A Model for Implementing "Supplemental Instruction" in Engineering

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Introduction

Supplemental Instruction (SI) is a learning enhancement program. SI targets high risk *courses* instead of high risk *students* and offers assistance on an outreach basis in regularly scheduled, out of class sessions. The primary goal of SI is to facilitate students' mastery of the course concepts, however a secondary goal is to encourage students to develop better learning skills and strategies. A student who has received a high grade in a targeted SI course is trained to become an SI leader. As an SI leader, the student re–attends the course to model effective student behaviors, and conducts weekly SI sessions. During the SI sessions, SI leaders facilitate students' understanding of course material via *interactive* learning strategies which encourage involvement, comprehension and higher order reasoning skills. SI leaders do not re–teach or simply work problems on the board; rather they offer alternative perspectives and exercises designed to *mirror* the course content.

During Fall semester 1996, Penn State's College of Engineering piloted SI programs for two introductory courses in Mechanical Engineering — Engineering Thermodynamics and Machine Dynamics. Our SI program was piloted as a part of our larger Undergraduate Teaching Intern Program. The Teaching Intern (TI) Program allows undergraduate students to partner with a professor on a particular course in order to learn about the responsibilities of being a faculty member. TIs generally help with in-class activities, hold office hours, run review sessions, teach several class sessions and do some test construction and grading.

This paper provides an overview of both the SI and TI programs, specific details on how to run a course to train for these programs, and preliminary results of the SI program in terms of experiences of the three student SI leaders and achievement results of those students who attended SI sessions versus those who did not.

Overview of Supplemental Instruction

What is Supplemental Instruction?

Supplemental instruction is a program designed to proactively address student performance in high risk courses. Note that SI is targeted at particular *courses* as opposed to particular groups of students (Arendale, 1994; Widmar, 1994). The SI program consists mainly of optional "supplemental" instruction sessions; these sessions, which are led by an SI leader who has successfully completed the targeted course, have the following characteristics:

- They are proactive, not remedial. Sessions are held from the first or second week of the semester so students may benefit from the sessions before they experience difficulty, and in the best case, prevent the difficulties from occurring.
- They are not traditional review sessions. Review sessions typically are held just prior to exams and consist of a leader working problems in front of the attendees. In contrast, SI sessions are held regularly throughout the semester and do not focus specifically on exam preparation, but rather on in-depth learning of all course materials.
- Attendees are active participants in the sessions. Leaders are trained to design active learning experiences around the content of the course. Leaders consistently set attendee expectations towards active participation. Some SI activities include having students review notes from class, practicing reading and interpreting texts, solving problems in pairs, questioning activities where students and the leader take turns questioning each other on course content (reciprocal questioning), and having students or groups take turns working problems at the board.
- Leaders explicitly model study and test-taking strategies within the context of the course's content. SI sessions are designed to help learners develop strategies that will make them successful. While some university programs address study skills, SI sessions address them within the meaningful context of the students' current course.
- SI leaders *mirror* the content of the course (lecture and readings) rather than teach new content. Leaders are trained to design activities and help learners see the material from their books or lectures in a different way. Lectures and course readings may present content in a certain fashion - via exercises that re-examine course content from alternative points of view and via different content presentations, SI may reach learners who did not understand the initial lecture or reading materials.

In general, sessions focus on actively involving attendees in in-depth learning activities of course content. Activities give learners the opportunity to see an alternative presentation of course materials as well as hone learner critical thinking and problem solving skills.

Roles Involved in Supplemental Instruction

For supplemental instruction to work, several roles must be filled (Arendale, 1994). We now review these roles and how they fit into the SI program. We begin with the SI leader. The SI leader for a targeted SI course has the most crucial role in the SI program. The SI leader is responsible for creating a learning environment during SI sessions where students are actively processing what has been covered in lecture or the text towards the goals of a) making connections between what the student already knows and the new knowledge in order to provide a synthesized knowledge domain, b) applying their new knowledge to applicable domain problems, and c) thinking about and honing their study and learning strategies as applied to that course.

Discussions with our SI leaders indicated that a typical SI session might include an exercise designed to get students to review and find holes and discrepancies in their notes, problem-solving activities where students work in pairs on problems similar to their homework or where students are asked to give the leader step-by-step instructions on how to solve a problem, and a questioning activity where the leader asks students various questions which require both surface

level and in-depth knowledge processing. The most important thing about these activities is that the learners are active - this in contrast to the typically passive student lecture experience.

In order for the SI leader to know what material the students are covering in lecture and in the readings, SI leaders are required to attend the lecture for the SI targeted course. While at these lectures, SI leaders take notes so that they may have a "good" set of notes as an example for the students attending their sessions and observe the dynamics of the class to determine what material the students may be struggling with in particular. SI leaders may also model good question-asking behavior during the lecture.

In addition to attending lectures and preparing for and implementing SI sessions, SI leaders hold office hours, may optionally provide feedback to the course professor on how the students are perceiving the course, and may do one or more of the main course's lectures. We estimate that SI leader responsibilities average out to about 10 hours per week.

Another key role in the SI program is that of the SI shadow. The SI shadow is an individual who is assigned to "mentor" new SI leaders. An SI shadow may be another student (graduate or undergraduate), a faculty or staff member or any individual who is qualified to give pedagogical feedback to SI leaders. For our first semester, we employed experienced graduate teaching assistants as SI shadows. The SI shadow is required to attend the first 4 or 5 weeks of the SI leader's sessions. *Immediately* after the session, the shadow provides the leader with guidance on the just-completed session. The shadow focuses on giving feedback on which activities worked best and which did not. The shadow's goal is to provide the leader with objective and timely feedback on how the leader might fine tune their activities for subsequent SI sessions. In our pilot, shadows attended SI sessions for 4 - 5 weeks. In general, shadows should attend the sessions until it is clear that the SI leader is comfortable and effective in their position.

The instructor/professor of the SI-targeted course is also a key player in the SI program. While the SI program does not ask a faculty member to change the way he/she teaches the SI targeted course, the faculty member must at a minimum agree to the competency of the proposed SI leader (if not have a hand in choosing that leader), agree to have the SI leader sit-in on lectures, and promote the SI sessions during the main lecture session. Obviously, faculty would announce these sessions at the beginning of the semester, but it is also beneficial to have them continually remind students of these sessions throughout the semester as well as introduce the SI leader. Faculty who wish to be more involved could also meet with SI leaders periodically to both receive student feedback via the SI leader and check on overall progress of the SI sessions.

The final role we describe is that of the SI program coordinator. The coordinator may be a faculty member interested in improved student performance, a student affairs staff person (minority or women in engineering directors may be candidates), or someone within the college or university who addresses issues of instruction. The coordinator is simply the person who makes sure that all of the previously described roles and responsibilities are carried out. The coordinator's involvement in actually implementing these may vary. In the case of our engineering program, the authors worked together to garner departmental support for the program, find classes for the SI program, and run the SI training.

There are many potential benefits that can accrue from an SI program. Research results (see section below) and anecdotal evidence show that students who attend SI sessions may experience the following benefits (Arendale, 1994; Widmar, 1994).

- Improved final course grades as compared to those who did not attend SI sessions.
- Lower drop-out rate from these high-risk courses where SI support is implemented.
- Improved critical thinking, studying and test-taking skills.
- Improved enrollment rate in subsequent semesters.

Student SI leaders, while their primary purpose is to support the students attending SI sessions, also may experience the incidental benefits of working more closely with departmental faculty members, learning to facilitate group activities, gaining the poise associated with regularly facilitating group activities, and learning a content domain inside and out (recall the old adage - the best way to learn something is to have to teach it).

While the potential benefits to the students participating in SI are fairly obvious, benefits to faculty may not be as clear. Marshall (1994), however discusses ways that SI can be used as the foundation for faculty development activities. At Salem State, Marshall set up an SI program which required more faculty commitment than previously described, and thus offered more opportunities for faculty development. Initially, faculty were involved in interviewing and choosing SI leaders from students that faculty members knew had successfully completed these high-risk courses. However, most faculty "development" occurred at the monthly seminars which were also a required portion for faculty participating in the SI program. Seminars focused on learning topics closely associated with SI such as student motivation and active learning techniques. Faculty members were motivated to participate because they recognized that the SI program offered the extra support some students need but which many faculty may not have the time to provide. Thus, this program which at its most basic level works at improving learning experiences for students *without* asking a course's instructor to change in any substantive way (recall from above that the commitment from the SI targeted course is minimal), can also serve as basis for faculty education.

Theoretical Underpinnings of Supplemental Instruction

Blanc, DeBuhr and Martin (1983) posit that the theoretical basis for supplemental instruction stems from a view of how humans develop intellectually from the educational philosophers Piaget and Inhelder (Piaget & Inhelder, 1958). Piaget and Inhelder distinguish between students who can reason at an abstract level versus a concrete level. Many students in college (especially freshman and sophomores) still reason at a concrete level, which means they have difficulty processing the unfamiliar information they often receive in lectures and textbooks. They are not typically capable of linking this new information with prior knowledge they have in the domain, and questions that they are capable of asking tend to be detail-oriented and at a superficial level. SI can help concrete thinkers move to an abstract level by providing additional instruction that helps to directly link new knowledge to learners' prior experiences as well as providing concrete examples of the new material. This additional instruction is critical for concrete thinkers as generally these opportunities are not otherwise available in the high risk courses that SI programs target.

Another theoretical basis for supplemental instruction comes from a different area of cognitive psychology - metacognition. Metacognition refers to "one's knowledge of one's own cognitive

processes" (Flavell, 1976) (p. 232). If a student is metacognitively aware of how he/she is studying their engineering thermodynamics, then that student may know what problem solving plans and techniques to use, what analysis techniques to apply to the text, and in general how to think about the domain in order to be successful in learning it. Most students are not "naturally" metacognitively aware. Thus, a student may either fail or succeed at an exam and equally have no idea why he or she did one or the other. As one component of SI sessions, SI leaders incorporate explicit modeling of study and test-taking skills as are relevant to the content. SI leaders try to get students to actively think about what mental processes they used when they were successful and unsuccessful. A specific SI leader strategy that accomplishes this is the post-exam survey. As soon as possible after receiving exam scores, students in SI sessions are asked to complete a survey that asks them to categorize the reason for their error on each missed exam item. For example, did the student mis-read the question, inaccurately perform calculations, or have a basic misunderstanding of the content. Such activities, as well as others from SI sessions help learners build up their metacognitive skills and be able to apply them successfully in current and future courses.

Prior Research With Supplemental Instruction

Supplemental instruction, for the most part, has been shown to be highly effective in a wide variety of disciplines when implemented in close approximation to the description above. We now examine a few examples of SI and their results[1]. A subsequent section examines the results of our SI pilot program in Penn State's College of Engineering.

Blanc, DeBuhr and Martin (1983) conducted the first long-term study of participation in SI. With a sample of approximately 700 students enrolled in at least one of four courses, students who attended SI sessions as compared to those who did not or could not due to scheduling conflicts, the SI participants had significantly higher final course grades and semester grade point averages. Subsequent tracking of the SI participants showed that they had a higher frequency of re-enrollment in college.

Supplemental instruction at Salem State university resulted in not only benefits for students, but for faculty as well. Supplemental instruction was implemented in approximately 25 different high risk (defined as 30 percent or more students earning a D, F or W) courses over a three-year period (Marshall, 1994). Results included the following.

- Students attending SI sessions received higher grades than those who did not attend - sometimes significantly higher.
- Students attending SI sessions withdrew from this high-risk courses less frequently than students who did not attend SI sessions.
- A statistically significant number of courses taught by participating faculty were no longer "high-risk" by the definition given above, and faculty felt they were able to raise their course standards in these traditionally difficult-to-teach high risk courses.

Not all the studies, however, show that students benefit from attending SI sessions. Students in a Fall 1989 calculus course for engineering and natural science students who had a TA leading

[1] This is by no means a complete review of the literature on supplemental instruction. Please see our section on "Further Readings" for more information on supplemental instruction research.

discussion groups that used SI techniques did not perform better than students in the same course offered a year earlier with the same faculty member and the same TA but without discussion groups using SI techniques (Kenney & Kallison, 1994). An important limitation of this study is that the data for the two groups was collected one year apart.

Finally, we mention a three-year study of SI sections implemented for several freshman and sophomore high-risk chemistry courses at Saint Xavier University where researchers examined perceptions of SI from the point of view of the student participants (Lockie and Van Lanen, 1994). One hundred and thirty students (59 percent) participated in at least one SI session while enrolled in the target chemistry courses. Each of these students were asked to complete an end-of -semester evaluation questionnaire about their experiences attending SI sessions. Results included the following:

- The SI leaders' individual attention and ability to tailor the SI sessions to the students needs, explicit modeling of study and test-taking strategies, activities that forced students to do the work themselves were often mentioned as the most effective parts of the SI program.
- About one third of the respondents suggested the program could be improved by having more SI leaders and more SI sessions available for students to attend. Others responded that no improvements were needed, but rather the program simply needed to be promoted more.
- Ninety-eight percent of the total student enrollment in all SI-supported courses over the period of the study (N=219) thought that SI should be continued.

Supplemental Instruction at Penn State's College of Engineering

This section describes how supplemental instruction has been piloted in Penn State's College of Engineering. We begin with a description of the Teaching Intern program - an already-established program in Penn State's College of Engineering from which we were able to develop SI, then describe the engineering courses that we targeted for SI, and finally review the one-credit-hour course that teaching interns and SI leaders attended.

Teaching Interns

The Undergraduate Teaching Interns (TI) program provides undergraduate students the opportunity to "intern" with a faculty mentor in a particular course for one or two semesters. Each department selects students (1 - 4) who are both academically sound and interested in teaching and finding out what it is like to perform the teaching duties associated with being a faculty member.

The goals of the Teaching Intern program are to

- improve the Intern's presentation and interpersonal skills through interaction with the faculty member and with students,
- improve the quality of the teaching and learning in the class via the additional resources provided by the Intern,
- stimulate Intern interest in graduate studies and academic careers.

While exact responsibilities vary, Interns - who are paid a per semester stipend - generally perform the following duties which amount to an average of 10 hours per week:

- hold office hours and/or help sessions for the students,
- participate in testing and grading for the course,
- attend class and provide feedback to the faculty mentor on how the class is progressing from a student point of view.

Additionally, new TI's are required to enroll for a one–credit-hour course designed to help Interns attain and practice the skills needed for their internships. The class, which meets for approximately the first 6 weeks of the semester, is run in a seminar–format where all participate in both the learning and sharing of new information.

The prior existence of the TI program in our college was important in launching a pilot SI program for several reasons.

- Faculty members, department heads and other undergraduate students are already familiar and comfortable with the idea of having accomplished undergraduate students participate in the education of other undergraduates.
- Prior to Fall '96, teaching interns already participated in informal "training"; this provided a natural way to institute a formal one credit course for teaching interns and SI leaders alike.
- The teaching intern program has a well-established funding sources; interns are funded partially by the College's Undergraduate Dean's office and each intern's department. By selecting our initial three SI leaders from the pool of teaching interns (and modifying their duties to become SI leaders) we did not incur any extra costs for paying the SI leaders.
- The teaching intern program selection process provided us with a highly qualified set of undergraduates from which to choose our SI leaders.

Next, we review the characteristics of the courses from the Mechanical Engineering department that were targeted for the SI program.

Supplemental Instruction Target Engineering Courses

Recall that SI is directed at high risk courses rather than high risk student groups. Other courses at PSU that have SI include introductory biology, chemistry and physics courses. These courses are held in large lecture halls holding approximately 400 students; in such situations, students have few opportunities to interact with professors or other students. In addition to having very large class sizes, these courses are

- often viewed as "weed out" courses to students who struggle to complete them successfully,
- are required courses where students feel they "have to be there",
- have infrequent exams that require higher order thinking skills,
- require large amounts of textbook and secondary readings (Arendale, 1994).

Engineering courses at Penn State are never as large as the class sizes mentioned above, however, introductory engineering courses do share some of the other characteristics of courses

that can benefit from SI. The courses for which we chose to run SI pilots, Machine Dynamics and Engineering Thermodynamics, are both large for engineering courses (multiple sections of 50 to 60 typically sophomore students), do not have recitations to supplement lectures, are required for many engineering majors, and have infrequent exams which focus on higher order problem solving skills. Note that there are larger engineering courses at Penn State, however since we were running a SI pilot, we also considered other factors such as which department would be most amenable to such a new program.

Supplemental Instruction Leader/Teaching Intern Course

To conclude this section on how we implemented SI in the College of Engineering at Penn State, we describe the one-credit-hour course that we designed and implemented for both the 24 TI's and the three SI leaders. The course had two main foci. First, to provide practice on *active* learning techniques that both SI leaders and TI's could use in their positions. SI leaders would obviously use these techniques in their weekly SI sessions. Most TI's however, also run "review" sessions. Even though these sessions are not formally SI sessions, as coordinators of the SI/TI programs we made a conscious decision to train the entire group with these techniques and encourage TI's as well as SI leaders to use these methods in their sessions.

The second focus of the course was to work with all attendees on fundamentals of teaching and presentations. Recall that SI sessions are designed to *mirror* the curriculum rather than to teach new material. So for the first course goal, the TI's and SI leaders were not asked to present new information, but rather work with the students and reinforce material covered by the professor in lecture. TI's, however, are also asked to do the main course's lecture several times during the semester. In order to prepare them for this responsibility, the seminar also addressed issues such as how to organize material for presentations, how to interact with students during a lecture, how to use the chalkboard, etc.

The TI/SI course sessions were 90 minutes and held once a week for six weeks. We began the semester by giving the students a learning styles inventory and discussing the interaction between how typical students learn and how typical professors teach. This discussion (accompanied with readings from Felder (1988)) uncovered the mismatches that often occur between learners and teachers. We used this as the basis for establishing the need to provide alternative learning activities (such as the ones used in SI sessions) for students. The next three weeks were spent achieving the first objective of the course - namely to provide suggestions and practice opportunities on executing active learning techniques in the classroom. Our aim was to give the students a "toolkit" of activities to use in their sessions.

Activities covered included but were not limited to paired problem solving, question-asking techniques to elicit student input, how to help students without giving them the answer, note reviewing techniques, and study and test-taking skills. Students had an opportunity to practice these skills when Dr. Litzinger gave them a "mini-lecture" on a thermodynamics topic and students were asked to prepare active learning events to "supplement" that lecture.

We finished the course by spending the last two weeks working on the basics of being a good presenter. Students, at this point in the semester, also had specific questions about situations they were dealing with in their jobs as TI's and SI leaders (i.e. "belligerent" students, uncontrollable crowds of students at office hours). Thus, we also spent time during these last

two weeks in open problem-solving discussions were we, as program coordinators, provided suggestions on how to manage these situations, but also (and more importantly) the other TI's and SI leaders offered solutions or strategies that seemed to work for them.

The course will be offered again next Fall. We do not have enough new TI's or SI leaders to merit offering the course during Spring semester. We will, however, work with the small group of new TI's on the same topics but in a less formal way.

Results

This section describes preliminary results from our Fall '96 pilot SI program for two ME courses at Penn State's College of Engineering. Further results, particularly on the relative grades of students who attended SI sessions versus those who did not will be available at the time of the conference presentation.

SI Session Preliminary Quantitative Analysis

At the beginning of the semester, we requested that SI leaders pass around an attendance sheet at each of their SI sessions. Two of the three SI leaders collected attendance. We report these attendance numbers here to provide an indication of what percentage of students from the targeted SI courses attended SI sessions.

Course	Course Enrollment	Attended SI Session (%)	Attended More Than One SI Session (%)
Machine Dynamics	**60**	**19 (32)**	**13 (22)**
Thermodynamics: Sections 1 & 2	**80**	**61 (76)**	**38 (48)**

Table 1. SI Session Attendance

While the attendance for both sets of SI sessions is respectable, the percentage of students from the Thermodynamics sections that attended at least one SI session (76%) is remarkable. In conversations with the SI leader for this course, we discovered that the course professor had referred students to the SI session for further details on certain necessary problem solving procedures. While directing students to SI sessions for such a specific task is not consistent with "traditional" SI, that task was only a small portion of how SI sessions were spent. As impressive as the 76% attendance is, it may be even more useful to observe that 48% of the class enrollment attended more than one SI session. We can infer from the fact that such a large number of students returned to more SI sessions, that students did indeed find the sessions to their benefit. In the Machine Dynamics course, students were encouraged to attend SI sessions, but not for such a specific purpose. However, consistent with the Thermodynamics' SI sessions, once students did attend a Machine Dynamics session, a large portion of them returned to other SI sessions. The combination of high repeat attendance for both sets of sessions, and the very high attendance for the course where the professor sent students to SI for a specific reason indicates that for maximum sustained SI attendance it may be useful to provide a concrete incentive for initial SI attendance.

The high repeat attendance figures from Table 1 indicate that Thermodynamics students found the SI sessions useful. Additional support for this statement comes from an analysis of quiz grades for students who attended at least one SI session as compared to those who did not attend

SI sessions also supports the usefulness of the sessions. An examination of the 400 separate quiz scores for the Thermodynamics class (5 quizzes each for 80 students) showed that those attending SI sessions averaged .7873 on quizzes versus an average of .6957 for those who did not attend SI sessions. A t test between these two averages found this to be statistically significant at the $p < .01$ level.

Interviews with SI Leaders and Shadows

In addition to the above results data, we also conducted brief, loosely structured interviews with the SI leaders and SI shadows from Fall '96. The goal of these interviews was to determine both how the program had worked during the current semester, as well as to gather ideas for improvement from these key participants.

Both the shadows and the leaders were overwhelmingly positive about the program. The leaders admitted that getting up in front of their peers was a "bit scary" at first, but this feeling quickly dissipated as they gained experience. One leader commented that he actually began to "enjoy" the sessions as the semester progressed. All leaders found the immediate feedback that shadows provided very useful. They strongly encouraged us to keep this form of feedback available to all new SI leaders. The leaders also felt that the seminar was helpful, but wished that we had covered some of the topics earlier as they needed the "toolkit" from the seminar sooner than it had been provided. All of our SI leaders from Fall '96 will continue in their capacity in Spring '97. Additionally, these SI leaders will be excellent candidates to act as SI shadows for the 97/98 academic year.

The SI shadows provided us with information that will help us "fine tune" shadows' responsibilities for the 97/98 academic year. Among the most useful comments was the idea that a shadow could perhaps work with as many as two SI leaders rather than having the one on one arrangement we had provided. Because shadows provided immediate feedback to the leaders and did not have to make arrangements to meet with leaders separately to provide feedback, the shadows felt they could fairly easily take on another leader without additional pay.

Unanswered Questions

Given the preliminary nature of both the program and the data, many questions that we and others have about the SI program remain unanswered at this writing. However, here are the high runner questions that we will continue to investigate both with the data from Fall '96 as well as data from subsequent semesters.

- What type of student is attending our SI sessions? Prior SI literature indicates that SI is a good, proactive way to address the needs of students who may need extra help, but without singling them out (Arendale, 1994; Widmar, 1994). We want to know if we are attracting students who really need help to SI sessions, or students who would tend to perform well anyway. To answer this question, we will analyze the GPAs of students prior to their attending the SI supported course and SI sessions to determine their predicted performance for a course.
- Do students who attend SI sessions earn higher final grades in the SI supported courses than those who do not attend SI sessions?

- Do students who attend SI sessions use the strategies they learned in their SI supported course in subsequent courses? Do their GPAs improve after they have learned these strategies?

Futures

Given the initial results of the first semester of the SI pilot, we are anxious to continue and expand the SI program at Penn State's College of Engineering. As the authors write this paper, we also prepare for our second semester of our pilot program of SI in the College of Engineering at Penn State. As during the Fall 1996 semester, in Spring 1997 we have three SI leaders. They will continue to cover Introductory Mechanical Engineering courses in Machine Dynamics and Engineering Thermodynamics, and will work with three different faculty members. Since these SI leaders have already had one semester's experience, and have completed the SI training, we will no longer need to employ SI shadows for these leaders.

As the Spring '97 program will continue to be quite small, we do not anticipate many, if any, significant changes in how we manage or implement the SI program. However, as we contemplate Fall '97 when we will have an entire new set of Teaching Interns we hope to expand the courses for which we can offer SI support. While our ultimate goal would be to completely convert all of the college's Teaching Interns into SI leaders for courses in their departments, this may not be achieved for quite some time and certainly not by Fall '97. We do believe that we will be able to add at least one other department's teaching interns into SI leaders which would result in a total of 5 - 8 SI leaders (versus our initial 3) for approximately as many different target SI courses. As mentioned earlier, as long as we continue to convert "traditional" teaching interns to SI leaders, the funding for these leaders is available. The most significant funding increase needed to expand the SI program comes from needing to hire more SI shadows. From our interviews with both SI leaders and SI shadows it seems that the shadow role is critical to the success of the program. We are currently exploring options for funding more SI shadows, however our "pioneer" SI shadows indicated that it would be reasonable for one shadow to work with two SI leaders in any given semester. This option is also being considered.

To conclude, while the results from our first semester's pilot of SI in the College of Engineering at Penn State are preliminary, what results we do have indicate the program can have a positive effect both on students grades in the targeted SI courses, as well as provide capable undergraduate students with the opportunity to experience a portion of teaching responsibilities. From these early positive results, we intend to both continue and expand our college's commitment to SI.

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