



## Examining the Impacts of Academic and Community Enrichment Resources on First-Year Civil Engineering Students

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# **Examining the Impacts of Academic and Community Enrichment Resources on First-Year Civil Engineering Students**

## **Introduction**

The Citadel School of Engineering conducted a critical internal review as part of strategic planning in 2011, which pointed to limited retention efforts for students that are many times ill prepared for college, especially engineering. Following the 2011 strategic planning efforts was a period of change and innovation within the School that led to improved retention efforts [1]. Several new personnel were hired, including several faculty and a retention and engagement expert, who prioritized improvement of services to promote retention.

### *Retention Efforts within the School of Engineering*

Several academic and community enrichment services were implemented after 2011. The first was Supplemental Instruction (SI), which was designed to give students' academic support in courses that commonly reported high percentages of low final grades (D or F) and/or withdrawals [2]. Courses are assigned an SI Leader, which is a student who has previously passed the course with a final grade of B or better, to hold twice-per-week support sessions. In addition, first-year outreach dinners were added to provide monthly academic and social integration programs for students majoring in Civil, Electrical and Mechanical Engineering. Events are designed to be supportive, engaging, and allow students to build rapport with their peers and faculty outside of the classroom [3].

In addition to new services, the School began advertising and encouraging first-year students to take advantage of additional campus resources. Specifically, students have access to the Math Lab, in which tutors are available on a drop-in basis to answer questions concerning Algebra, Functions, Trigonometry, Finite Mathematics, Calculus, and Calculus II. The campus academic support center also provides subject-area tutoring, where students are provided with a (free) one-on-one tutor in designated subject areas. Each of the engineering departments also hosts active professional societies, including the American Society of Civil Engineers (ASCE), the Institute of Electrical and Electronic Engineers (IEEE), and the American Society of Mechanical Engineers (ASME). Each of these organizations promotes professional development through engagement with the engineering community, as well as other engineering departments across the country.

Ultimately, reform within the School of Engineering has led to improved retention rates. In 2011, the retention of freshmen from Fall to Spring semesters was 75%, with only 67% returning as engineers their sophomore year. However, by 2016, the retention of freshmen from Fall to Spring semesters was 83%, with 73% returning as engineers their sophomore year (Figure 1).

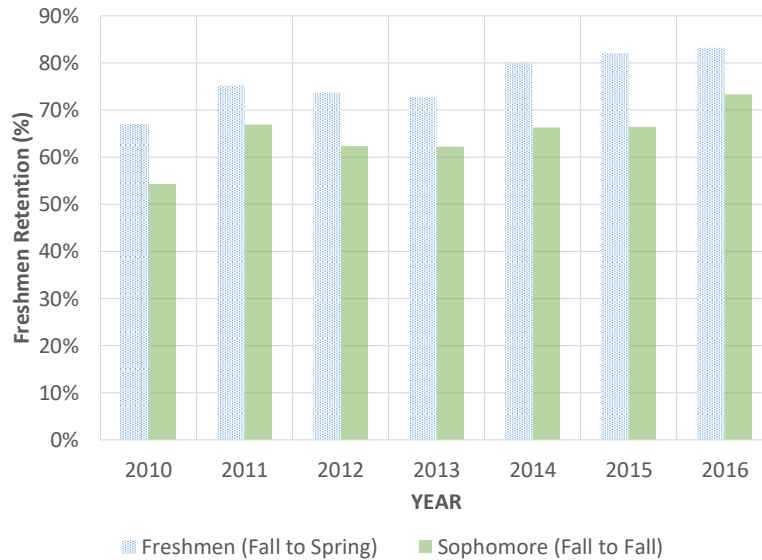


Figure 1. Retention within the School of Engineering [Freshmen (Fall to Spring) represents the percentage of students retained from fall to spring semesters; Sophomore (Fall to Fall) represents the percentage of students returning as engineers for their sophomore year].

### *Retention Efforts with Civil and Environmental Engineering*

Efforts within the Civil and Environmental Engineering (CEE) Department focused on improvement of the first-year civil engineering course [4, 5]. In 2013, the course was redesigned to support student development following Ray Landis’s model “Introduction to Engineering” course [6]. The accompanying textbook, *Studying Engineering: A Road Map to a Rewarding Career* [7], has been used by over 100,000 students at more than 300 institutions [8]. Through this course, students gain a clear picture of what success in engineering study will bring to their lives [6].

The major goals of this course are to: (1) encourage students to develop the study skills needed to succeed in engineering and (2) guide them in becoming integrated into the engineering community on campus. To accomplish these goals, students participate in interactive class discussions and projects related to academic success and community building, as previously reported [5]. In addition, students are required to attend and submit a reflection on each of the academic and community building resources offered through the CEE Department, the School of Engineering, and the Academic Support Center. Specifically, students were required to attend one session of the following: SI, Math Lab, First-Year Outreach Dinners, ASCE meetings, and any additional event (Table 1).

Table 1. Academic and community support services that first-year engineering students were encouraged to attend and reflect upon.

Academic and Community Support Services	Description
Supplemental Instruction ( <i>Required to attend once</i> )	Courses with a high D/F/W rate are assigned a student who has previously passed the course with a final grade of B or better to hold two study sessions per week.
Math Lab ( <i>Required to attend once</i> )	Tutors are available on a drop-in basis to answer questions concerning Algebra, Functions, Trigonometry, Finite Mathematics, Calculus, and Calculus II.
Subject-Area Tutoring ( <i>Could be used as required “choose your own event” requirement</i> )	The Academic Support Center provides with a (free) one-on-one tutor in designated subject areas.
First-Year Outreach Dinners ( <i>Required to attend once</i> )	Provide monthly academic and social integration programs to allow students to build rapport with their peers and faculty outside of the classroom.
ASCE Meetings ( <i>Required to attend once</i> )	Students engage with professionals and peers to discuss employment opportunities and engage in nation-wide civil engineering competitions.

### *Study Outline*

The goal of this study is to evaluate the effectiveness of a variety of school-wide support and enrichment services for civil engineering students. Currently, the first-year civil engineering course requires (or encourages) students to attend SI, Math Lab, Subject-Area Tutoring, First-Year Outreach Dinners, and ASCE meetings at least once. The objectives were to: (1) Identify services that most impact students’ perceived academic success and community integration and (2) Quantify the impacts of attendance frequency on students’ perceived academic success and community integration. Overall, to maximize student impact, course administrators are interested in evaluating whether or not certain services should be required or encouraged with greater frequency.

## **Methods**

### *Survey Development*

A six-part survey was developed to capture students’ perceptions of retention and enrichment activities, as well as their satisfaction with community integration and academic atmosphere. In Part 1, students were asked to provide their attendance frequency (Never, 1-2 times, 3 – 5 times, more than 5 times) at SI, Math Lab, Subject-Area Tutoring, First-Year Outreach Dinners, and ASCE Meetings. In Parts 2 – 4, students were asked to use a seven-point scale to describe the

extent to which the support and enrichment services contributed to academic success, promoted community integration, and provided enjoyment, respectively (Table 2). Part 5 (adapted from [7]) prompted students to use a five-point scale ranging from *strongly disagree* to *strongly agree* in reflecting on their satisfaction with community integration and academic atmosphere (Table 3). In Part 6, students were asked a series of open-ended questions, which are not analyzed as part of this study.

Table 2. Survey prompts used to collect student perceptions of support and enrichment services (including SI, Math Lab, Subject-Area Tutoring, First-Year Outreach Dinners, and ASCE Meetings).

Part	Survey Prompt	Scale
2	To what extent did the following support and enrichment services help you achieve academic success?	
3	To what extent did the following support and enrichment services help you become part of the engineering community?	[1-7]
4	To what extent did you enjoy the following support and enrichment services?	

Table 3. Survey prompts used in Part 5 of survey to collect students' satisfaction with community integration and academic atmosphere.

Survey Prompt	Scale
My interaction with my professors was positive & beneficial, thus helping me succeed during my first semester.	
The Military Requirements at The Citadel (i.e. PT, Inspections, Uniform Prep, Formations, etc) had a negative impact on me completing my academic coursework.	
The Mandatory Weekend Events took up time that I could have been spent completing my academic coursework.	
I am highly motivated through a clear understanding of the rewards that graduating in my chosen major will bring to my life.	
At The Citadel, I know other students in my classes & feel part of an academic learning community.	
I feel good about The Citadel and about the educational experience I am receiving.	
	Strongly Agree [1] Agree [2] Neutral [3] Disagree [4] Strongly Disagree [5]

### *Survey Administration*

The paper survey was administered to all first-year civil engineering students ( $N = 56$ ) on the last day of the Fall 2017 semester. While the survey was not required, students were offered extra credit on the final exam for thoughtful completion of the survey. In total, 54 of the 56 students (96.4%) completed all survey questions. Students who did not complete the survey were given an alternative extra credit opportunity. No time limit was enforced for survey completion, although most students required 15 – 25 minutes.

## *Data Analysis*

For Part 1, students' self-reported attendance was binned to facilitate subsequent statistical analyses. *Low attendance* was defined as participating in a support event less than three times. *High attendance* was defined as participating in a support event three or more times. When appropriate, those students never attending an event were included in the *low attendance* category. Attendance categories were identified based on sample sizes and visual examination of frequency charts.

For Parts 2 – 4, descriptive and inferential statistics were used to evaluate students' perceived impact of support and enrichment services on academic success, community integration, and enjoyment. Responses of 1 – 2 were categorized as *low impact*, responses of 3 – 5 were categorized as *medium impact*, and responses of 6 – 7 were categorized as *high impact*. For each support and enrichment service, frequencies (as percentages) were reported for each impact category. Non-parametric Mann-Whitney *U* Tests were used to infer the level of impact on academic success, community integration, and enjoyment based on frequency of attendance (*low* or *high*) for each support and enrichment service. Significant relationships were identified as those yielding a *p*-value of 0.05 or lower.

For Part 5, descriptive and inferential statistics were used to evaluate students' satisfaction with community integration and academic atmosphere. For each statement, frequency plots were generated and medians were used as measures of central tendency (due to typically non-normal distributions). Non-parametric Mann-Whitney *U* Tests were used to infer the impact of support and enrichment service attendance (*high attendance* versus *no/low attendance*) on student satisfaction. Significant relationships were identified as those yielding a *p*-value of 0.05 or lower.

## **Results**

### *Attendance*

Students' self-reported attendance at academic and community enrichment services varied (Table 4). Most of the 54 respondents attended Math Lab (90.7%), Supplemental Instruction (87.5%), ASCE Meetings (87.0%), and First-Year Outreach dinners (85.2%) at least once. Participation in subject-area tutoring, however, was low (50.0%).

Table 4. Self-reported attendance at academic and community enrichment services ( $n = 54$ ).

	Never	1 – 2 Times	3 – 5 Times	More than 5 Times
Supplemental Instruction	12.5	54.2	27.1	18.8
Math Lab	9.3	51.9	18.5	20.4
Subject Area Tutoring	50.0	25.9	14.8	9.3
First-Year Outreach Dinners	14.8	31.5	33.3	20.4
ASCE Meetings	13.0	46.3	31.5	9.3

### Supplemental Instruction

Supplemental Instruction contributed most to students' perceived academic success, but had less impact on their integration into the engineering community (Figure 2). Of the 48 students who attended SI, 43.8% believed it had a *high* impact on their academic success, while 8.3% believed it had a *low* impact. In contrast, 27.1% believed it had a *high* impact on their integration into the engineering community, while 18.8% believed it had a *low* impact. Overall, just under 40% of attendees expressed a *high* level of enjoyment at participating in SI.

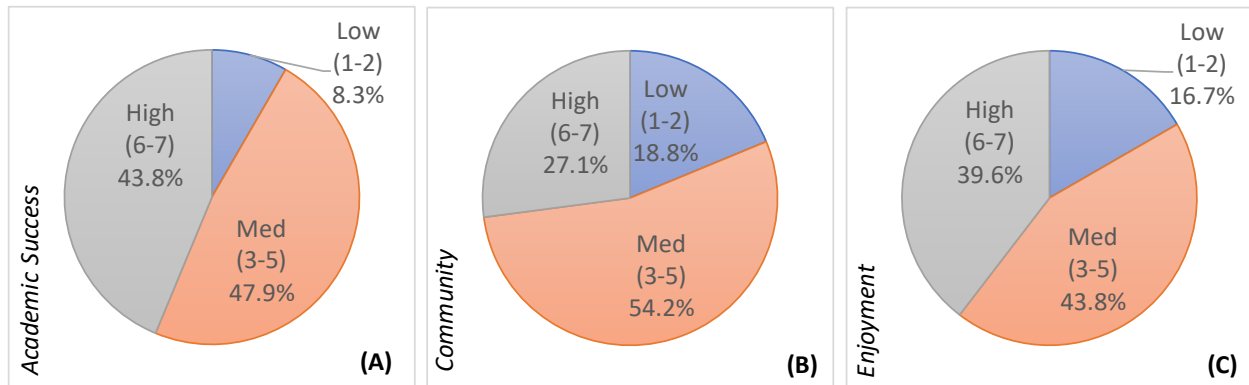


Figure 2. Students' perceived impact of SI on academic success, community integration, and enjoyment ( $n = 48$ ).

In general, the impact of SI increased as the frequency of student attendance increased (Table 5). Those who attended SI three or more times (*high attendance*) reported significantly greater impact on academic success, community integration, and enjoyment, as compared to those who attended SI less than three times (*low attendance*).

Table 5. Impact of frequency of SI attendance on perceived academic success, community integration, and enjoyment.

	Median			Mann-Whitney <i>U</i>	
	All Attendees ( <i>n</i> = 48)	Low Attendance ( <i>n</i> = 26)	High Attendance ( <i>n</i> = 22)	<i>U</i>	<i>p</i>
Achieve academic success	5.0	5.0	6.0	137.0	0.002***
Become part of community	4.0	3.0	5.0	117.5	< 0.001***
Level of enjoyment	5.0	4.5	5.0	153.5	0.005**

### Math Lab

Math Lab contributed most to students’ perceived academic success, but had less impact on their integration into the engineering community (Figure 3). Of the 49 students who attended Math Lab, 51.0% believed it had a *high* impact on their academic success, while 8.2% believed it had a *low* impact. In contrast, 18.4% believed it had a *high* impact on their integration into the engineering community, while 14.3% believed it had a *low* impact. Overall, just under 40% of attendees expressed a *high* level of enjoyment at participating in Math Lab.

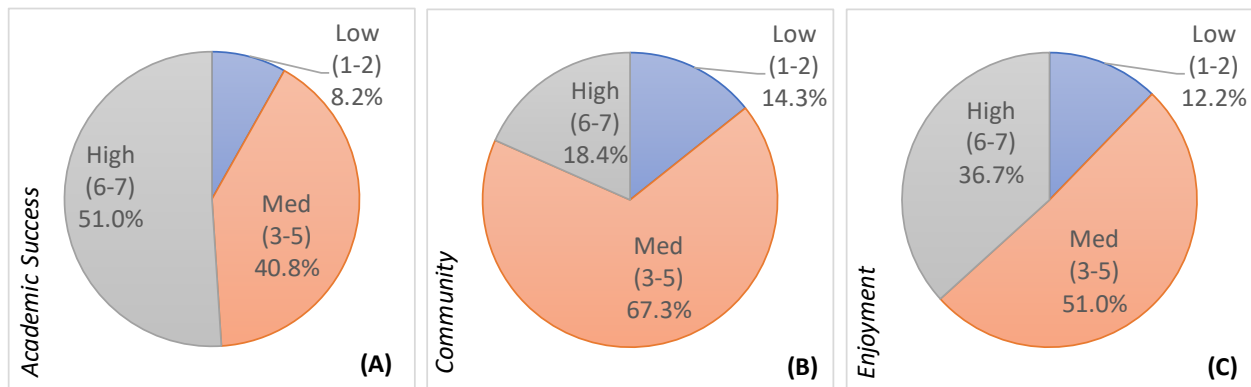


Figure 3. Students’ perceived impact of Math Lab on academic success, community integration, and enjoyment (*n* = 49).

In general, the impact of Math Lab increased as the frequency of student attendance increased (Table 6). Those who attended Math Lab three or more times (*high attendance*) reported significantly greater impact on academic success and community integration, as compared to those who attended Math Lab less than three times (*low attendance*). Level of enjoyment did not increase significantly based on student Math Lab attendance.



Table 6. Impact of frequency of Math Lab attendance on perceived academic success, community integration, and enjoyment.

	All Attendees ( <i>n</i> = 49)	Median		Mann-Whitney <i>U</i>	
		Low Attendance ( <i>n</i> = 28)	High Attendance ( <i>n</i> = 21)	<i>U</i>	<i>p</i>
Achieve academic success	6.0	5.0	6.0	188.5	0.029*
Become part of community	3.0	3.0	5.0	181.5	0.019*
Level of enjoyment	5.0	5.0	6.0	226.0	0.163

### Subject Area Tutoring

Subject Area Tutoring contributed most to students' perceived academic success, but had less impact on their integration into the engineering community (Figure 4). Of the 27 students who attended Subject Area Tutoring, 44.4% believed it had a *high* impact on their academic success, while 3.7% believed it had a *low* impact. In contrast, 29.6% believed it had a *high* impact on their integration into the engineering community, while 11.1% believed it had a *low* impact. Overall, just under 50% of attendees expressed a *high* level of enjoyment at participating in Subject Level Tutoring.

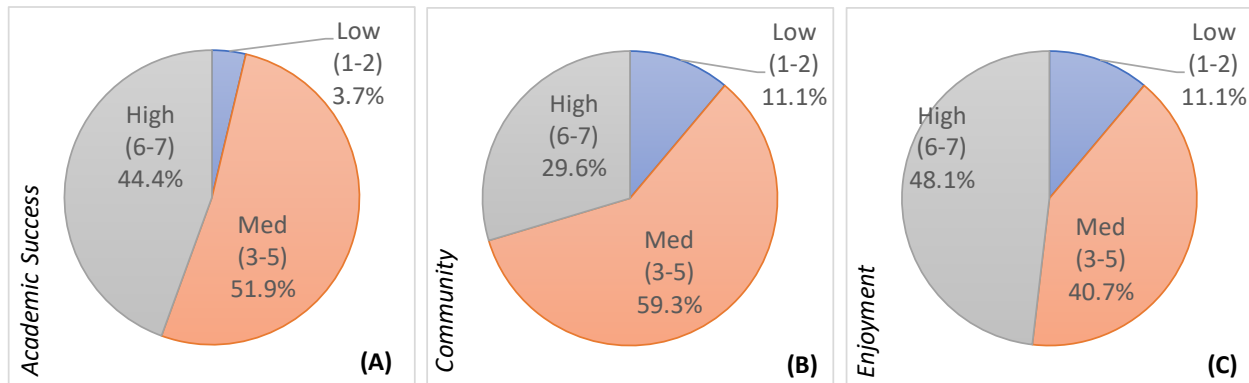


Figure 4. Students' perceived impact of Subject-Level Tutoring on academic success, community integration, and enjoyment (*n* = 27).

In general, the impact of Subject-Area Tutoring did not change based on the frequency of student attendance (Table 7). Impact on academic success, community integration, and level of enjoyment was similar for both those who attended Subject-Area Tutoring three or more times (*high attendance*) and those who attended Subject-Area Tutoring less than three times (*low attendance*).

Table 7. Impact of frequency of Subject-Area Tutoring attendance on perceived academic success, community integration, and enjoyment.

	All Attendees ( <i>n</i> = 27)	Median		Mann-Whitney <i>U</i>	
		Low Attendance ( <i>n</i> = 14)	High Attendance ( <i>n</i> = 13)	<i>U</i>	<i>p</i>
Achieve academic success	5.0	5.0	6.0	76.5	0.488
Become part of community	4.0	4.0	5.0	74.5	0.430
Level of enjoyment	5.0	6.0	5.0	85.0	0.793

### First-Year Outreach Dinners

First-Year Outreach Dinners contributed most to students' integration into the engineering community, but had less impact on their perceived academic success (Figure 5). Of the 46 students who attended First-Year Outreach Dinners, 76.1% believed it had a *high* impact on their integration into the engineering community, while 6.5% believed it had a *low* impact. In contrast, 30.4% believed it had a *high* impact on their academic success, while 6.5% believed it had a *low* impact. Overall, nearly 80% of attendees expressed a *high* level of enjoyment at participating in First-Year Outreach Dinners.

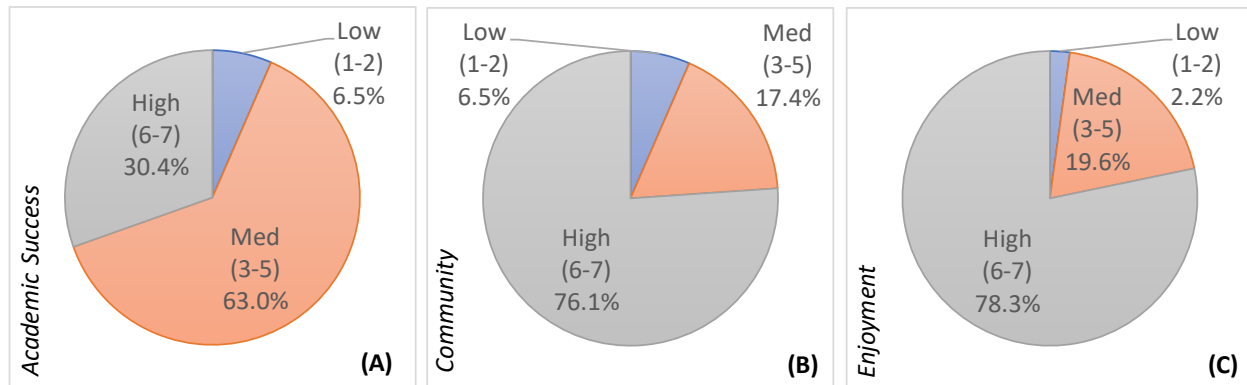


Figure 5. Students' perceived impact of First-Year Outreach Dinners on academic success, community integration, and enjoyment (*n* = 46).

In general, the impact of First-Year Outreach Dinners increased as the frequency of student attendance increased (Table 8). Those who attended First-Year Outreach Dinners three or more times (*high attendance*) reported significantly greater impact on academic success, community integration, and enjoyment, compared to those who attended First-Year Outreach Dinners less than three times (*low attendance*).

Table 8. Impact of frequency of First-Year Outreach Dinner attendance on perceived academic success, community integration, and enjoyment.

	All Attendees ( <i>n</i> = 46)	Median		Mann-Whitney <i>U</i>	
		Low Attendance ( <i>n</i> = 17)	High Attendance ( <i>n</i> = 29)	<i>U</i>	<i>p</i>
Achieve academic success	5.0	4.0	5.0	148.5	0.022*
Become part of community	6.5	5.0	7.0	98.5	< 0.001***
Level of enjoyment	7.0	6.0	7.0	153.0	0.007**

### ASCE Meetings

American Society of Civil Engineers meetings contributed most to students' integration into the engineering community, but had less impact on their perceived academic success (Figure 6). Of the 47 students who attended ASCE meetings, 59.6% believed it had a *high* impact on their integration into the engineering community, while 4.3% believed it had a *low* impact. In contrast, 27.7% believed it had a *high* impact on their academic success, while 21.3% believed it had a *low* impact. Overall, just over 50% of attendees expressed a *high* level of enjoyment at participating in ASCE meetings.

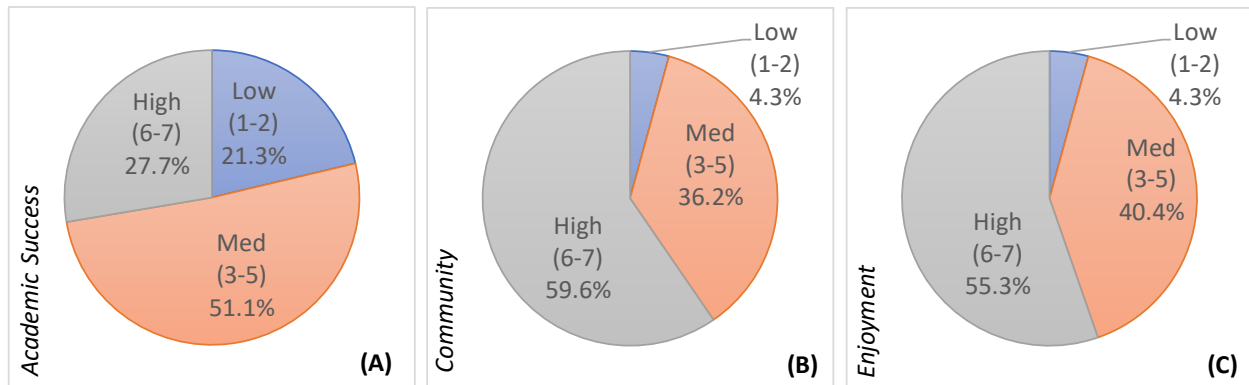


Figure 6. Students' perceived impact of ASCE meetings on academic success, community integration, and enjoyment (*n* = 47).

In general, the impact of ASCE meetings increased as the frequency of student attendance increased (Table 9). Those who attended ASCE meetings three or more times (*high attendance*) reported significantly greater impact on academic success, community integration, and enjoyment, compared to those who attended ASCE meetings less than three times (*low attendance*).

Table 9. Impact of frequency of ASCE Meeting attendance on perceived academic success, community integration, and enjoyment.

	All Attendees ( <i>n</i> = 47)	Median		Mann-Whitney <i>U</i>	
		Low Attendance ( <i>n</i> = 25)	High Attendance ( <i>n</i> = 42)	<i>U</i>	<i>p</i>
Achieve academic success	4.0	4.0	5.5	141.0	0.004**
Become part of community	6.0	5.0	7.0	111.5	< 0.001***
Level of enjoyment	6.0	5.0	7.0	116.5	< 0.001***

*Attitudes Towards Community Integration and Academic Atmosphere*

Students were asked to reflect on several statements related to their attitudes towards community integration and academic atmosphere. Overwhelmingly, 74.1% of students *strongly agreed* that “[their] interaction[s] with [their] professors were positive and beneficial, thus helping [them] succeed during [their] first semester” (Figure 7A). In contrast 37.0% of students *strongly agreed* and 51.9% *agreed* that “[they knew] other students in [their] classes and [felt] part of an academic learning community” (Figure 7B). While students certainly cited satisfaction with their professor and peer relationships, they were most satisfied with their professorial relationships.

Student responses were generally positive concerning their academic environment. In total, 42.6% of students *strongly agreed* and 50.0% *agreed* that “[they] are highly motivated through a clear understanding of the rewards that graduating in [their] chosen major will bring to [their] life” (Figure 7C). Similarly, 38.9% of students *strongly agreed* and 50.0% *agreed* that “I feel good about The Citadel and the education experience I am receiving” (Figure 7D). Overall, after their first semester, students indicated satisfaction with their degree and their institution.

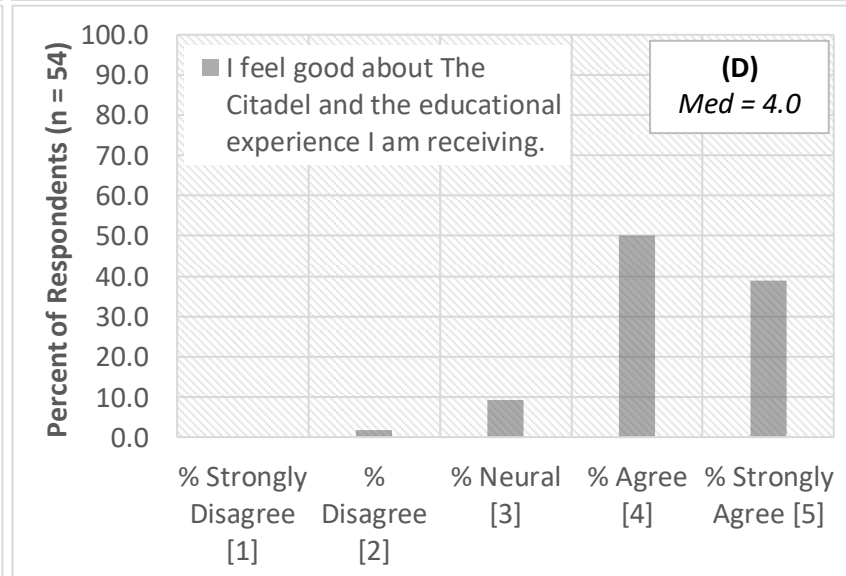
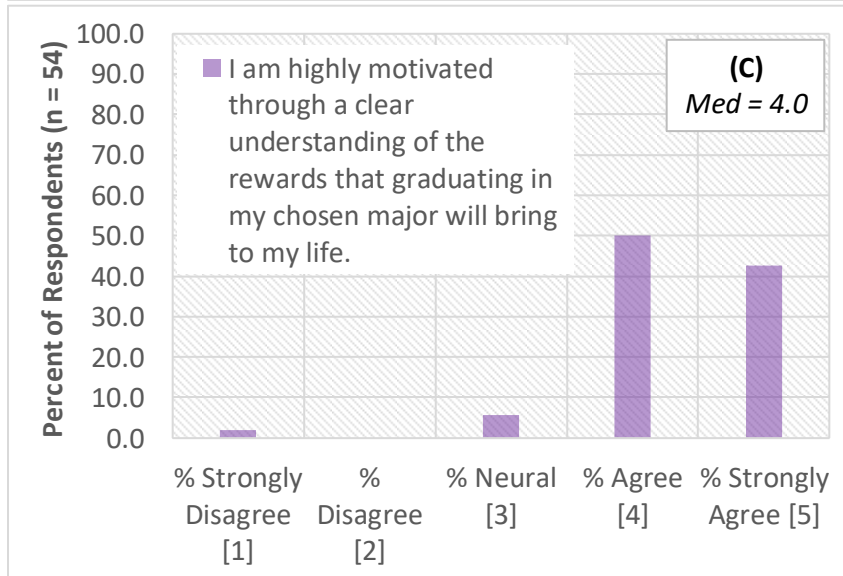
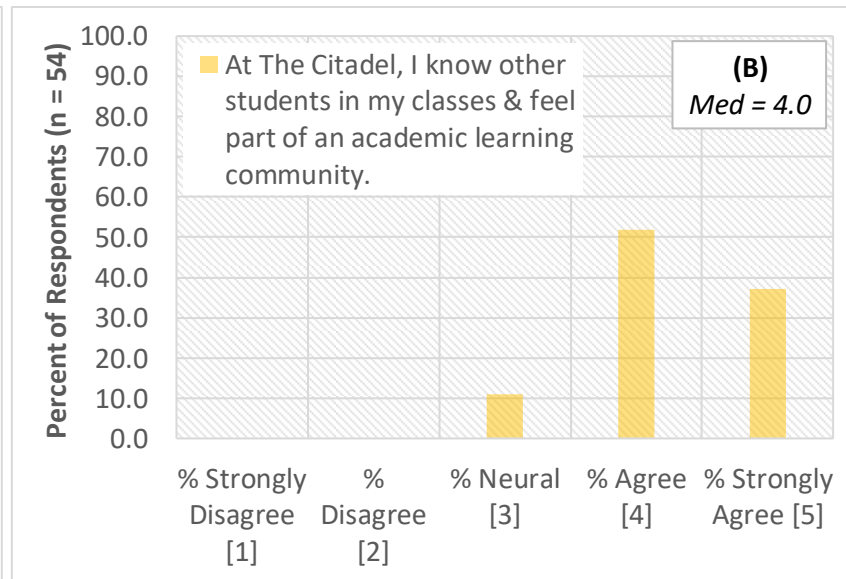
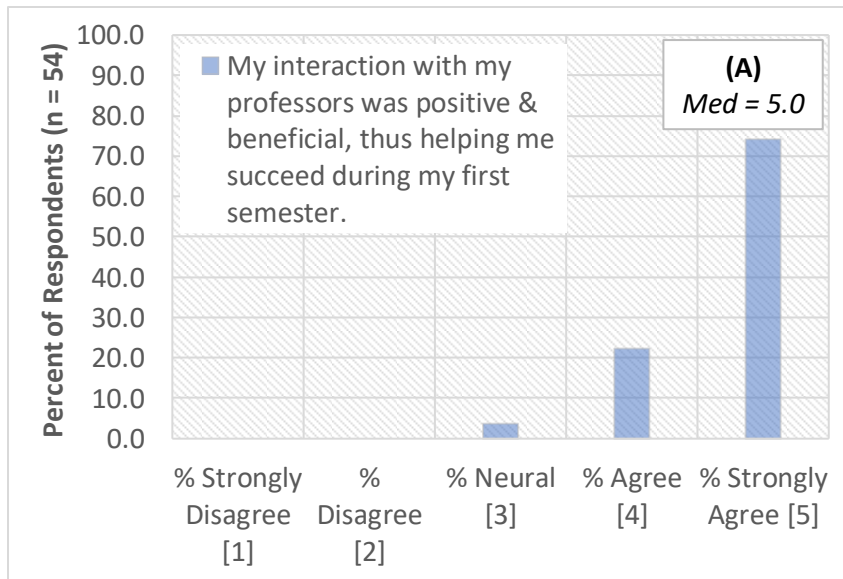


Figure 7 (A-D). Students' attitudes related to community integration and academic atmosphere.

Attendance at First-Year Outreach Dinners positively impacted students' attitudes towards community integration and academic atmosphere (Table 10). Those who attended First-Year Outreach Dinners three or more times (*high attendance*) reported significantly higher satisfaction with their professorial interactions, peer relationships, and overall educational experience, compared to those who attended less than three times (*no/low attendance*). No other significant relationships were found based on First-Year Outreach Dinner attendance.

To a lesser extent, Math Lab attendance positively impacted students' attitudes towards their professorial interactions (Table 11). In fact, those who attend Math Lab three or more times (*high attendance*) reported significantly higher satisfaction with their professorial interactions, compared to those who attended less than three times (*no/low attendance*). No other significant relationships were found based on Math Lab attendance.

Table 10. Impact of First-Year Outreach Dinner attendance on students' attitudes towards community integration and academic atmosphere.

	Median		Mann-Whitney <i>U</i> Test	
	No/Low Attendance ( <i>n</i> = 25)	High Attendance ( <i>n</i> = 29)	<i>U</i>	<i>p</i>
My interaction with my professors was positive & beneficial, thus helping me succeed during my first semester.	5.0 <sup>1</sup>	5.0 <sup>2</sup>	237.5	0.005**
At The Citadel, I know other students in my classes & feel part of an academic learning community.	4.0	5.0	256.5	0.041*
I am highly motivated through a clear understanding of the rewards that graduating in my chosen major will bring to my life.	4.0 <sup>3</sup>	5.0 <sup>4</sup>	455.0	0.072
I feel good about The Citadel and the educational experience I am receiving.	4.0	5.0	231.0	0.012*

<sup>1</sup>Mean Rank = 22.50; <sup>2</sup>Mean Rank = 31.81; <sup>3</sup>Mean Rank = 23.80; <sup>4</sup>Mean Rank = 30.69.

Table 11. Impact of Math Lab attendance on students' attitudes towards community integration and academic atmosphere.

	Median		Mann-Whitney <i>U</i> Test	
	No/Low Attendance ( <i>n</i> = 33)	High Attendance ( <i>n</i> = 21)	<i>U</i>	<i>p</i>
My interaction with my professors was positive & beneficial, thus helping me succeed during my first semester.	5.0	5.0	356.5	0.816
At The Citadel, I know other students in my classes & feel part of an academic learning community.	4.0	4.0	357.5	0.828
I am highly motivated through a clear understanding of the rewards that graduating in my chosen major will bring to my life.	4.0	5.0	447.0	0.046*
I feel good about The Citadel and the educational experience I am receiving.	4.0 <sup>1</sup>	5.0 <sup>2</sup>	421.0	0.143

<sup>1</sup>Mean Rank = 25.4; <sup>2</sup>Mean Rank = 31.05

## Discussion

### *Resources that Impact Academic Success and Community Integration*

#### 1. Academic Success

Based on descriptive frequencies of all respondents' responses, attendance at Math Lab, Subject-Area Tutoring, and SI had the greatest impact on perceived academic success. For each of these support services, 51.0%, 44.4%, and 43.8% of attendees found the experience to be *highly* impactful, respectively. All three of these support services likely impact academic success because they all include extra course-related instruction for students. At Math Lab, students can easily access instructors and/or graduate students to clarify class concepts and work on specific homework problems. Similarly, subject-area tutoring allows students to regularly meet with the same tutor to master academic material. At SI, students are matched with undergraduates who have already received an "A or B" in the course and can aid current students with course work. Enjoyment for these academic enrichment services were fairly low with 39.6% (SI) and 36.7% (Math Lab) of attendees citing *high* enjoyment. Although fewer students took advantage of Subject-Area Tutoring, reported enjoyment was higher (48.1%). Follow-up interviews are needed with a sample of those students who indicated only *medium* or *low* impact for these services to identify strategies for improvement.

## 2. Community Integration

Based on descriptive frequencies of all respondents' responses, attendance at First-Year Outreach Dinners and ASCE meetings had the greatest impact on community integration. For each of these outreach events, 76.1% and 59.6% of attendees found the experience to be *highly* impactful, respectively. At First-Year Outreach Dinners, all activities are specifically designed to create a welcoming environment for freshmen. Whether they are engaging in engineering design challenges, peer mentoring, or professional mentoring, the fourth-class system is completely absent from these events. First-year students are able to relax, eat, and enjoy engineering. The unique freshmen-focused atmosphere likely explains why 78.3% of attendees *highly* enjoyed the dinners. ASCE meetings, however, are structured to provide professional mentoring and promote departmental community for all students (not just first-year students). While upperclassmen are encouraged to interact with first-year students, students can often be observed siloed by academic class. Consequently, only 55.3% of first-year attendees *highly* enjoyed ASCE meetings.

## 3. Most Impactful Support and Enrichment Event

Overall, First-Year Outreach Dinners stand out as one of the most overall impactful support services. The dinners were exceedingly successful at meeting the intended purpose of promoting integration of first-year students into the engineering community. In fact, no other service or event exceeds the 76.1% *high* impact score that First-Year Outreach Dinners earned for community integration. While not providing direct academic support (in the form of instruction or tutoring), only 6.5% of attendees report *low* impact of the dinners on academic success. In context, no other service or event (with the exception of Subject-Area Tutoring) received a lower *low* impact rating for academic success. Even still, the First-Year Outreach Dinners were the most enjoyable event, with 78.3% of students citing *high* enjoyment and only 2.2% citing *low* enjoyment.

### *Impact of Attendance Frequency*

#### 1. Academic Success

In general, increased attendance frequency at support and enrichment events positively impacted students' perceived academic success. Most significantly ( $p = 0.002$ ), *high* SI attendance led to perception of greater academic success, as compared to *low* attendance. Likely, more interactions with experienced (undergraduate) SI leaders and peers contributed to the increased sense of achievement. With similar significance ( $p = 0.004$ ), *high* ASCE Meeting attendance led to perception of greater academic success, as compared to *low* attendance. While first-year students certainly had a chance to network with others to seek academic assistance, it is possible that sustained interactions with professionals helped them to engage with course content outside



of the classroom. Only increased Subject-Area Tutoring attendance did not lead to significant impacts on perceived academic success, perhaps due to low sample size ( $n = 27$ ).

## 2. Community Integration

In addition, increased attendance frequency at support and enrichment events positively impacted integration of first-year students into the engineering community. Most significantly ( $p \leq 0.001$ ), *high* SI, First-Year Outreach Dinner, and ASCE Meeting attendance led to greater community integration. As opposed to Math Lab and Subject-Area Tutoring, each of these high-impact events connects first-year students with engineering faculty, upperclassmen, and/or peers. Accordingly, the more that first-year students interact with these groups, the more connected to the engineering community they become.

## 3. Most Impactful Support and Enrichment Event on Student Attitudes

Increased attendance at First-Year Outreach Dinners most commonly impacted students' attitudes towards community integration and academic atmosphere. Most significantly ( $p = 0.005$ ), *high* attendance led to more favorable perceptions of students' interactions with their professors, as compared to *low* attendance. Indeed, civil engineering faculty are always present at the dinners to engage with first-year students outside of the classroom. Furthermore, *high* attendance significantly ( $p \leq 0.05$ ) impacted students' positive perceptions of peer interactions and their overall educational experience. Again, First-Year Outreach Dinners seem to have a unique impact on attendees, as compared to other support and enrichment services.

## Conclusions

A study was conducted to evaluate the effectiveness of a variety of school-wide support and enrichment services for civil engineering students. A survey was developed and administered to first-year students to capture the impact of several support and enrichment services on their perceived academic success, community integration, enjoyment, and related attitudes. Based on descriptive and inferential statistical analyses, the following conclusions were made based on the results.

1. Math Lab, Subject-Area Tutoring, and SI had the greatest impact on students' perceived academic success, likely because these services provide students with additional course-related instruction.
2. First-Year Outreach Dinners and ASCE meetings had the greatest impact on student integration into the engineering community, likely because these services connect first-year students with peers, upperclassmen, faculty, and/or professionals.
3. Attending support and enrichment activities three or more times generally led to higher perceived academic success and community integration.

4. First-Year Outreach dinners were overall most impactful, as they overwhelmingly supported community engagement, encouraged notable improvements in perceived academic success, and led to improved attitudes towards community integration and academic atmosphere. Future introductory civil engineering classes will encourage students to attend these events more frequently.

Overall, this study depicts the fact that several interventions may be needed to positively impact student retention. At The Citadel, implementation of and/or increased encouragement to attend Supplemental Instruction (SI), Math Lab, Subject-Area Tutoring, First-Year Outreach Dinners, and ASCE meetings has led to substantial improvements in freshmen retention. Based on survey data, civil engineering professors will certainly encourage students to attend First-Year Outreach Dinners with increased frequency, due to their impact on both community integration and perceived academic performance.

However, it is noted that other institutions may require a different blend of support resources to improve retention, depending on the characteristics and needs of their students. Nevertheless, other educators may find the outcomes of this study informative. Specifically, attendance at events primarily intended to build community (e.g., First Year Outreach Dinners) can also have positive impacts on students' perceived academic success, perhaps to improved within-class networking. In addition, for support resources to be most impactful, students should be encouraged to attend with regular frequency.

To further refine the support services offered at The Citadel, and perhaps provide generalizable insights for other institutions, future work will include conducting semi-structured interviews with students who attended each event with either *high* or *low* frequency. Through student viewpoints, we hope to identify specific aspects of our events that are particularly impactful (or un-impactful), as well as identify barriers to student attendance.

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