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Does Supplemental Instruction Really Work and What is it Anyway?

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ABSTRACT *Supplemental instruction (SI) has been in existence in the USA since the late 1970s but too many institutions still do not realize the range of academic benefits for students from this program. The researchers describe an SI program in the USA at the University of North Carolina at Charlotte from 1987 to 1990. They present inferential statistical data on the impact of this form of assistance on student academic performance as a measure of learning. The results indicate that students attending SI sessions earn higher final grade averages and receive fewer low grades and withdrawals than non-attendees. These favorable results are so in spite of the fact that SI attendees enter college with lower predicted academic potential and indicators of industriousness.*

Introduction

A supplemental instruction (SI) program has operated at the University of North Carolina (UNCC) since the spring of 1985 when a pilot study was initiated. The impact of the SI program on low grades (D or F grades) or withdrawal rates [1] and student academic performance has been consistent throughout its existence. Data used here are typical of the impact of SI on students and cover the academic year 1988–89.

The benefits of SI attendance go beyond better academic performance in a given semester. In a study at the University of Missouri at Kansas City, SI has produced higher re-enrollment in subsequent semesters. Students in highest *and* lowest quartiles of entry tests produced better academic performance than would be expected. Encouragingly, minority students who attended SI sessions had a higher number of A, B and C grades and a lower number of D, F and W grades than minority students not attending SI sessions (Blanc *et al.*, 1983).

SI In Operation

SI focuses on high risk classes, not high risk students. In this way, no individual or group is singled out and made to feel conspicuous or treated differently from other students. High risk classes are those introductory classes in which 30% or more of the students enrolled typically receive grades of D, F or W for withdrawal.

After a high risk class is identified, a student is hired who has taken that class before and earned an 'A' in it. These students, called *SI leaders*, receive training in non-directive leadership skills, group process skills and learning skills and commit 10 hours per week to SI for which they receive a salary. The obligations within the 10 hours per week are as follows: 3 hours in class, 3 hours leading SI sessions, 2 hours training (individual and group), 1 hour

preparation time and 1 hour to meet with the class instructor. SI leaders attend all classes, take notes, complete reading assignments and do all the homework, just as those enrolled in the class. Students are made aware of this which fosters a perception that SI leaders are peers. It also creates a 'safe environment' in SI sessions where students feel freer to take chances, reveal weaknesses, ask for help and accept advice.

Three 1 hour SI sessions are held each week for students enrolled in the class to attend. To encourage attendance at SI sessions, SI leaders are presented to the class as having mastered the content of the class. But *more importantly*, SI leaders are presented as *knowing strategies for learning class content* that they will pass on as a major focus of SI. It is explained that better grades are the end product of a process involving the use of effective learning skills and that these skills are not magically and mysteriously endowed on some and not others. Learning skills are presented as identifiable and learnable and may be refined until a chosen grade level is earned.

SI sessions are unique in that SI leaders do not ask content oriented questions or give answers. SI leaders do not relecture or act as a surrogate for the instructor. Course content is the realm of the instructor. What are covered in SI sessions are topics on which students have questions or want to check completeness and accuracy of their notes (Anderson *et al.*, 1979; Webb 1980, 1982a & b). Simply being told answers to questions or given solutions and answers to problems is avoided because it does not lead to an understanding of how to solve problems (Webb, 1980).

After a question is asked, students in the group supply missing information or solutions to problems. Students are encouraged to verbalize explanations and attempts at problem-solving. Students are often encouraged to relate course information to real-life situations to promote understanding and recall (Fuller, 1980; McClosky *et al.*, 1980; Trowbridge & McDermott, 1980; Clement, 1982; Nickerson, 1984). This is one means by which students help themselves and others while at the same time facilitating the learning of the material (Gagne & Smith, 1962; Davis, 1968; Weir & Helgoe, 1968; DiVesta & Rickards, 1971; Carmean & Weir, 1976).

How to learn the course content and understanding course content is the focus of SI sessions. SI leaders promote this learning and understanding through a variety of techniques including modeling cognitive and information processing skills and by creating a safe environment in which to practice these skills. Thinking, reasoning, analyzing, organizing, problem-solving, gaining concrete experience with application of ideas and using the language of the subject matter are facilitated by the SI leader (Schneider & Renner, 1980; Whimbey, 1984). This is done because many students in high risk classes lack these cognitive skills needed to do college level work (Tomlinson-Keasey, 1972; Renner & Lawson, 1973; Karplus, 1974; Carpenter *et al.*, 1980). The development of cognitive skills allows for greater assimilation of information and is essential for college students (Piaget, 1964). SI leaders promote interaction with concepts and structure practice to promote self-esteem and confidence that understanding has been achieved. These are important elements in promoting learning in SI sessions (Brookover *et al.*, 1967; Maslow, 1968; Cohen & Cohen, 1975; Maqsud, 1983).

SI leaders encourage students to formulate questions out of what they find confusing or unclear. When a specific question has been formed, those in attendance are called on to build an answer. Students in attendance at SI sessions determine what is covered in each SI session. In this way, specific needs in content understanding and study skills are addressed when students are receptive to help, thus avoiding the common practice of 'shotgun' relecturing in the hopes of hitting something some students may need at a particular moment.

In response to content oriented questions, those in the group are expected and encour-

aged to answer questions and solve problems. Simply being told answers to questions or given solutions to problems is avoided because it does not lead to an understanding of how to solve problems (Webb, 1980). SI leaders elicit, urge, coax and praise participation to create as safe an environment as possible in which students may formulate questions and attempt answers. It is attempts at answers which are praised, not only the correctness of answers. In this manner, the SI leader creates a 'low risk' environment in which to venture information, verbalize attempts at thinking through answers or problems. In other words, SI creates opportunities to practice thinking, reasoning, problem-solving, analyzing and organizing skills free of the evaluative onus of the classroom and the instructor. This practice is conducted with fellow students in SI sessions who wish to learn to do the same thing.

In response to study skills questions, SI leaders may model what they did to understand and learn a certain concept or idea when they took the course, or model an effective study hint or memory device for learning the material. Students earning better grades are encouraged to describe how they learn/learned a concept or how they study/studied for a test. This process creates a steady exchange of ideas and models for learning which others may adopt as they are ready. When students indicate a need, instructional hand-outs on study skills are distributed which describe, step-by-step, efficient ways to study, learn and self-test. SI leaders may circulate personal samples of lecture and/or textbook notes which students may use as a model for their own notes. SI leaders may describe personal successful study skills and/or model one or more on the chalkboard.

As mentioned previously in relation to course content, study skills information is presented when *students* in the SI session indicate a need for it and not when the group leader believes it is needed. Because SI leaders are presented to a class as previously earning an 'A' in the course, students tend to regard them as a knowledgeable and reliable resource of study skills information. Students see SI leaders as willing to respond to their needs. This is opposed to the typical educational environment where students are expected to 'grab' information as best they can when it is presented.

SI participants do cover course content in SI sessions but only as a means for refining the cognitive and applied learning skills which lead to better grades. In this way, students are repeatedly manipulating knowledge about the material they need to learn for the class, but more than this, they receive information and see models on learning skills which not only help them in this class, but in other classes from that point on. Therefore, when students no longer need to attend SI sessions, the SI program is successful. A major goal of the SI leaders, in one sense, is to work themselves out of a job.

Mode of Operation

In the weekly SI sessions, there are 3 basic modes of operation:

Mode 1: building complete and accurate notes

In response to student requests to do so, SI leaders ask attendees to reconstruct the contents of a previous lecture or textbook chapter in note form. As individuals contribute what is in their notes, omissions and incorrectly recorded information become apparent making a remedy possible. Each person checks the contributions of others against their own notes. Additions, deletions and corrections are pointed out as a normal part of the SI process. Students are free to participate when they are confident and comfortable enough to do so and are praised for the effort. As information is covered, SI leaders place it on the board in a format modeling efficiently organized notes. The SI leader also records questions and

answers on the chalkboard as they are presented by the group to be used as a model for organizing notes. Hints for learning specific concepts and helpful mnemonics are presented by the SI leader and/or solicited from the group as note content is covered.

Mode 2: formulating possible examination questions and answers

This second mode of operation is important because it takes students beyond simply organizing and memorizing notes. Students must mentally manipulate information by analyzing it and then organizing it into one or more questions and answers. This exercise requires understanding of how pieces of information are related to each other and how they must be arranged to form coherent questions and answers. Students learn, for example, to discriminate between main ideas and relevant details and between causes and effects. Students learn to recognize the different patterns in which information is presented such as sequential, chronological, inductive, deductive or hierarchical. In these and many other ways, forming questions and answers takes students beyond memorizing and fosters understanding.

As questions and answers are formulated, students are urged to set them up in a written format which promotes self-testing. This may involve the use of note cards where questions are placed on one side of a note card and appropriate answer(s) on the other. To review this material, students are encouraged to read the question aloud, recite the answer aloud without looking and then check the back of the card for accuracy. Correct answers are immediately reinforced while incorrectly recited answers are corrected. To recite an answer aloud, students must think about, recall, organize and verbalize the answers. The exercise of higher level cognitive skills is necessary to formulate coherent answers to questions.

Students are encouraged to use the question-and-answer format or something similar to test themselves. In this way, students discover what has and what has not been learned before an examination is taken when something can still be done about it. When students learn to form possible questions and build complete and accurate answers, they are self-testing, which involves them with the material to be learned. An added bonus is that many student-formulated questions appear in examination in similar form and sometimes word-for-word. SI supervisory staff at UNCC have regularly observed SI students predicting 75–90% of the questions that appear in examinations. Of course, students are not attempting to predict and select only those questions they believe will appear in an examination. SI leaders are not privy to copies of examination papers prior to the day they are sat. But because students are recording the finite number of major ideas in the form of questions and then recording related details in the form of answers, it is inevitable that the actual questions will, at least, be similar to students' questions in their notes. With a little applied instructor decoding skill, many students become proficient at identifying main ideas likely to appear in examinations.

The required mental and physical skills mentioned above are all characteristic of academically successful students who learn well on their own. SI creates an environment in which to develop and refine such skills to become a successful independent learner.

Mode 3: post-test survey

Students are apt to repeat mistakes in study skills and content understanding in examinations unless they go over their examination scripts when returned. SI leaders help students refine detective skills that identify what was correct in examination answers and associate correct answers with study skills that led to correct answers. In this way, productive study skills may be repeated.

Conversely, students identify what was missed in examination answers and identify

which study skills or lack of them resulted in a missing element. Ineffective study skills can then be substituted with more promising ones. Unless this is done, it is unlikely that students will make informed and productive changes in study habits. Without a post-test survey, it is doubtful that students will admit or even discover that they are doing something which leads to ineffective learning and, therefore, low grades.

The Role of the Instructor

The role of the instructor is small but, nonetheless, crucial to the success of an SI program. Unless there is frequent, regular and enthusiastic verbal support for students in the class to attend SI sessions, they are unlikely to assume the extra burden in time and effort. Faculty members must believe in SI and make it clear to students that they believe SI attendance is beneficial in terms of understanding and mastering course content, refining essential learning skills and earning higher final grades.

Participating instructors must be willing to provide copies of test scores to SI staff to use in analyzing the impact of the program on students. Also, instructors must be willing to allow 5 minutes periodically for SI staff to report the differences in test scores of students attending SI vs non-attendees. This announcement is one device for encouraging students to attend SI sessions. Instructors must also be willing to allow about 20 minutes to survey the class at the end of a semester to determine why students did and did not attend SI sessions.

Administration of an SI Program

The success of any SI program is heavily dependent on the quality of SI leaders. Good SI leaders tend to produce better attendance at SI sessions and greater final course grade averages. Therefore, effective SI leader training is central to the program's success.

Training of SI leaders is extensive. It begins with 2 full days of training before the start of *each* semester and continues weekly until the semester's end. During each semester, SI supervisors attend up to two of the three weekly SI sessions to observe SI leaders and meet with them for half an hour after a session. At this time, praise is given for behaviors which are consistent with the SI model. Problems SI leaders encounter are identified and alternatives for dealing with those problems are developed to use in future similar situations. Also, 1 hour weekly staff training meetings are held to discuss problems, receive information on relevant learning theory, exchange information on what worked in SI and what did not and to generate a sense of team effort.

In terms of supervisory staff, SI components attached to 12 separate classes in one semester have successfully been managed by a full-time co-ordinator and one graduate assistant at UNCC. This translated into having SI assistance available for about 1600 students in high risk courses during one semester.

Qualifications for SI leaders include a minimum of a 'B' average overall and an 'A' in the high risk class they will work with. Excellent interpersonal relations skills are essential for good relationships with students. Many students are not mature enough to see benefits beyond personality characteristics. It has been observed at UNCC that if students do not like an SI leader as a person, no matter how good that person is in SI leadership skills, attendance will be lower. Consequently, if students like an SI leader as a person, even though SI leadership skills need refinement, attendance will be higher. Additional qualifications considered include counseling, teaching and leadership experiences.

General Characteristics of Supplemental Instruction

SI is proactive in its approach. It focuses on delivering help to students *before* they find themselves in academic difficulty. At UNCC, if a student is in academic difficulty after the first 6 weeks, chances are very low that much can be done to help. At the University of Missouri at Kansas City, attrition was also found to be highest within the first 6 weeks (Martin *et. al.*, 1983).

SI focuses on high risk courses and not on high risk students. Consequently, no one person or group need feel conspicuous or singled out as needing 'special' help.

SI is open to any student enrolled in the class and SI sessions usually contain a mixture of students with varying degrees of scholarly talent and skills for learning. SI is never presented as 'remedial'. As a result, attendance at SI sessions does not imply weakness or suggest problems. SI is perceived as an integral part of the normal teaching–learning process which goes beyond what instructors normally are able to do within the time limitations of the traditional classroom.

Students see SI as a program for anyone interested in *learning how to learn course content.* Because a peer is leading SI sessions, students feel more able to reveal weaknesses, venture questions, tender answers, and accept information on study skills than in the traditional classroom setting. The risk, real or perceived, of revealing weaknesses in content understanding and/or study skills to the person giving grades is moot in SI sessions because the SI leader is not involved in grading and evaluation of students.

Method

SI assistance has been available to instructors and students at UNCC since the spring of 1985 when a pilot study was initiated. The impact of the SI program on D, F and W rates and student academic performance is most easily presented on a semester-by-semester basis. Data from two typical semesters, Fall 1988 and Spring 1989 are used in this article as an example of the consistent impact of SI on student academic performance.

The keys for data interpretation are listed below:

SI attendees = students attending SI sessions five or more times for a semester.
SAT = Scholastic Aptitude Test.
SATV = SAT—verbal ability score.
SATQ = SAT—quantitative ability score.
SATC = SAT—sum of SATV and SATQ.
CRANK = converted high school rank (high school class rank divided by class size) – lower scores = higher rank and visa versa.
PGPA = predicted grade point average before matriculation, based on SAT verbal scores, SAT quantitative scores and CRANK.
GRADE = final grade for the course.
OSL = observed significance level.

The SAT is an entrance examination taken by almost all freshmen entering post-secondary education in the USA. It is used as one criterion for determining the scholarly potential of the student. Sometimes it is used to assist with placement of freshmen in appropriate levels of mathematics and English classes. Many institutions require specific minimum SAT scores before students will even be considered for admission. The CRANK gives an additional indication of a student's academic potential, motivation and industriousness.

The grade point average (GPA) is used to indicate a level of academic performance and ability. On this scale in the USA, an A average is equal to a 4.0, B average a 3.0, C average

a 2.0, D average a 1.0 and an F average a 0.0. To determine an individual's GPA, the final grade for the class (4.0, 3.0, etc.) is multiplied by the number of credit hours given to a class. This gives what is called the quality points for one class. The quality points for all classes in one semester are summed and divided by the total number of credit hours a student is taking that semester. This gives a student's GPA for that semester. Using various formulae including high school GPA and high school class rank, many institutions develop a predicted GPA in an attempt to assess a student's potential to succeed at college.

In this article, the basic strategy used in the analysis shows that in spite of the comparability of SI vs non-SI groups in academic potential and previous academic performance, there were differences in actual course performance. Although this does not prove the differences were due to SI intervention, it gives evidence to support that explanation.

By nature, the SI program has a self-selection bias; but some of the selection bias explanation can be played down if the groups are actually comparable on all measures except the final grade in the course. In this study, academic potential is assessed by the use of SAT scores, and previous academic performance is assessed by high school rank. Although these measures are not direct evidence of those constructs, high school performance does address motivational and industry factors that might explain performance in college courses.

Statistical analyses were conducted on data from the fall of 1987 to spring of 1991. Results were consistent from semester to semester. To economize space in this article, a typical academic year was selected to show how the data were analyzed and to show the typical outcome of SI participation on students.

In assessing the effectiveness of the SI program, the following analyses were performed using SAS (Statistical Analysis System). Chi-square tables compared SI and non-SI students with grade groupings of A, B and C. and D, F and W. The percentage of students receiving grades of A, B & C and D, F & W are reported for the SI group, the non-SI group, and the combined groups. The contingency coefficient is also reported. The contingency coefficient gives a type of correlation coefficient for qualitative data.

Differences in SI and non-SI groups were investigated for the variables SATV, SATQ, SATC, CRANK, PGPA, and GRADE using independent *t*-tests. *t*-tests compared the means of the SI group and non-SI group to see the probability that differences of that magnitude would be attributed to chance. Values of OSL that are small, for example, less than 0.05, give evidence that observed differences are significant, that is unlikely to be simply chance differences. A *t*-test comparison for the first five variables was conducted to provide evidence that differences in grades between the SI and non-SI groups were not merely the result of a self-selection process resulting in mostly students with greater academic potential or greater industriousness being in the SI group.

An analysis of covariance attempted to correct for the effect that differences between groups on SATC and PGPA had on final course grade. The General Linear Model (GLM) procedure in SAS can be used to analyse covariance and allows a comparison of least squares means. One rationale for using analysis of covariance evolved from the problem of students with missing SAT scores. Without accounting for students' SAT performance, it would not be clear whether higher final course grades were a result of people who had higher SATs at the outset (had their SAT scores been available for this study) or the influence of SI. There were two separate analyses for each semester: one using SATC as the covariate and the other using PGPA as the covariate. This analysis was done using first an *F* test to find the effect of SI attendance and SATC on predicting grade in the course. A significant *F* statistic leads to the conclusion that there are significant differences in grade as a result of SI attendance and SATC. A further analysis uses least squares means, that is means for the two groups adjusted for the differences in the covariate, e.g. SATC. Then the adjusted means are

TABLE I. Comparative percentages for non-SI and SI groups for fall 1988

	ABC (%)	DFW (%)
Non-SI (n = 907)	62.07	37.93
SI (n = 169)	82.25	17.75
Combined	65.24	34.76

Chi-square = 25.572; df = 1;OSL = 0.000; contingency coefficient = 0.152.

compared to determine whether or not the SI and non-SI groups are significantly different after accounting for differences in SATC. Output from the GLM procedure also gives the R-square. R-square is a measure of the proportion of variability in grade (the dependent variable) that is attributable to the independent variables of SI attendance and SATC. Analysis of the residuals gave evidence that the residuals gave evidence that the assumptions for using this analysis were met.

Results

The SI program showed significantly higher grades for students in spite of the fact that the SATs and CRANKs and PGPAs were not significantly different for the two groups. When SATC scores were significantly different, they were higher for the non-SI group.

Table I shows the difference in percentages between the A, B and C grades and D, F and W grades for the SI and non-SI attendees. A chi-square test of association showed significance beyond the 0.001 level with a contingency coefficient of 0.152. Table I shows that in the SI group, the percentage of high grades is higher than the percentage of high grades for those who did not attend SI.

A series of independent t-tests showed the differences between groups for SATV, SATQ, SATC, PGPA, CRANK and GRADE. For each comparison , the mean and standard deviation of each group was reported along with the observed significance level (OSL).

Table II shows that grades for SI attendees are significantly higher than for the non-SI group but that for the other variables, either there are no significant differences *or* the differences favor the non-SI group. A further analysis was carried out to look more carefully at the combined effect of these variables on grade. In order to compare groups and to adjust the grades for the effect of SATC performance and PGPA (which is a linear combination of SATC and high school rank), an analysis of covariance was done using SATC as a covariate in one analysis and PGPA as a covariate in another analysis. Tables III and IV report these results with covariates SATC and PGPA, respectively.

It can be seen in the results of the analysis of covariance that, after adjusting for the effect of SATC on grade, on average the SI group made significantly higher grades. Not surprisingly, the overall R-Square is low (only 0.134) which indicates that there are variables which

TABLE II. Comparison of means for non-SI and SI groups for fall 1988

	SATV	SATQ	SATC	PGPA	CRANK	GRADE
Non-SI	437	488	924	2.36	0.223	1.894
	(73)	(85)	(137)	(0.31)	(0.137)	(1.14)
SI	425	462	887	2.35	0.217	2.391
	(74)	(83)	(138)	(0.30)	(0.139)	(1.075)
OSL	0.0963	0.0006	0.0027	0.8232	0.6370	0.0000

Numbers in parentheses are standard deviations

TABLE III a and b. General linear models procedure using SATC as a covariate for fall 1988
(a) Dependent variable = GRADE

Source	df	Sum of squares	Mean squares	*F* value	OSL
Model	2	155.50807	77.75403	71.12	0.0001
Error	916	1001.47996	1.09332		
Corrected total	918	1156.98803			

R-square = 0.134408

(b) Least squares means (Covariate = SATC)

	Grade adjusted for covariate	OSL
Non-SI	1.85353287	0.0001
SI	2.46832009	

have not yet been identified contributing to a person's grade, other academic potential and SI attendance. However, SI attendance appears to have an effect in improving students' grades.

To include the possible effects of motivation and industriousness, PGPA was considered as a covariate. The PGPA calculation considers SATC and high school class rank. In Table IV, it can be noted that SI attendees had significantly higher grades even when PGPA was the covariate. Using PGPA the *R*-Square was increased to 0.234; however, the number of persons who had missing class ranks reduced the number of observations to only 598 of the original 1076 in the group. By using either SATC or PGPA, however, the SI program is favorably affecting grades, as can be seen by the significant differences (OSL = 0.0001) in grade between the two groups (SI mean = 2.498; non-SI mean = 1.880) when adjusting for differences in PGPA.

Tables V–VIII show the results for the spring of 1989 and show similar patterns with respect to SI attendees and those who did not attend SI sessions. Note that except for the grade (which for the SI attendees was higher), the other variables that were used to consider academic potential and industriousness were either not significantly different in the two groups or else significantly *higher* for the non-SI group. This suggests that the self-selection criticism that only the more motivated, more industrious students would attend SI was not evident.

TABLE IV a and b. General linear models procedure using PGPA as a covariate for fall 1988
(a) Dependent variable = GRADE

Source	df	Sum of squares	Mean squares	*F* value	OSL
Model	2	173.85502	86.92751	90.90	0.0001
Error	596	569.97804	0.95634		
Corrected total	598	743.83306			

R-square = 0.233729

(b) Least squares means (covariate = PGPA)

	Grade adjusted for covariate	OSL
Non-SI	1.88009664	0.0001
SI	2.49831776	

TABLE V. Comparative percentages for Non-SI and SI groups for spring 1989

	ABC(%)	DFW(%)
Non-SI (n = 888)	73.20	26.80
SI (n = 102)	95.10	4.90
Combined (990)	75.45	24.55

Chi-square = 23.692; df = 1; OSL = 0.000; contingency coefficient = 0.153.

TABLE VI. Comparison of means for non-SI and SI groups for spring 1989

	SATV	SATQ	SATC	PGPA	CRANK	GRADE
Non-SI	433	484	917	2.40	0.223	2.219
(76)	(81)	(136)	(0.31)	(0.135)	(1.15)	
SI	411	443	854	2.30	0.242	2.843
(80)	(75)	(128)	(0.23)	(0.155)	(1.93)	
OSL	0.0138	0.0000	0.0001	0.0071	0.2258	0.0001

Numbers in parentheses are standard deviations.

TABLE VII a and b. General linear models procedure using SATC as a covariate for spring 1989

(a) Dependent variable = GRADE

Source	df	Sum of squares	Mean squares	F value	OSL
Model	2	79.977199	39.988599	35.34	0.0001
Error	840	950.608803	1.131677		
Corrected total	842	1030.586002			

R-square = 0.077604

(b) Least square means (covariate = SATC)

	Grade adjusted for covariate	OSL
Non-SI	2.20601117	0.0001
SI	2.80773304	

Conclusions

The research in this article strongly suggests that SI attendance has a positive impact on student academic performance. The data give evidence of better academic performance for SI students. While this study presented data from one academic year, the data are consistent on the impact of SI from 1985 to the present.

To implement an SI program is not a complicated venture. Administratively, SI easily fits into existing learning assistance programs or stands alone within an organizational structure. The SI model itself is simple to grasp and is quickly mastered by administrators, supervisors and undergraduate SI leaders. The SI model itself is simple to grasp and is quickly mastered by administrators, supervisors and undergraduate SI leaders. The SI goal of creating independent self-educators is one which most institutions will embrace and it attracts the support of hard-working faculty members. Students who participate in SI are more likely to re-enroll in subsequent semesters and are more likely to graduate (Martin *et*

TABLE VIII a and b. General linear models procedure using PGPA as a covariate for spring 1989

(a) Dependent variable = GRADE

Source	df	Sum of squares	Mean squares	*F* value	OSL
Model	2	128.04153	64.02077	63.23	0.0001
Error	523	529.56493	1.01255		
Corrected total	525	657.60646			

R-square = 0.194708

(b) Least squares means (covariate = PGPA)

	Grade adjusted for covariate	OSL
Non-SI	2.12569568	0.0001
SI	2.82337712	

al., 1983). In this light, administrators are more willing to commit financial resources because it is very likely that the initial investment will be returned with 'interest'. The model for assessing the impact on students is uncomplicated and necessitates only a basic understanding of statistical analysis. With over 200 institutions in the USA already having and with British polytechnics beginning to have successful SI programs, there is a background of experience from which to gather information on effective administration of SI programs.

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NOTE

[1] In the US grading system, A = superior, B = above average, C = average, D = below average but passing, F = failing and W = withdrawal. Students often withdraw to avoid receiving a D or F.

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