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Utilizing a Student Led Program to Make Major Leaps in Persistence

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Utilizing a Student Led Program to Make Major Leaps in Persistence

1 Abstract

Retention of undergraduate students in the College of Engineering (CoE) at Louisiana State University (LSU) has been a concern for many years; this has led administrators to ask: what additional academic support should be available so more students are retained and graduate? This question has a multitude of answers that have varying levels of effectiveness. One approach to increase retention is a peer led learning module called Supplemental Instruction (SI), which is currently funded by the NSF STEM Talent Expansion Program for sophomore level engineering courses. SI is an inexpensive program that utilizes undergraduate students who have previously taken and received a high grade in difficult, high enrollment courses. These student SIs hold active learning sessions and focus on the problem solving process that commonly confounds engineering students. LSU's engineering SI program was created in 2013 and has been available to over 4000 students, with two-thirds of these opting to participate in the program (n=2738). Previous research conducted by the authors has shown that SI improves LSU students' success in these courses, with those who utilize SI passing at a much higher rate; other institutions across the United States have illustrated similar successes. Measuring student success outside of the individual courses where SI is offered was not explored in this work and leads to a bigger question: "Are students who attend SI are more likely to be retained and to graduate in engineering." At LSU, the answer to this question is yes. Students who attend SI regularly, defined as attending 34% or more of sessions, have a graduation and retention rate of 91% through year four of their respective majors. Students who do not utilize SI have a graduation and retention rate of 77%. This suggests that students who regularly attend SI have a 14% higher chance of persisting in their respective engineering curriculum. Although Supplemental Instruction has been shown to benefit students in its respective courses, it is clear that SI is benefiting students past the individual course and onwards through graduation. This can be attributed to many reasons such as improved study habits, improved problem solving abilities, and a greater sense of community with fellow students all attained through attending SI.

2 Background

Active learning has been shown to aid in comprehension and metacognition in undergraduate students [1, 2, 3]. With constant budget cuts, larger enrollment and, therefore, larger class sizes, active learning becomes more difficult for instructors to implement effectively, if at all. While a number of solutions exist to engage students, Supplemental Instruction has been shown at Louisiana State University (LSU) to be an effective resource that allows smaller groups of students to be further engaged in an active environment [4, 5].

Supplemental Instruction (SI) is a peer led learning model that utilizes undergraduate students to hold active learning sessions. Supplemental Instructors typically hold two sessions per week that last approximately 1.5 hours each. These sessions focus on problem solving by bridging the gap between the theories learned in lecture and the actual analysis of problems. Supplemental Instructors (SIs) use a variety of active learning methods ranging from cooperative learning to board work models. SIs also hold review sessions prior to each exam that can range from 2-3 hours long. Due to the time-crunched nature of these sessions and the substantial spike in attendance, active learning is not used at the same degree as compared to a normal session.

In addition to offering weekly sessions, SIs also hold 3-6 office hours per week. This is not meant to replace the course instructor's office hours, but it offers a more relaxed environment where students can ask questions free from potential judgment since SIs are not allowed to grade any of their work. For many SIs, office hours become a study hall where students will come to do their coursework and ask for help from the SI when they get stuck. SIs receiving training once a semester where they learn active learning strategies and general responsibilities required. Weekly meetings are also held to collect session attendance and to discuss pedagogical topics that vary from week to week. SIs are also asked to attend lecture so that they stay on the same page as the course instructor and plan their sessions accordingly.

To be hired as an SI, a student must be an undergraduate who has at least a 3.0 GPA. They must have excelled in the course they are applying for by having earned an A or B, and they need a professor's recommendation. Finally, potential SIs are interviewed by the SI Coordinator to ensure the SIs sufficient communication skills are sufficient to perform the job. SIs are typically already effective communicators and experience has shown their communication skills improve substantially throughout their time in the position.

2.1 History

LSU has two active SI programs, one that provides assistance for mostly freshman courses across the university, such as introductions to history, biology, and psychology, and one that specifically targets courses offered by the College of Engineering. The Engineering SI program (ESI) is funded by an NSF STEM Talent Expansion Program (STEP) grant that began in 2013. While a large percentage of students drop out of engineering after their first year, other students fail to persist between their second and third year in these degree programs due to difficult gateway courses. The ESI program targets sophomore-level courses with high enrollment and combined DFW (combined rate in which students grades are D's, F's or a withdrawal) rates of at least 30%. Currently, ESI is offered in 14 engineering and computer science classes.

Since the creation of ESI in 2013, the coordinators have spent significant effort evaluating its impact. In the past, the authors were able to show that with regular attendance in SI sessions (defined as 34% attendance or higher), passing rates for these courses increased by 23.2%, as shown in Figure 1 [(4)].

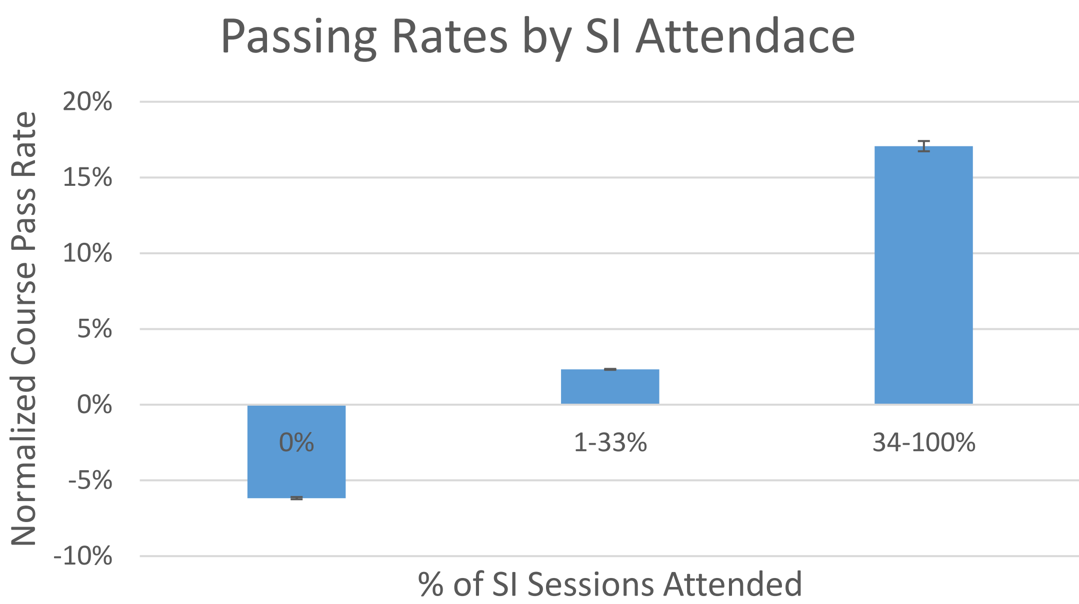

Figure 1 - Course Passing Rates Correlated with SI Session Attendance

The authors next wanted to determine if there was a self-selection bias, i.e. whether only good students go to SI. It may seem that students are more likely to pass if they regularly attend SI because they are already better students–those who are more likely to have better study habits, have more academic preparation, and are more likely to seek help. Math ACT was used as an indicator of academic preparation to look for this bias. It was found that Math ACT and course passing rates were positively correlated, that SI attendance and course passing rates were also positively correlated, and that Math Act and SI attendance appeared negatively correlated. This suggests that "good students" who do not need additional help to pass courses were not the students utilizing SI the most [5, 6]. What this means is that if Math ACT is an unbiased predictor of success in courses, the students who were least likely to pass a course were the most likely to attend SI sessions. Although all students were shown to benefit from SI attendance, the group with the lowest Math ACT scores gained the most benefit from doing so.

Previous research at LSU and other institutions has thoroughly examined the impact of the SI program on course passing rates; however, there has not been much research on how SI attendance affects student retention and graduation [7]. It is common to infer that if a student is more likely to pass a course, they will be more likely to be retained; however, the objective of this study is directly look for this correlation by examining persistence rates of students 2, 3, and 4 years after their participation in SI. Persistence is defined here as the combination of retention and graduation rates.

2.2 Factors that influence Persistence

Most students who fail to persist in STEM drop out in years 1 and 2 according to Krause [8]. A multitude of factors can be attributed to this phenomenon, but academic preparation and underlying psychological factors are the top reasons. These issues are paramount to understand if one wishes to design a program to improve persistence. Freshmen GPA as well as standardized test scores, such as the ACT, seem to be the best indicators of academic preparation. Persists were found to also be more likely to use services and programs such as SI [9]. One of the most important psychological factors that affect persistence is self-efficacy, or the confidence a student has in their own academic abilities [10, 11, 12]. One study found that a student's academic preparation was not correlated to his belief that they would pass the course [9]. High self-efficacy can lead students to perform better than expected as compared to their peers with similar test scores. Along with confidence is how a student sees their own academic abilities with respect to their peers [9, 11]. If a student feels that their prerequisite knowledge is lacking compared to their peers, this can easily discourage the student and make them more likely to leave engineering.

Supplemental Instruction is able to alleviate many of these factors that affect persistence. SI is bridging the gap between higher and lower performing students, because, as previously shown, most students attending SI were less academically prepared than other students, yet showed the most gains in passing rates with regular participation [4, 5]. Also, by utilizing active learning strategies, students work out more problems and are guided to obtaining a solution that helps to improve their confidence in their abilities.

Other programs that have shown similar success include: use of counselors and summer bridge programs [13], implementing active learning in courses [14], student and industry mentoring programs [15, 16], and supplemental courses [16, 17]. The Citadel was able to improve freshmen retention in engineering by 20% by utilizing their SI program for introductory courses [18]. It is the goal of the authors to make clear that there is no one program that can be used to solve retention problems in engineering. It is instead a collaborative effort by utilizing multiple programs that will pave the way towards graduating more students in STEM disciplines.

3 Methods

Preliminary analyses showed that regular attendance in SI over the four years that the program has existed was correlated with a 9% increase in graduation rate. While this is a very positive result, it is unfortunately not the entire picture; several complications and potential biases needed to be accounted for to best answer this question. The longer a student is in college, the more likely he is to graduate, therefore comparing graduation rates of students who have been in the program for two years verses five years is not reasonable. This problem was addressed by analyzing persistence, the combination of retention with graduation rates. Similarly, grouping or comparing students with no SI attendance with students who were never enrolled in courses that offered SI add another layer of complexity to this dataset.

The university registrar compiled four years of student engineering retention and graduation rates, into which SI attendance data were mapped. The dataset included all students who had, upon entry into LSU, declared a desired major in one of the engineering curricula (this includes: undecided interest in engineering or sciences, biological engineering, civil engineering, chemical engineering, construction management, computer science, electrical engineering, computer engineering, environmental engineering, industrial engineering, mechanical engineering, and petroleum engineering). It also included students who transferred into the college into one of these majors. Only students who were offered SI in their sophomore or freshman year were included in these analyses (n=2341). Persistence was coded as a binary variable calculated for each year of the student's college career. The value was "1" if the student either remained or graduated in engineering for each year. The value was "0" if the student switched to a different curriculum, graduated in a different curriculum, dropped out, or transferred out of the university. Retention was determined using the 14th day enrollment figure defined by the registrar's office, and graduation was recorded for fall, spring, and summer of each year.

SI attendance was recorded using sign in sheets during each session. In previous studies, an individual student could be counted multiple times in the dataset if they had taken more than one course where SI was offered. For this study, students were only counted once in the dataset; the percent attendance in every course the student took was examined, and the maximum percentage was used in order to place that student in the proper bin.

4 Results

Persistence rates were plotted for each year of a student's college career for all 2341 students who took a course where ESI was offered (Figure 2). Students were put into one of three bins according the maximum percentage of sessions they attended as designated in the authors' previous research: no attendance, low attendance (1-33%), or regular attendance (>34%) [4, 5]. Figure 3 illustrates the large improvement seen in persistence rates for students who attended any amount of SI; students were at least 8% more likely to persist every year, with the largest differences appearing in years three and four. With regular SI participation, students are 15% more likely to persist in engineering through their fourth year. The amount of error increases with time due to the reduction in students that have been in the dataset for all four years of the program. The relationship between students not attending SI and those attending regularly is somewhat expected as it confirms the authors' previous assumptions–that increased passing rates would correlate with increased persistence. What was most surprising was that the low attendance group appears to benefit almost as much as those students who attend SI regularly.

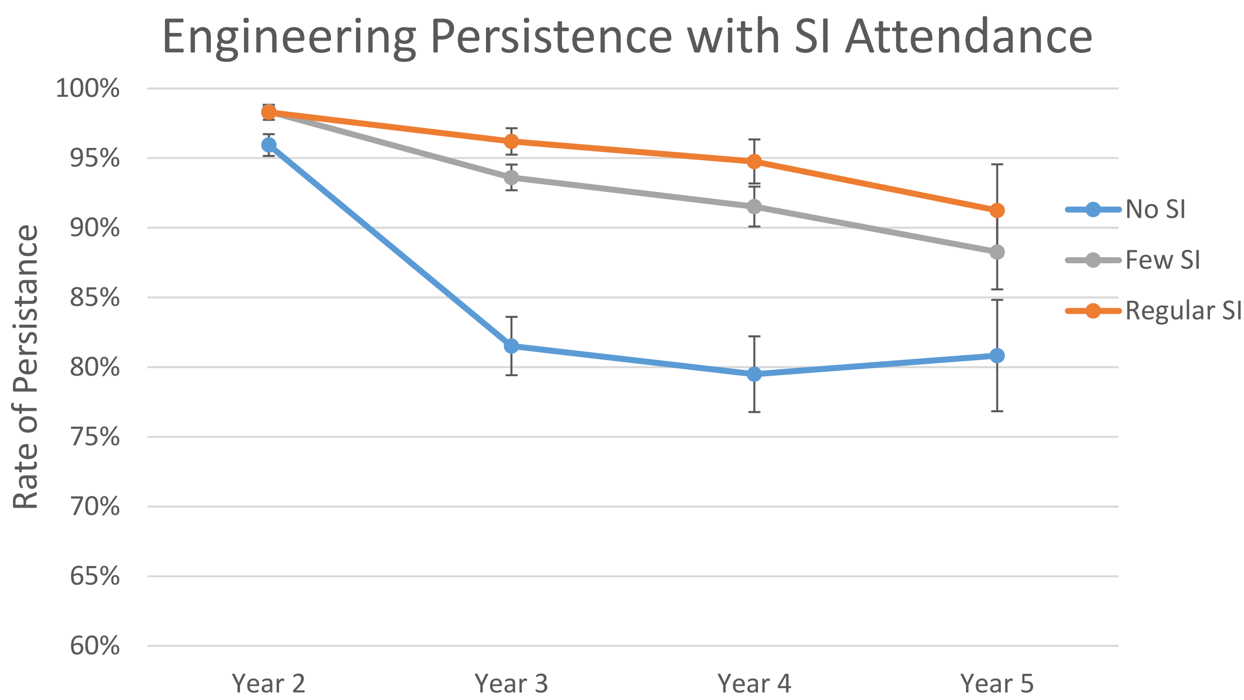

Figure 2 - Student Persistence in Engineering with SI Attendance

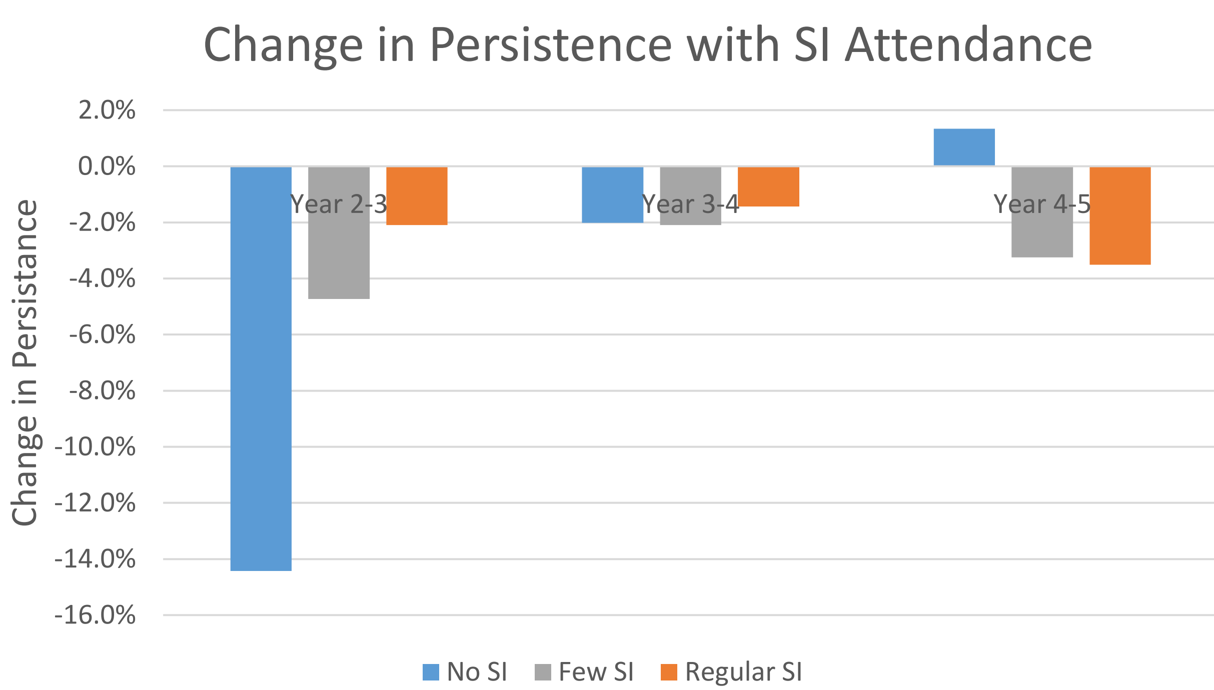

Figure 3 - Change in Persistence with SI Attendance by Year

The one irregularity found in Figure 2 is the increase in retention between year 4 and 5 for students who did not participate in any SI. Though the error accounts for this, the mean raises due to different bin sizes for each year group (Table 1). For example, a student that was a sophomore in 2013 (when the program first began) would be have been counted in year 2 in 2013, year 3 in 2014, year 4 in 2015, and year 5 in 2016 while a student who was a sophomore in 2015 would only be counted in year 2 in 2015 and year 3 in 2016. This essentially allows there to be a comparison between students who are in separate cohorts. Therefore, as each year progresses, there is a smaller bin size; however, these bins are still large enough to have statistical significance.

Table 1: Bin Sizes Found in Figures 2 and 3

# of Students Represented (Year):	2	3	4	5
No SI	638	344	221	97
Few SI	1128	704	378	143
Regular SI	575	405	199	73
Total Students Represented	2341	1453	798	313

5 Discussion

The effects of Supplemental Instruction on student performance have been studied extensively with respect to class performance, and great success has been shown at LSU with SI attendees performing 23.2% higher than non-attendees [4, 5]. Other conclusive work has shown that there is no evidence of a self-selection bias by using predictive methods that show the success associated with SI is not due to better academic preparation of the students choosing to attend. Since students with low Math ACT scores are benefitting the most from SI attendance, they must be learning new skills to help them succeed in these courses. These skills can include increasing academic knowledge by spending more time on the course material, gains in problem solving confidence, interaction with peers, and general improvement in self-efficacy.

But is SI actually improving retention and graduation rates in engineering? Students who attend SI regularly are 15.2% more likely to persist by year 4 and 10.4% more likely to persist by year 5. The most important aspect is between years 2 and 3 where SI is offered to students. There is a significant change in slope (12.3%) between students who attend SI regularly and those who do not attend at all showing the specific impact of SI. The rate at which regular SI participation has assisted students in sophomore courses seems to be correlated to their persistence into the third year of engineering curricula. Due to the slopes becoming relatively constant between year 3 and 4, it could be theorized that SI is having its effect mainly in the specific courses where it is being offered. However, without valuable skills learned in SI, students that would normally fail to persist in the second year should fail to persist in the third year without the additional assistance. It could be inferred that students may be learning a valuable set of learning techniques in SI that they are applying to other engineering courses.

This research has presented new information that has yet to be found by the authors in a literature review, having tracked students for several years past their enrollment in ESI courses. A few programs have examined retention for one year, but this study tracked students for up to five years. With this amount of longitudinal data, we can effectively show that there is an increase in the likelihood of students being retained and graduating with an engineering degree due to participation in ESI. As time continues and more data are collected, the authors expect to be able to say this with increased statistical certainty.

One major success of SI is the peer interaction. Students can receive positive reinforcement by learning from a student who has been able to excel in a historically difficult class. Additionally, SIs tend to teach the material in a method that reflects a student's train of thought, which is more appealing to fellow undergraduate students. SI is also capitalizing on an important stage of the learning process–repetition. By the SI repeating the material previously discussed in lecture, students often come to understand the material better. As mentioned previously, other institutions have found SI to be beneficial for the same reasons as LSU [(1)]. The authors would like to call for further investigation at other universities that extend past the examination of improvements in course grades alone, which is a point of critique by Dawson regarding inadequate representation on the success of SI [(7)].

The SI program at LSU recently began using surveys for a qualitative look into the program's success. A common trend of student responses was the usefulness of SI in developing problem solving strategies. The ability to effectively solve problems is a critical skill learned in most second year engineering programs and is a skill that could be retained for use in other courses. Based on survey responses in 2015 and 2016, 95.9% of responses state that SI gave benefit in developing problem solving strategies. 33.9% of students who went on to write further comments also stated that SI assisted in problem solving. This supports the hypothesis that students regularly attending SI are gaining a valuable skill that can be applied outside of the classes in which SI is offered.

Overall, SI is an effective tool to help students enrolled in engineering programs. Major leaps in persistence can be made with relatively low cost. Not only is this useful for students, but it is often fun. Students seem to enjoy attending SI due to a welcoming atmosphere presented by a peer; this creates an environment where students are more willing to learn. The authors are not claiming that SI is the "end all, be all" solution to improve retention and graduation rates, but it is an excellent tool that can assist in improving engineering persistence.

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