Student and Instructor Perceptions of a Supplemental Instruction Program

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Abstract

The first two years of undergraduate engineering have been traditionally high attrition years for engineering programs. Students enter their freshman year quite capable of completing an engineering degree with high enthusiasm, but many never complete the first or second year's required math courses. One program at this institution designed to assist students outside of the classroom is the Supplemental Instruction (SI) program. The SI program is part of a larger campus effort allowing students to be part of a dynamic and supportive educational environment outside of the classroom. The administration of the SI program requires keen oversight of the concerted effort between different departments and organizations on campus. Although the SI program at this institution has been active for several years, an internal assessment of the program is necessary to identify student perceptions and areas for improvement. This is a preliminary study of the SI program for students majoring in the Science, Technology, Engineering or Math (STEM) fields. The implementation of this study will provide a baseline of data and information about how to continue developing and improving the program. This paper describes the student perceptions, SI leader survey results and program components to increase engagement of engineering students with peers outside of the classroom to maintain student interest in working towards their engineering degree.

Keywords

Supplemental Instruction, Freshmen Success, STEM

Background

Supplemental Instruction (SI) is a program that offers students an opportunity to supplement the knowledge they have acquired from their lectures with sessions proctored by an SI leader. The SI program at The Citadel has been described in depth and how it correlates to student retention in engineering[1]. Since SI is administered in the evenings, it is not a mandatory event but highly encouraged by instructors, student groups and academic advisors. Attendance is taken through a sign in sheet to assist the program coordinator monitor SI loads and demand. Since SI is not mandatory, some instructors do offer extra points on assignments when students attend, some offer points at the end of the course, while some do nothing more than advertise the opportunity. The importance of SI programs has been documented by McGuire who stated that SI is essential for introducing students to the learning process, engaging them in collaborative learning, and providing a community that increases motivation to learn[2]. SI leaders can be another student who has taken the course or a graduate student with an expertise in that area. These sessions are administered in the evening, so all students have an opportunity to attend, and sessions usually last between an hour and two hours. In the sessions students usually work on practice problems,

homework, study guides, or old tests. The SI leader works with them and guides them; however, they do not give the students the answers to the problems, because that would not work towards the goal of teaching the students how to learn the material or solve problems.

As mentioned above, SI is intended to be a group study session where students can work with their fellow classmates to solve problems as well as work with the SI leader if they encounter a gap in knowledge. This leader is selected by the SI coordinator with input from faculty. SI leaders can be recommended by their professors, academic department, or other SI leaders, to administer SI sessions to a specific class. This type of environment promotes teamwork as well as develops the ability to ask for help from people who have better knowledge in the subject than themselves, two of the most essential skills that lead to success in the work place. In the words of a General Electric employee, "One of the most important things about being successful in a big company is to have a deep network because you cannot possibly know everything. Therefore, you need to know what you do not know and you need to know where to go to find it."

There are three factors affecting student academic performance. The *ability factors* comprise 50 percent of the prediction for student success and they are previously attained, which include high school GPA, ACT/SAT test scores, etc. Next, are the *circumstance factors* taking approximately 10 percent and are variables of context including socio-economic status, family situation, etc. The final category of *personal factors* consumes 40 percent and is a factor that a student has influence over because it includes their attitude, self-perception, behavior, problem solving skills, etc.[3] The SI program strategically fits into personal factors and becomes a considerable tool in giving students the support they need to succeed academically.

In order to make this clear among our students, we must know first what they believe about the program so that way we can continue to develop these skills. Alternately, we can provide a different outlook and show them how these skills are useful in the workplace so that the students can build on them. Through this, we believe that this program parallels and promotes our institution's mission of producing principled leaders in the military and private sectors.

Actual SI sessions are shown in Figures 1 and 2.

Figure 1: MATH 119 Pre-Calculus SI Session

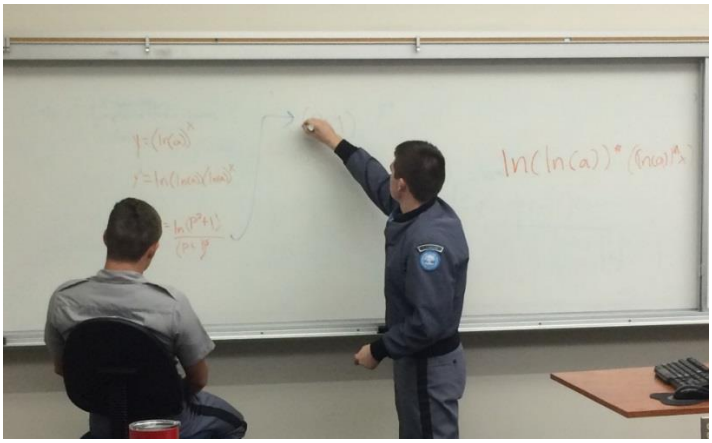

Figure 2: SI Leader conducting Individualized Instruction

Method

Success of the SI program is partly based on student use. Student use of the program is often grounded on perception, so it is necessary to answer the following:

1) What are the student perceptions of the SI program, whether positive or negative?
2) What areas can be improved / what are good practices to sustain?

Data in this study was collected through a survey administered to all Pre-Calculus and Calculus I sections, excluding Honors Program level courses. The survey discussed in this paper was administered after SI sessions had begun and were heavily advertised to the students. Courses had progressed far enough that there had been an exam and personal or referred cognizance of need for SI.

Most of these students are current Science, Technology, Engineering, and Math (STEM) majors, who are required to take more complex mathematical courses later in their program of study, such as Calculus 3 and Applied Engineering Mathematics I. The questions mainly gauged the students expectations about the format of SI, what they expected from their leader, and if they had any current suggestions on improving the program. This study is a work in progress and will examine the perceptions early in the semester and again at the conclusion of the semester. Currently, data for the early SI surveys will be presented and discussed.

The survey is in the format of the 5-point Likert Scale, in which students select on a scale of "1" for strongly disagree to "5" for strongly agree, whether that statement fits their perception. We believed in this way we could get a more accurate range on the students' thoughts versus a true or false or yes or no format. We also believed we could account for the opinions and thoughts of those who had not considered some of the statements we asked them to rate.

Data

Overall, there were 170 freshmen students that completed the survey, from both the calculus (MATH 131) and pre-calculus (MATH 119) levels. The two groups were almost evenly divided. The survey consisted of 15 questions shown below in Table and three free response questions.

Students were asked for their names on the survey, so it was not anonymous. Part of a future study will be to correlate student grades in the courses to their perceptions of the program and attendance at SI sessions. The results are shown in Figures 3 and 4 with individual bars for the MATH 119 Pre-Calculus (blue), MATH 131 Calculus 1 (red), and the combined average (green). There is fairly close agreement between the two math courses.

Table 1: Pre-SI Survey Questions

1. Before deciding to come to SI, I believed that SI would consist of a lecture style format, reviewing lessons from the classroom.
2. I believed that SI would be in a Question and Answer format.
3. I believed that the assigned instructor would give me the answers to assigned problems.
4. I believed that the instructor would teach the method and allow me to apply it to the homework.
5. I plan to come to SI weekly.
6. I plan to attend only just before a test.
7. I plan to attend only when I need questions answered.
8. I expect the instructors to already have worked out the problems before they come toSI.
9. From experience, I believe SI is a helpful program.
10. Before coming to SI, I try to work out the material on my own, through either the book or lecture notes.
11. I find troubleshooting and struggling with problems helps me learn more effectively then walking through the method.
12. I would recommend SI to my classmates.
13. I come to SI prepared with questions and ready to build on classroom instruction.
14. I find assistance form my classmates / friends helpful.
15. I believe that SI attendees are better prepared for success in their assigned class.

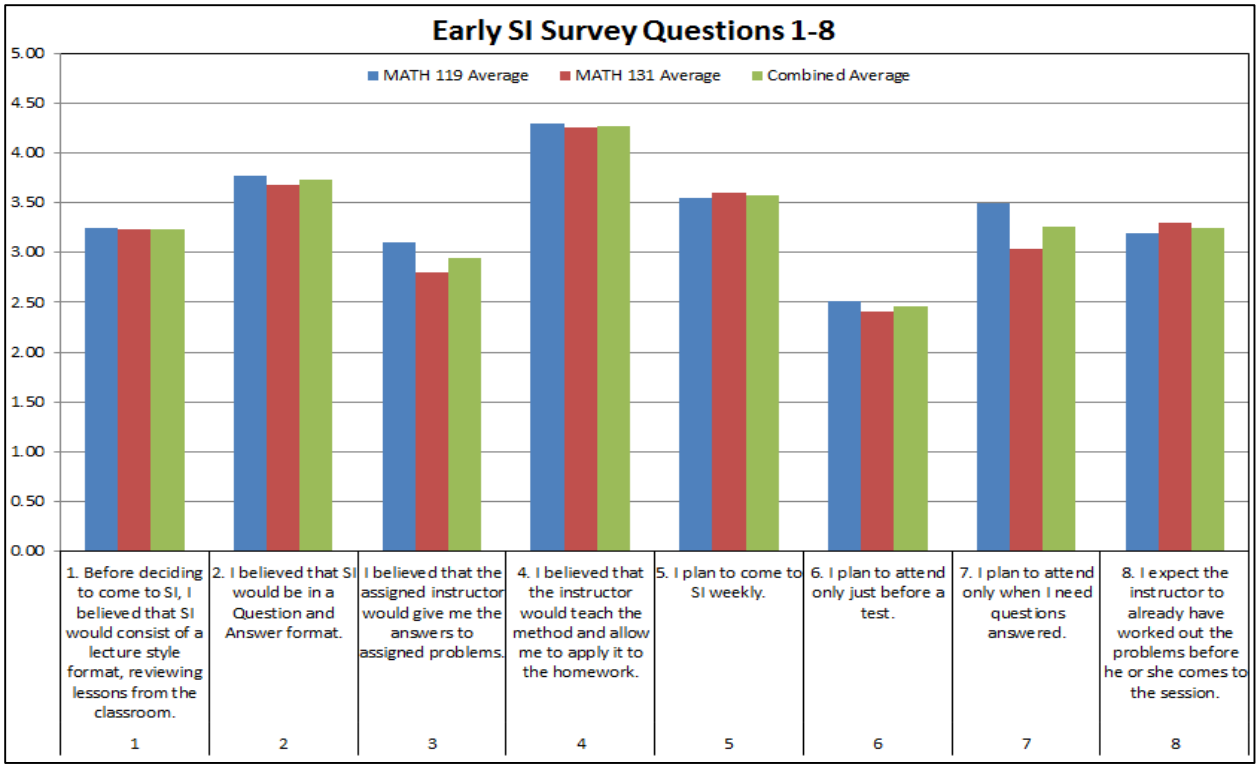

Figure 3: Early SI Survey Questions 1-8

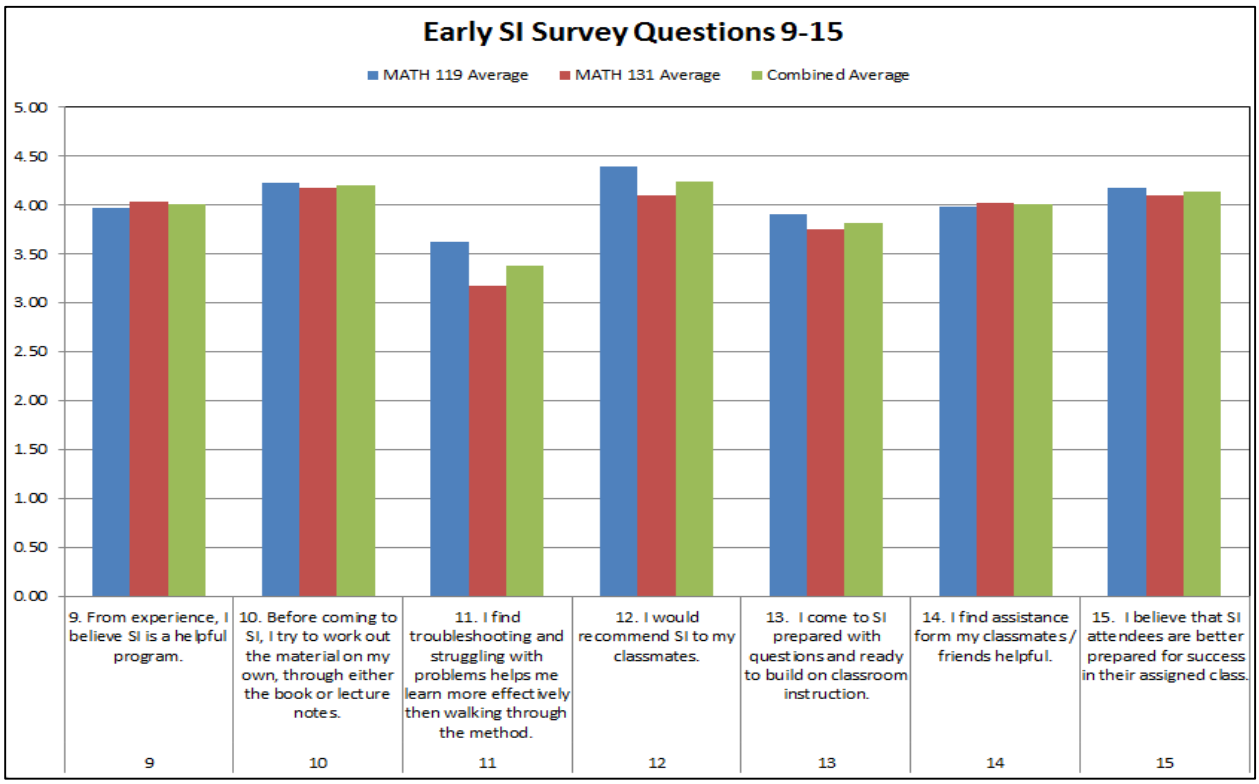

Figure 4: Early SI Survey Questions 9-15

Overall, most of the survey shows areas to sustain and some show areas for improvement and attention. The survey results show that SI sessions have achieved a goal of establishing a cohesive environment in which students work together in groups to solve problems, opposed to receiving the answers. The main questions that contribute to this conclusion are outlined below.

Discussion

The third question on our survey was directed to have students examine their perception of how a normal SI session would operate. Question 3's intent was to establish a clear difference between students who attended the night before homework was due (and just ask how to do the assignment) vs. a student that is trying to formulate a method and working through step by step to obtain a solution. This established line plays into the comment from the General Electric employee quoted earlier who identified that successful employees know where to look for assistance when given a multitude of issues with few resources with which to solve. Our students answered an average of 2.94, slightly below the neutral mark. This average is inconclusive if the SI program has expelled the idea that an immediate solution is present for every problem. SI leaders and the program coordinator also find it beneficial for students to actually struggle with problems because it helps them: 1) conceptualize the situation, 2) sort out a possible set of solution steps, and 3) instill critical thinking, another important facet of surviving in the corporate world. The fact that these mental processes are already instilled in our students allows the institution to develop it further and prevent the students from succumbing to pressure from problems that seem too difficult or unsolvable at the first look. Another positive result stems from the sixth question of the survey, asking students if they only attended SI before an exam. The purpose of this question was to see how successful the students were in avoiding procrastination, especially in studying for exams. The students answered an average of 2.46, showing an overall response of disagreement. This is obviously a good result, because as educators of these students we want them to succeed, and we believe that one way for them to achieve this success is to make sure they stay current in their work and avoid the need to 'surge' before a major requirement. STEM majors are in high demand across campus; however, STEM majors, due to heavy course load and difficult calculus based courses, face many challenges when staying in these programs. In turn, it is viable to have a program that students know can help them keep up with their heavy work load.

Additionally, this study wanted to gain more information about how students viewed the effectiveness of the program. Question 11 is the key question in evaluating this. Question 11 asks if the students found working and struggling with problems as an effective method for learning the material they encountered in lecture. The results were relatively inconclusive, averaging a 3.39 response. From this average, we infer that students, most of whom are freshman, may not have been introduced to this learning style from their high school studies. Therefore, they may not have had enough exposure to this environment where they are more responsible for their own learning.

Question 14 questioned the students' perception of the effectiveness of group activities. Since the workplace, in majority, deals with group work, we find this question as one of, if not the most important questions on this survey. Succeeding after college absolutely depends on one's ability to work with coworkers to reach a common goal. The average response was 4.01, which is a positive response coming from the students. As a result, it can be concluded that the program has

been providing an environment in which they can and will continue to develop these skills that are both helpful as a professional and a team member. This data is good news because many students have had less than ideal experiences with group work from high school, possibly due to having their fellow students inadequately share the work load.

Another interesting and encouraging observation can be drawn from the connections between the student responses to Questions 12 and 15, which asked the students if they would recommend SI to their classmates and whether they believed that students who attended SI had a better chance of succeeding in the class than those who did not, respectively. Students averaged a response of 4.25 on Question 12 and 4.14 on Question 15, agreeing with the idea that SI helps them succeed in the class they are attending. This average is also one of highest average responses on the survey. For the founders of the program, this is an encouraging response. This data also complements another study completed at Indiana University on the benefits of supplemental instruction which found that students who participate in SI engage in effective educational practices and report higher self-reported gains in practical skills, personal and social development, and general education than students who do not.[4] Both positive and negative feedback are crucial to the process of growing and improving any new program and SI is no different. However, when there is positive feedback, it allows the program coordinator to perceive that this program is a necessity for some students to thrive in technical majors. Also, if students are willing to recommend the program to their classmates, the program will continue to grow and develop on its own, allowing more students to obtain the help they need.

Students offered many ideas to improve the SI program. Overwhelmingly, the most frequent free text response to "What can the SI program do to get better?" was to have more SI sessions or SI leaders.

- "more hours"
- "be longer, perhaps go over the source material more"
- "everyday sessions"
- "increase the amount of time SI is available to better fit around student's schedules"

Future Work

The implementation of this survey provided a baseline of data and information about how to continue developing the SI program. A needed area of improvement is SI promotion. Although faculty do advertise and promote the program, the fact that students saw the value of the program is promising. Students who are beneficiaries of the SI sessions are probably the best salespersons for SI. Given the free text question: "What can we do to make SI sessions better?" some responses were:

- "Advertise more and be clear on what, when, and where it is."
- "Make a small incentive to come, like 1 full week will be 1 point extra credit"

Faculty support of the SI program is critical to its success. Each year we have received more support from faculty who work side by side with SI leaders. SI leaders sit in on their course to follow along with instruction and also meet with the faculty member to discuss topics to cover during an SI session. However, some faculty are still cautious about having a student assist them

in their course. Another area for analysis is to correlate objectively the value of SI sessions to a student's final grade. The number of sessions attended will be correlated to final grades to examine success rates and average grades. As the SI program grows across the campus, data collection for specific courses will become increasingly important.

Conclusion

Based on this survey, the data supports some of the learning goals of the SI program and the institution. Seeking assistance when needed is a survival skill for the rigors of engineering and a necessary life skill for the workforce. This study serves as a complement for continued growth in the initiatives sponsored or supported by the School of Engineering.

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Robert Rabb received his B.S. in Mechanical Engineering from the United States Military Academy and his M.S.E. and PhD in Mechanical Engineering from the University of Texas at Austin. He taught at the United States Military Academy at West Point, NY and has worked for the U.S. Army Corps of Engineers. His research and teaching interests are in mechatronics, regenerative power, and multidisciplinary engineering. He is an Associate Professor in Mechanical Engineering at The Citadel.