participating, 72% were males and 28% were females. It should be noted that of the 25% of students who did not participate in the survey, 76% were males and 24% were females, a distribution similar as that of the survey participants. Of the 367 students who participated in both pre- and post-surveys, 74 students were in the honors section of the class. In the honors section 57% were males and 43% females.

Table 1 summarizes grades on exams for students who completed surveys at both the start and end of the Fall 2013 semester. The honors and non-honors sections were taught by different instructors, with common exams given for both honors section and for all four non-honors sections, although different exams were given to honors and to non-honors students. In the non-honors sections females performed slightly better on all exams than did males. Female students

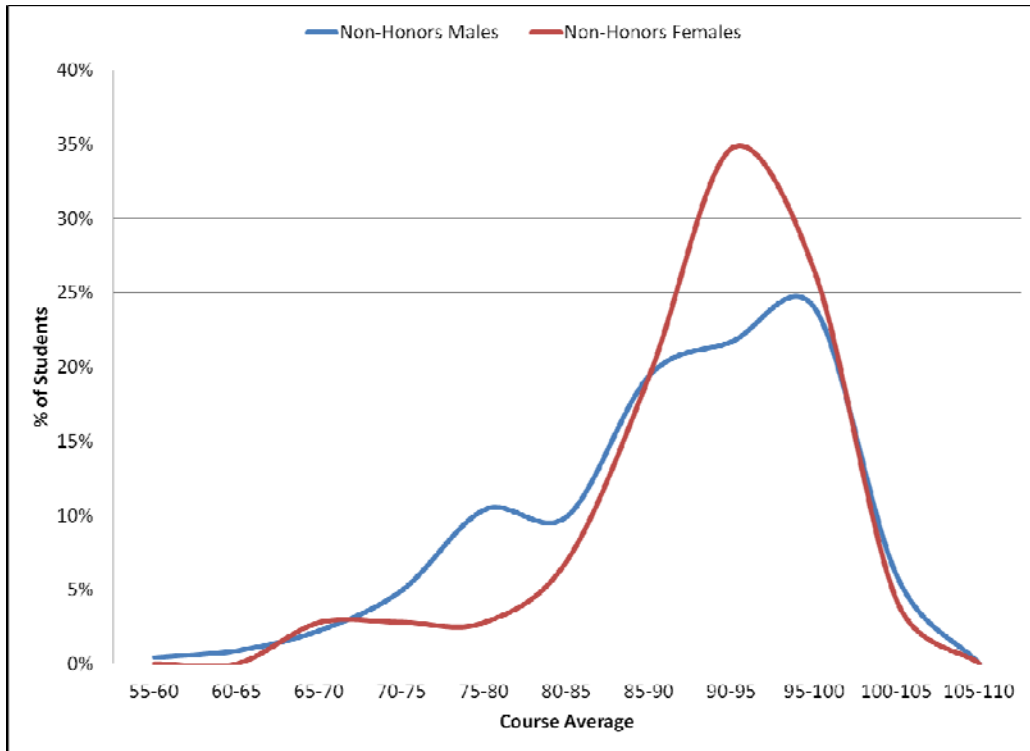
in the non-honors sections also had a slightly higher overall course average, 90.8, than did males, 88.5. Differences in scores for the final exam and course averages for non-honors male *vs.* female students were statistically significant at a 95% confidence level. In the honors section the course averages for males and females were not statistically different at a 95% confidence level, with respective averages of 91.8 and 91.1 for males and females, respectively.

**Table 1: Grades for Individual Exams**

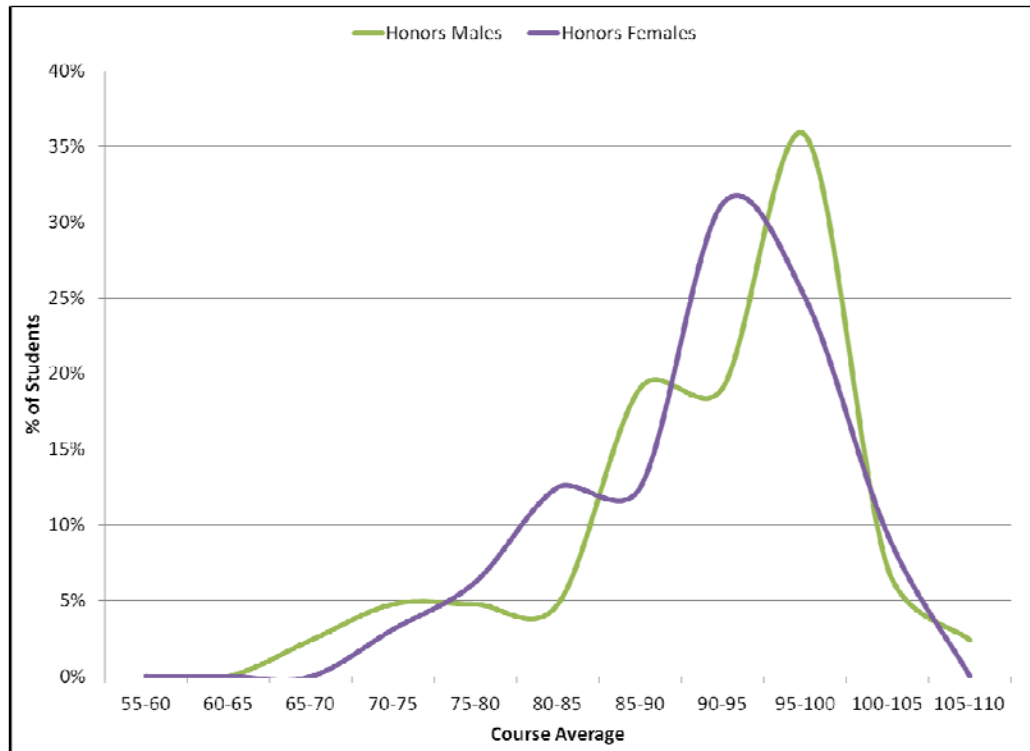
<b>Exam</b>	<b>Non-Honors Sections</b>		<b>Honors Sections</b>	
	<b>Males</b>	<b>Females</b>	<b>Males</b>	<b>Females</b>
<b>Exam 1</b>	<b>80.8</b>	<b>83.0</b>	<b>80.9</b>	<b>80.1</b>
<b>Exam 2</b>	<b>76.1</b>	<b>78.3</b>	<b>82.6</b>	<b>80.4</b>
<b>Exam 3</b>	<b>77.9</b>	<b>89.4</b>	<b>80.8</b>	<b>78.2</b>
<b>Final Exam</b>	<b>67.3</b>	<b>71.6</b>	<b>78.4</b>	<b>77.1</b>

We also found that distributions of final grades were similar for the honors and non-honors sections, as depicted in Figure 1. The availability of bonus points associated with participation in lecture and recitation and successful completion of an extra homework assignment during finals week resulted in some students having course averages greater than 100%. Honors students on average did better on their final exam than non-honors students, but overall course grades were similar between honors and non-honors students. Grades for both non-honors and honors sections were awarded based on the grade scale  $A \geq 90 > B \geq 80 > C \geq 70 > D \geq 60 > F$ .

Figure 1 also shows that distributions of final grades for males and females in both types of sections generally were similar. Tails in these distributions associated with students with lower course averages were more pronounced for males compared to females among the non-honors students, with a smaller percentage of the non-honors females receiving grades lower than a B-.



(a)



(b)

**Figure 1: Distribution of course averages. (a) Non-honors students; (b) Honors students.**



Table 2 summarizes survey responses for when both males and females in the non-honors and honors sections sought extra help based on their grade in chemistry. This question was posed after completion of General Chemistry for Engineers as:

When, based on your grades, did you feel the need to seek out extra help? Please check **one**.

- Doing very well, but need clarification (A)
- Doing well, but seeking to do better (B)
- Doing okay (C)
- Doing poorly (D)
- Failing the class (F)
- Did not seek any extra help in this course

We posed this same question to non-honors students in a survey last year, allowing comparison of our current findings with results from our previous study.

**Table 2: Correlations between End-of-Semester Trigger Point for Seeking Supplemental Instruction and Final Course Average**

Non-Honors Males			Honors Males		
Trigger Point	% Responded	Course Average	Trigger Point	% Responded	Course Average
A	12%	95.1	A	10%	101.4
B	22%	88.2	B	23%	92.0
C	16%	80.8	C	25%	85.5
D	9%	75.2	D	3%	86.6
F	0%	0.0	F	0%	0.0
Non-Honors Females			Honors Females		
Trigger Point	% Responded	Course Average	Trigger Point	% Responded	Course Average
A	20%	96.1	A	23%	98.1
B	37%	90.8	B	29%	93.1
C	18%	87.2	C	29%	86.8
D	6%	83.1	D	10%	82.2
F	1%	86.8	F	0%	0.0

% responded does not total 100% due to students who did not utilize supplemental instruction.

Course average can exceed 100% due to extra-credit.

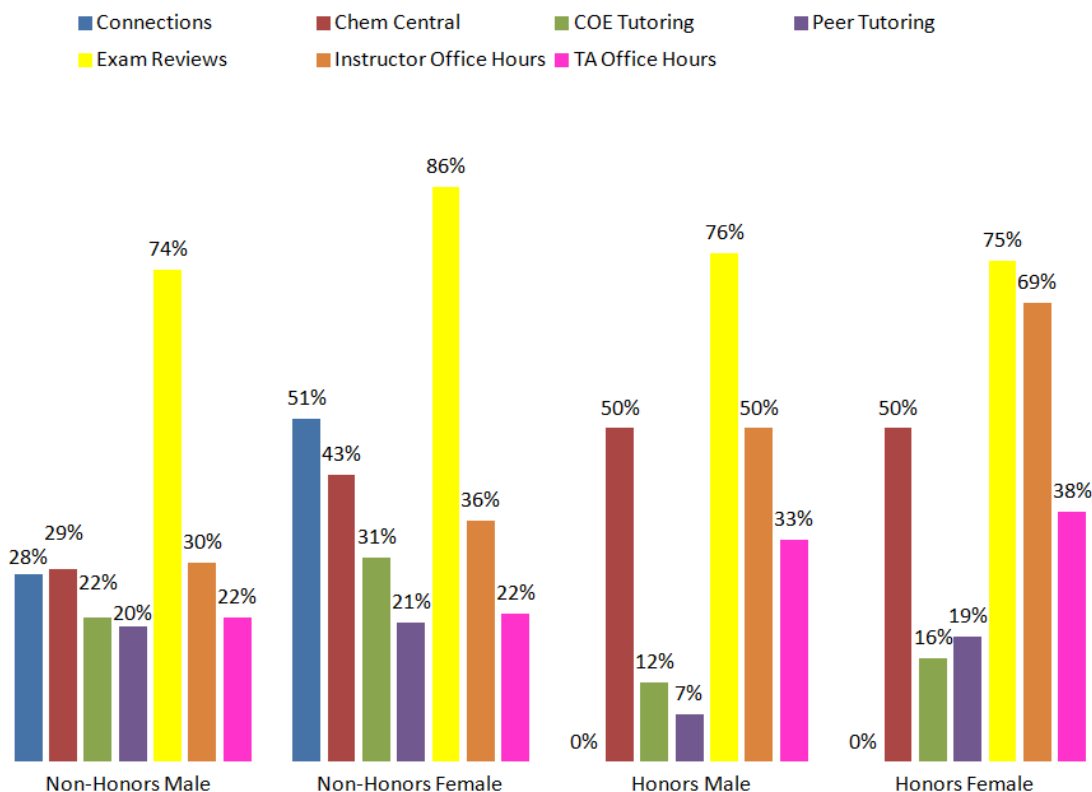
This year at the beginning of the semester 93% of males and 99% of females in the non-honors sections reported that they would seek supplemental instruction if they had a grade of C or better. While female students had the same threshold for seeking supplemental instruction this year as they did last year, males had a lower threshold this year than they had last year. At the end of the semester this year most non-honors males and females reported that they actually did seek extra help when they had a grade of B or lower in the course. This year 82% of females and 60% of males used some form of supplemental instruction during the semester. The percentage of females who used one or more forms of supplemental instruction increased this year by 6%

compared to last year; the percentage of males was unchanged from last year. These differences can be attributed to some students receiving better grades than their trigger point for seeking help and some students not seeking help when they projected they would.

This year 47% of honors males and 48% of honors females indicated at the beginning of the semester that they would seek out extra help with grades of B or C. We found that at the end of the semester these honors students sought extra help with grades of B or C, as they projected. The average threshold value was slightly lower, closer to a grade of C, for honors students than for non-honors students. 90% of honors females and 60% of honors males used some form of extra help during the semester. A higher percentage of honors females used extra help than non-honors females, while the percentage of honors and non-honors males who used extra help was the same. At the beginning of the semester 93% of honors males and 97% of honors females reported that they would seek extra help with a grade of A, B, or C while only 60% of males and 90% of females sought extra help at any grade. This trend is similar to what was seen in the non-honors section, and may be a result of students not seeking out extra help when they expected to or students receiving better grades than their trigger points.

Table 2 also correlates the trigger point grade at which a student sought extra help with their course average at the end of the semester. Overall, course averages were greater than many students' trigger points. This outcome supports the hypothesis that students may not have sought supplemental instruction when they expected to or when they had grades higher than their trigger points, helping them to succeed in the course. Most students who did not use supplemental instruction were succeeding in the course, receiving grades of B+ or better, and therefore did not feel the need to seek extra help in the course.

Figure 2 examines what percentage of male and female students in both the honors and non-honors sections used each form of supplemental instruction available. Instructor-led exam reviews were used most by all students, with three quarters of students attending these reviews. Honors students then used Chem Central, instructor office hours, and TA office hours most while non-honors students used the College of Engineering tutoring office and the Connections reviews. The College of Engineering tutoring office was more publicized to the non-honors students than the honors students, and the Connections reviews were not available for the honors students, which may explain why students in the non-honors sections used these resources more. More females used the Connections reviews than males, possibly because all three undergraduate tutors who led these reviews were female. Students stated that the main reason they did not use specific resources for supplemental instruction was because the help was offered at an inconvenient time, they did not think the resource would be useful, or they did not know the extra help resource existed.

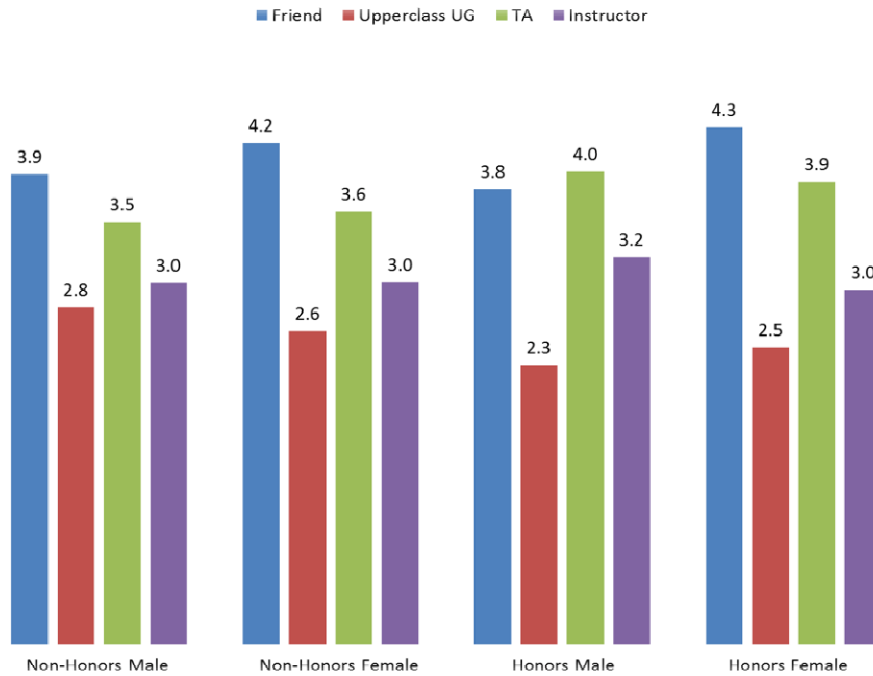


**Figure 2: Percentages of students using different forms of supplemental instruction**

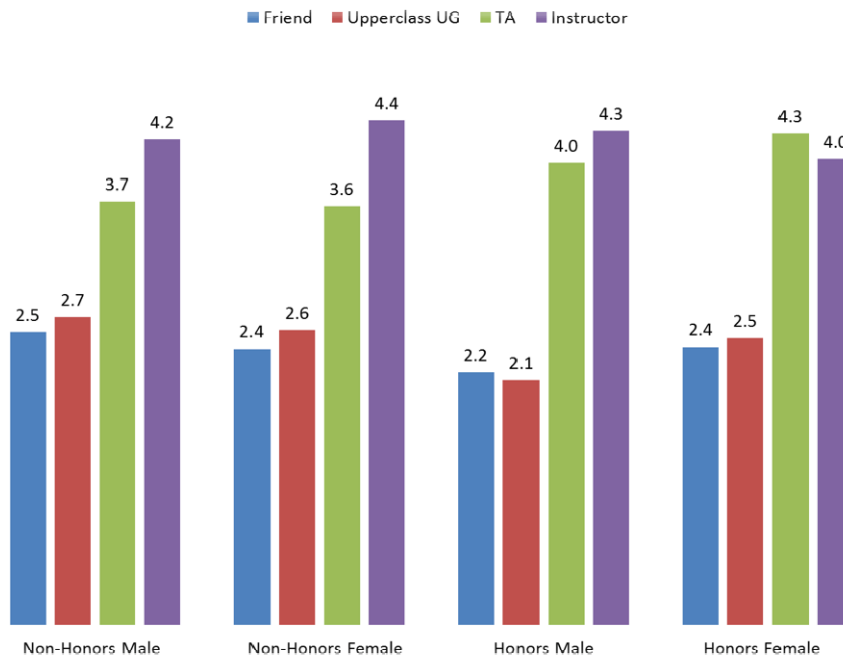
Figure 3 shows comfort levels students had with different individuals as sources of supplemental instruction. Students were asked to rank their comfort level with each individual on a one through five scale, with one being the least comfortable and five being the most comfortable, using each number only once. Responses were averaged to determine the numbers shown on the graph. Responses by males and females to the same question at the beginning of the semester were not measurably different than their responses at the end of the semester.

In this year's study students again reported that they felt most comfortable getting extra help from a friend, consistent with what we reported last year. Students this year also indicated that they were more comfortable getting help from the TA and course instructor than an undergraduate tutor. These trends were similar for both males and females in both the honors and non-honors sections. These outcomes may be the result of students having a chance to get to know the TA and course instructor better than the undergraduate tutors throughout the semester. Our findings this year differ from our findings last year, when we observed students felt more comfortable with undergraduate tutors who were closer in education level.

Figure 4 summarizes students' impressions of competence level with different individuals as additional resources after taking chemistry. Students were asked to rank the competence level of each individual on a one through five scale, with one being the least competent and five being the most competent, using each number only once. Responses from post-surveys were averaged to determine the numbers reported.



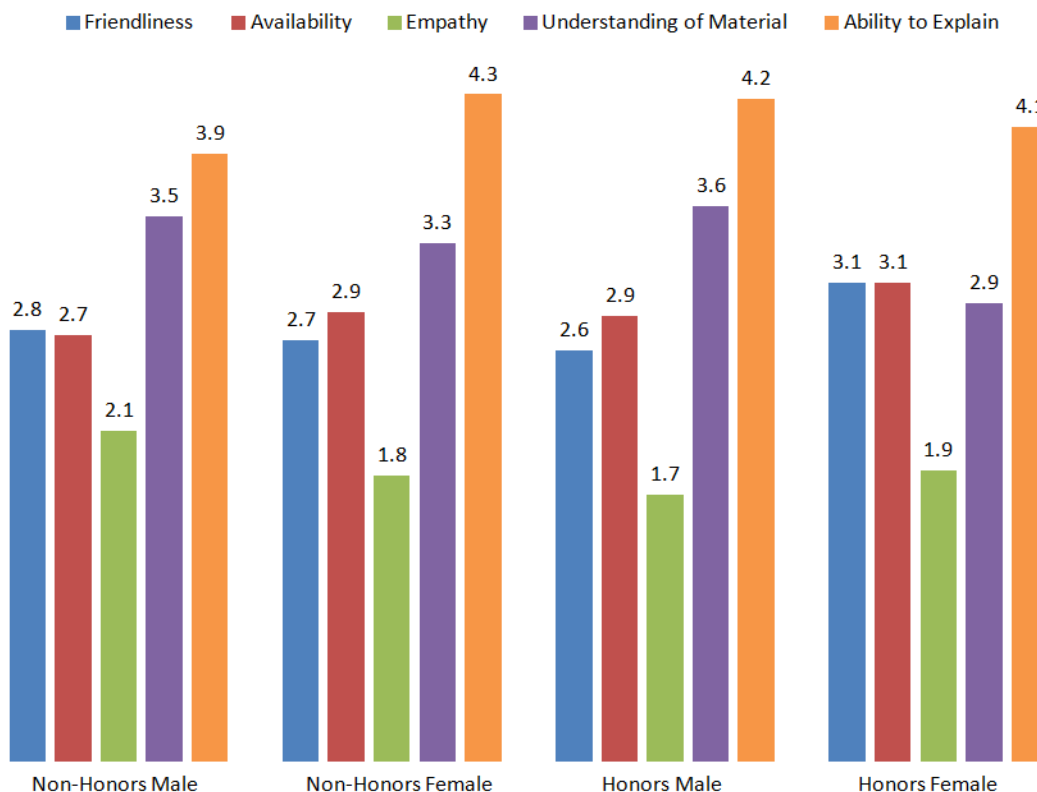
**Figure 3: Comfort level with different individuals as a source of supplemental instruction.** Average scores reported by students. Students ranked comfort level on a 1-5 scale, with 5 = most comfortable to 1 = least comfortable.



**Figure 4: Student perceptions of competence of different individuals as supplemental instructors.** Students ranked competence on a 1-5 scale, with 5 = most competent to 1 = least competent.

Students reported that they considered the instructor and TA to be most competent individuals for providing extra help. Friends, upper-class undergraduate tutors, and other faculty were all ranked similarly as least competent. This trend was similar for males and females in both the honors and non-honors sections. These outcomes demonstrate that students were least comfortable with sources of supplemental instruction that they also felt were the best at tutoring them in the course.

Figure 5 shows the importance of certain qualities in a tutor as reported by male and female students after taking chemistry. Students were asked to rank the importance of each quality on a one through five scale, with one being the least important and five being the most important, using each number only once. Responses were averaged to determine the numbers shown on the graph. The trends were found to be near identical before and after taking chemistry for both males and females.

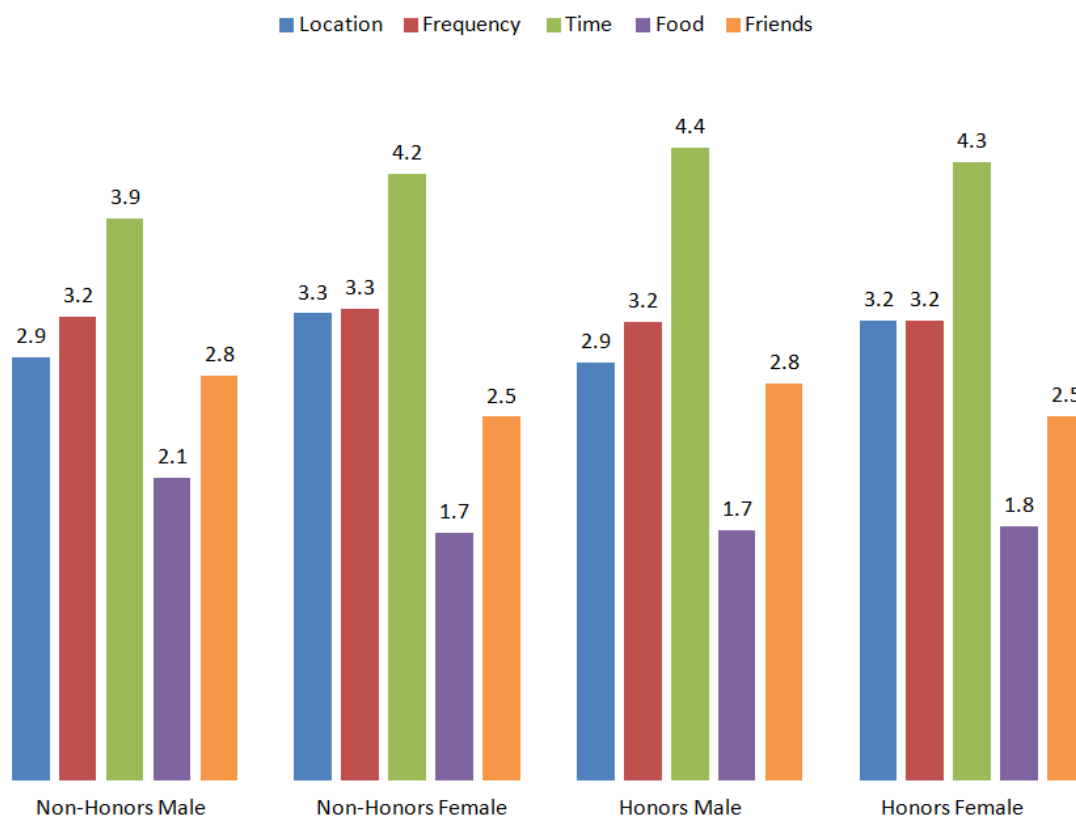


**Figure 5: Student perceptions of importance of different attributes of supplemental instructors.** Students ranked attributes on a 1-5 scale, with 5 = most important to 1 = least important.

As we observed last year, this year all populations of students ranked the ability to explain the material as the most important quality for a tutor to have. Non-honors males and females and honors males ranked a tutor’s understanding of the material as the next most important quality, in contrast to honors females, who ranked availability and friendliness of a tutor as just as important as understanding of material. Empathy was ranked least important by all students. The trends for

the male and female non-honors students and male honors students were the same as the trends seen in the study last year.

Figure 6 examines the importance of specific factors for male and female non-honors and honors students when seeking out extra help resources after taking chemistry. Students were asked to rank the importance of each quality on a one through five scale, with one being the least important and five being the most important, using each number only once. Responses were averaged to determine the numbers reported.



**Figure 6: Student perceptions of importance of different factors on whether they used a source of supplemental instruction.** Students ranked factors on a 1-5 scale, with 5 = most important to 1 = least important.

This year both honors and non-honors students ranked time as the most important factor when seeking extra help, followed by frequency, similar to what we found last year. In both the honors and non-honors sections males ranked the location of help and whether or not friends attended help sessions as almost equally important and as the next most important factors after time and frequency. Females also ranked location of help as next most important, but did not find whether or not friends attended the help session to be as important as males. All students ranked whether or not food was provided at the help session as the least important factor.

At the end of the semester students were asked about their attitude towards this chemistry course. Students were given a list of four positive and four negative adjectives and asked to circle all that

applied. The most popular responses were "prepared" or "discouraged". Table 3 shows what percentage of males and females in the non-honors and honors sections responded that they felt "prepared" or "discouraged" about general chemistry. Table 3 also shows the average course grade of these groups of students.

**Table 3: Students' Feelings towards General Chemistry vs. Course Success**

Non-Honors Males			Honors Males		
Attitude	% Responded	Course Average	Attitude	% Responded	Course Average
Prepared	45%	91.1	Prepared	40%	93.8
Discouraged	17%	82.9	Discouraged	22%	86.6
Non-Honors Females			Honors Females		
Attitude	% Responded	Course Average	Attitude	% Responded	Course Average
Prepared	40%	95.1	Prepared	28%	97.2
Discouraged	19%	86.1	Discouraged	34%	80.9

More students felt "prepared" than "discouraged" about chemistry, with the exception of honors females, who had a slightly higher percentage of students who felt "discouraged" than "prepared". Across all groups students that felt "prepared" had course averages in the A range; in contrast, students who felt "discouraged" had averages in the B range. This outcome is consistent with most students doing well in the course and the hypothesis that students who had grades in the B range were striving to raise their grades to the A range and/or expecting such a grade. Overall, students with more negative feelings towards this course in general chemistry had lower course averages, and students with more positive feelings had higher course averages.

## Conclusions

This study examined the correlation between first year engineering students' use of supplemental instruction and their performance in a required general chemistry course. Several interesting conclusions have been drawn from the data:

- Students selected resources for extra help that were convenient;
- Students were most concerned with the ability of the supplemental instructor (professor, TA, tutor, etc.) to be able to explain the material;
- Students recognized that their instructors and/or TAs were "most competent" to provide supplemental instruction (vs. a friend);
- Students were consistently more comfortable going to a friend or TA for extra help over an instructor or other faculty member;
- Females were more likely than males to attend group tutoring provided by upper-class women if that resource was available (as it was for non-honors students at this institution);
- Females indicated a higher trigger point (grade of A or B) compared to males (grade of B or C) for seeking supplemental instruction in this General Chemistry Course.

While all of these results are significant, there are points that should be made in regards to the population sampled. The students sampled were from a high level institution, with many students having taken an honors or AP level chemistry course in high school.

Elements of the key results we have found for the role of supplemental instruction for freshmen enrolled in a required course in general chemistry for engineers may have an impact on how resources for supplemental instruction can be structured to support students in other courses during the freshmen year. For example, given grade inflation that is widespread nationally, understanding how trigger points affect whether students use supplemental instruction in the face of elevated grades is important. The similar responses of honors and non-honors populations to supplemental instruction suggest that strategies developed for struggling students from disadvantaged backgrounds may be applicable to higher achievers. Consideration of the wider applicability of our findings through implementation and assessment of the impact of supplemental instruction in other freshmen core courses is warranted, including evaluation of whether trigger thresholds and impact differ among other demographic populations (*e.g.*, international students and students for whom English is not their native language). The issues raised are important topics of focus for future work in order to gain a better understanding of the impact of supplemental instruction on demographics other than male/female and honors/non-honors and in the freshmen curriculum as a whole.

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Please <b>check</b> how often you expect to do the following:	Never	Sometimes	Always
15. Sleep during class	_____	_____	_____
16. Use your cell phone during class	_____	_____	_____
17. Browse the internet, check email, or similar activities during class	_____	_____	_____
18. Do work for other classes during class	_____	_____	_____
19. Skip classes	_____	_____	_____

**General Conceptions of and Attitudes towards Resources for Succeeding in Chemistry**

20. When, based on your grades, would you feel the need to seek out extra help? Please check **one**.  
 \_\_\_\_\_ Doing very well, but need clarification (A)    \_\_\_\_\_ Doing well, but seeking to do better (B)  
 \_\_\_\_\_ Doing okay (C)    \_\_\_\_\_ Doing poorly (D)    \_\_\_\_\_ Failing the class (F)

For Questions 21 & 22 please **rank** each of the following factors on a 1-5 scale (with 5=most important and 1=least important). Please use each number only **once** per question.

21. How important is each of the following factors when seeking out extra help from any available resource?  
 \_\_\_\_\_ Location of help    \_\_\_\_\_ Frequency that help is offered  
 \_\_\_\_\_ Time of help    \_\_\_\_\_ Food is offered    \_\_\_\_\_ Friends go with you

22. How important is each quality in a tutor?  
 \_\_\_\_\_ Friendliness    \_\_\_\_\_ Availability    \_\_\_\_\_ Empathy  
 \_\_\_\_\_ Depth of understanding of material    \_\_\_\_\_ Ability to explain the material

23. Please **rank** your comfort level with using the following people as an extra help resource on a 1-5 scale (with 5=most comfortable and 1=least comfortable). Please use each number only **once**.  
 \_\_\_\_\_ Friend    \_\_\_\_\_ Upperclass undergraduate student  
 \_\_\_\_\_ TA/graduate student    \_\_\_\_\_ Course instructor    \_\_\_\_\_ Other faculty

Please check <b>all</b> that apply for the following four questions.	1-on-1 Tutoring	Instructor's Office Hours	Group Tutoring
24. Have you used these resources for any class in high school?	_____	_____	_____
25. Are you planning to use these resources for any class this semester?	_____	_____	_____
26. Have you used these resources for chemistry in high school?	_____	_____	_____
27. Are you planning to use these resources for chemistry this semester?	_____	_____	_____

**General Conceptions of and Attitudes Towards this Semester in Chemistry**

28. Please **circle** how confident you are that you will do **well** in this class: 1 2 3 4 5  
 (1=not confident, 2=little confidence, 3=some what confident, 4=confident, 5=very confident)

29. Please circle the grade you think you'll receive in this class: A B C lower than C

Please <b>circle</b> your selections for the following four questions regarding whether these activities will help you in this class.	Yes	No	Not Sure
30. Reading the textbook before class?	_____	_____	_____
31. Going to the instructor's office hours?	_____	_____	_____
32. Using the COE Freshman Tutoring Center?	_____	_____	_____
33. Attending Monday Night Chemistry Review sessions?	_____	_____	_____

**Thank you very much for your participation!**

## Appendix B: Questions Posed to Students on Post-Survey

Directions: Please enter your NU student ID in the box below as your Student Code. Your student ID is NOT located on your Husky Card but can be found on your myNEU portal. It will be used to match your responses to this pre-survey with the post-survey. Under no conditions will your responses be matched to your name.

Student Code \_\_\_\_\_

**DO NOT WRITE YOUR NAME ON THIS FORM!**

### CHEM 1151 General Chemistry for Engineers Post-Survey on Perceptions of Chemistry by Freshmen in Engineering

Fall 2013

Thank you very much for your willingness to complete this survey for our study of support programs for students taking CHEM 1151. This survey should take no more than 15 minutes of your time. Your responses will be held in complete confidence. Note that “this class” means CHEM 1151 & CHEM 1153.

#### General Conceptions of and Attitudes towards Chemistry

Please answer the following five questions by **circling** Yes or No.

- |   |     |    |
|---|-----|----|
| 1. Chemistry is a hard subject to understand                            | Yes | No |
| 2. Understanding chemistry is important for being a successful engineer | Yes | No |
| 3. I worked hard in this class  | Yes | No |
| 4. My attitude towards chemistry changed as a result of this class      | Yes | No |
| 5. If your attitude changed, was it more positive?                      | Yes | No |

Please **check** how often you did the following **during class**:

- |   | Never | Sometimes | Always |
|---|-------|-----------|--------|
| 6. Slept  | _____ | _____     | _____  |
| 7. Used your cell phone for activities unrelated to class     | _____ | _____     | _____  |
| 8. Browsed the internet, checked email, or similar activities | _____ | _____     | _____  |
| 9. Did work for other classes                                 | _____ | _____     | _____  |

#### Resources for Succeeding in Chemistry

Please rate how effective the following were in helping you in this class this semester by **circling** the appropriate number using the scale defined below. Circle “Not Used” if you did not use the service.

1 = Detrimental      2 = Not useful      3 = Somewhat useful      4 = Useful      5 = Very useful

10. Lectures (in general)	1	2	3	4	5	Not Used
11. Clicker/Responseware/Top Hat questions during lectures	1	2	3	4	5	Not Used
12. Handouts (“practice problems”) in lectures	1	2	3	4	5	Not Used
13. Recitations (in general)	1	2	3	4	5	Not Used
14. Activities/worksheets in recitations	1	2	3	4	5	Not Used
15. Required on-line homework assignments	1	2	3	4	5	Not Used
16. Ungraded on-line practice questions for homework assignments	1	2	3	4	5	Not Used
17. Posting of notes & other materials on Blackboard	1	2	3	4	5	Not Used
18. Textbook	1	2	3	4	5	Not Used
19. Monday Connections reviews	1	2	3	4	5	Not Used
20. Chem Central	1	2	3	4	5	Not Used
21. COE Freshman Tutoring Center (368F SN)	1	2	3	4	5	Not Used

22. One-on-one peer tutoring	1	2	3	4	5	Not Used
23. Instructor-led exam reviews	1	2	3	4	5	Not Used
24. Instructor office hours	1	2	3	4	5	Not Used
25. TA office hours	1	2	3	4	5	Not Used
26. Studying in groups	1	2	3	4	5	Not Used

Please <b>check</b> any of the factors that led you to <b>NOT</b> use the following resources:	Gender of supplemental instructor/tutor	Intimidating supplemental instructor/tutor	Inconvenient time	Inconvenient location	Did not think it would be useful	Did not know it existed	Other (Please specify below)
27. Monday Connections reviews							
28. Chem Central							
29. COE Freshman Tutoring Center (368F SN)							
30. One-on-one peer tutoring							
31. Instructor-led exam reviews							
32. Instructor office hours							
33. TA office hours							

Other factors that led you to not use extra help resources: \_\_\_\_\_

34. When, based on your grades, did you seek out extra help? Please check **ONE**.  
 \_\_\_\_\_ Doing very well, but needed clarification (A) \_\_\_\_\_ Doing well, but sought to do better (B)  
 \_\_\_\_\_ Doing okay (C) \_\_\_\_\_ Doing poorly (D) \_\_\_\_\_ Failing the class (F)  
 \_\_\_\_\_ Did not seek any extra help in this course

For Questions 35 & 36 please **RANK** each of the following factors on a 1-5 scale (5=most important and 1=least important). Please use each number only **ONCE**.

35. How important was each factor when seeking out extra help from an available resource?  
 \_\_\_\_\_ Location of help \_\_\_\_\_ Frequency that help was offered  
 \_\_\_\_\_ Time of help \_\_\_\_\_ Food was offered \_\_\_\_\_ Friends went with you

36. How important was each quality in a supplemental instructor/tutor?  
 \_\_\_\_\_ Friendliness \_\_\_\_\_ Availability \_\_\_\_\_ Empathy  
 \_\_\_\_\_ Depth of understanding of material \_\_\_\_\_ Ability to explain the material

37. Please **RANK** your **comfort level** with using the following people as an supplemental instructor/tutor on a 1-5 scale (5=most comfortable and 1=least comfortable). Please use each number only **ONCE**.  
 \_\_\_\_\_ Friend \_\_\_\_\_ Upperclass undergraduate student  
 \_\_\_\_\_ TA/graduate student \_\_\_\_\_ Course instructor \_\_\_\_\_ Other faculty

38. Please **RANK** the **competence** of the following people as an supplemental instructor/tutor on a 1-5 scale (5=most competent and 1=least competent). Please use each number only **ONCE**.
- \_\_\_\_\_ Friend                      \_\_\_\_\_ Upperclass undergraduate student  
 \_\_\_\_\_ TA/graduate student        \_\_\_\_\_ Course instructor                      \_\_\_\_\_ Other faculty

**Questions Regarding Impact of Undergraduate TA in Lectures**

Please answer Questions 39-44 **ONLY IF YOU ATTENDED THE 9:15 AM DIMILLA LECTURES**

Please rate the impact having an **upperclass undergraduate TA** had on the following factors by **circling** the appropriate number using the scale defined below.

= Very negative	2 = Somewhat negative	3 = Neutral	4 = Somewhat positive	5 = Very positive
-----------------	-----------------------	-------------	-----------------------	-------------------

39. Whether you went to lecture	1	2	3	4	5
40. How you learned in lecture	1	2	3	4	5
41. How much you learned in lecture	1	2	3	4	5
42. How you enjoyed lecture	1	2	3	4	5
43. Whether you attended the Monday Connections reviews	1	2	3	4	5
44. Whether you sought other forms of supplemental instruction (e.g., tutoring, Chem Central, office hours)	1	2	3	4	5

**Final Questions**

45. Please **check** how well prepared you feel you are for the Final Exam in this class:  
 \_\_\_\_\_ Very well prepared        \_\_\_\_\_ Somewhat prepared        \_\_\_\_\_ Not prepared
46. Please **circle** the final grade you think you'll receive in this class:  
 A/A-        B+/B/B-        C+/C/C-        D+/D/D-        F
47. Please **circle** how committed you are, after this semester, to pursue a degree in engineering:  
 Very committed        Somewhat committed        Not committed        Uncertain
48. Please **circle** how your experience in this class affected your desire to pursue a degree in engineering:  
 Positive effect        Negative effect        No effect
49. Please **circle** your (intended) major:  
 Chemical Eng.        Civil Eng.        Mechanical Eng.        Undecided Engineering  
 Computer Eng.        Electrical Eng.        Industrial Eng.        Other : \_\_\_\_\_
50. Please **CHECK ANY** of the following that describe your current feelings towards **this class**:  
 \_\_\_\_\_ Excited        \_\_\_\_\_ Optimistic        \_\_\_\_\_ Prepared        \_\_\_\_\_ Inspired  
 \_\_\_\_\_ Overwhelmed        \_\_\_\_\_ Discouraged        \_\_\_\_\_ Bored        \_\_\_\_\_ Lost
51. Please **CHECK ANY** of the following that describe your current feelings towards **your overall studies**:  
 \_\_\_\_\_ Excited        \_\_\_\_\_ Optimistic        \_\_\_\_\_ Prepared        \_\_\_\_\_ Inspired  
 \_\_\_\_\_ Overwhelmed        \_\_\_\_\_ Discouraged        \_\_\_\_\_ Bored        \_\_\_\_\_ Lost
52. Please **check** any of the following that apply:  
 \_\_\_\_\_ I was a Transfer student        \_\_\_\_\_ I am a Provisional Engineering student  
 \_\_\_\_\_ I am not enrolled in the College of Engineering at this time
53. Please **circle** whether English is your native language:        Yes        No  
 If no, what is your native language? \_\_\_\_\_

**Thank you very much for your participation!**