

## Summarizing the Effects of Supplemental Instruction (SI) on Student Performance

### Major Findings

1. *Supplemental Instruction increases participants' course grade even adjusting for self-selection and controlling other factors' influences.*
2. *Course instructors and SI leaders is the most important factor affecting SI participation and SI effects.*
3. *Students who need SI the most received the largest benefits from SI participation but are the least likely to participate in SI.*

### ANALYTICAL FOCUS

In this study, we first identified the factors affecting SI participation. We then evaluated the effect of SI participation on students' performance as measured by course grade and its moderating factors.

### METHODOLOGY

The data in this study include 3,205 students who enrolled in SI courses in spring 2013. These students are classified into two groups: SI students and Non-SI students. SI students are those who participated in SI sessions for three times or more. Two-stage modeling approach is used to handle the self-selection issue when determining the effects of SI on students' course grade. This approach consists of two models: SI participation model in the first stage and SI effects model in the second stage. The SI participation model would generate a sample selection correction factor, called Lambda, which is the probability of students participating in SI sessions. This value is then incorporated into the SI effects model to reduce the bias in the estimates of the SI effect (See Methodological notes in the Appendix section for the details). The major findings are discussed in the following section.

### SUMMARY OF MAJOR FINDINGS

**SI Participation.** Overall, 18.7% of undergraduates who enrolled in SI courses participated in SI sessions in spring 2013 (598 out of 3,205 students). However, SI participation rate is varied among student subgroups (Table 1-2) as well as among course instructors/SI leaders (Table 3).

In the SI participation model, there are 13 variables considered (Table 4). Among them, six factors have significant effects on SI participation: 1) Course instructors/SI leaders; 2) English remediation status; 3) Gender; 4) Cumulative GPA group; 5) Failure experience and 6) Math remediation status. Course instructors/SI leaders is the strongest factor affecting SI participation. For example, students in CHEM 8 are about 15 times more likely to participate in SI than students in BIOL 10. On the other hand, there is no significant difference in SI participation between BIOL 1B and BIOL 10.

It was found that students who require English remediation are 1.95 times more likely to participate in SI than students who do not require English remediation. Students who require Math remediation are 1.29 times more likely to participate in SI than those who do not. Interestingly, female students are 1.66 times more likely to participate in SI than male students.

Also of particular interest is the finding that a significantly positive relationship between cumulative GPA group and SI participation is evident. That is to say, students who have higher cumulative GPA are more likely to participate in SI than students with a lower GPA. Compared to students whose cumulative GPA is below 2.0, students whose cumulative GPA is 3.0 or higher are 2 times more likely to participate in SI. Moreover, students whose cumulative GPA is 2.0 to 2.99 are 1.19 times more likely to participate in SI. In addition, students who had failure experience in the previous courses are 0.74 times less likely to participate in SI than students who did not have a course failure experience. The above finding suggests that students who need SI the most are the least likely to participate in SI.

**SI Effects on Students' Performance.** Overall, SI students' average course grade is 0.54 higher than Non-SI students. However, the performance differences are varied among student subgroups (Table 1-2) as well as among course instructors/SI leaders (Table 3).

Based on results from the SI effect model (Table 6-7), SI participation is a significant factor affecting students' course grade. Put simply, SI participation increases course grades by 0.91 points when adjusting for self-selection and controlling the influence of other factors.

Course instructors/SI leaders and Gender are two additional factors of significance moderating SI effects on students' course grade. The course instructors/SI leaders factor is the strongest. In 11 out of 15 courses, SI participation significantly increases the course grade by 0.75 in BIOL 1A to 1.89 in CHEM 8. On the other hand, SI participation has no significant effect on course grade in the other four courses (CRIM 50, ECON 40, MATH 75 and PHYS 4A), all of which were taught by the instructors who did not have previous SI experience.

SI effects are also moderated by Gender. For female students, SI participation significantly increases course grades by 0.79 points, while for male students the increase is 1.03 points.

The effects of SI participation on students' course grade are different among three cumulative GPA groups even though cumulative GPA group is not a significant factor affecting SI effects. SI participation is found to significantly increase course grades by 1.16 points for students with cumulative GPA below 2.0, by 0.75 for students with cumulative GPA of 2.0-2.99, and by 0.82 for students with cumulative GPA of 3.0 or higher, which suggests that students who need SI the most received the largest benefit from SI participation.

### **CONCLUDING REMARKS**

Descriptively, SI students' average course grade is 0.54 higher than Non-SI students. When adjusting for self-selection and controlling the influence of other factors, the effect of SI participation gets even larger. SI participation significantly increases course grade by 0.91 points.

There are wide variations in SI participation and SI effect among course instructors/SI leaders. Course instructors and SI leaders is the most important factor affecting SI participation and SI effects, which is confirmed by two statistical models. The results show that courses taught by the instructors who have had previous SI experience tend to have higher SI participation rates and larger SI effects than the courses taught by the instructors who are the first timers for SI (Table 3). This would suggest student performance improvement could be achieved by involving more instructors in SI as well as involving more SI leader interactive help with students.

Students whose cumulative GPA is below 2.0 in the beginning of Spring 2013 are less likely to participate in SI but received the larger increase in course grade from SI participation than other students. This finding needs more exploratory study.

**TABLE 1**

**SI Participation and Performance by Students' Demographics and Academic Preparation Characteristics**

Student group	Headcount			SI participation rate	Course performance				Overall performance				Performance Difference (SI - Non-SI)			
					Avg. Course Grade		Course Passing Rate		Avg. Term GPA		Next Term Retention Rate		Avg. Course Grade	Course Passing Rate	Avg. Term GPA	Next Term Retention Rate
	Non-SI	SI	Total		Non-SI	SI	Non-SI	SI	Non-SI	SI	Non-SI	SI				
<b>Grand Total</b>	2,607	598	3,205	18.7%	2.07	2.61	64.4%	80.4%	2.46	2.99	85.1%	89.8%	0.54	16.0%	0.53	4.7%
<b>Gender</b>																
Female	1,476	406	1,882	21.6%	2.05	2.56	63.9%	79.1%	2.50	3.00	87.3%	88.4%	0.52	15.2%	0.50	1.1%
Male	1,131	192	1,323	14.5%	2.10	2.70	65.2%	83.3%	2.41	2.99	82.2%	92.7%	0.60	18.2%	0.57	10.5%
<b>Ethnicity</b>																
African American	109	31	140	22.1%	1.74	2.55	56.9%	80.6%	2.13	2.80	77.1%	83.9%	0.81	23.8%	0.67	6.8%
American Indian	12	1	13	7.7%	2.00	0.00	75.0%	0.0%	2.43	2.80	100.0%	100.0%	-2.00	-75.0%	0.37	0.0%
Asian	491	112	603	18.6%	2.06	2.75	67.0%	80.4%	2.39	3.10	85.3%	96.4%	0.69	13.4%	0.72	11.1%
Pacific Islander	8	3	11	27.3%	2.13	3.33	75.0%	100.0%	2.18	2.62	87.5%	100.0%	1.21	25.0%	0.44	12.5%
Hispanic	1,151	262	1,413	18.5%	1.92	2.47	60.2%	78.2%	2.35	2.87	85.4%	91.6%	0.55	18.0%	0.52	6.2%
White	581	112	693	16.2%	2.43	2.67	71.8%	83.9%	2.77	3.13	86.4%	84.8%	0.24	12.2%	0.36	-1.6%
Other/ Unknown	195	54	249	21.7%	2.15	2.77	65.6%	87.0%	2.53	3.07	81.0%	81.5%	0.63	21.4%	0.55	0.5%
Non-Resident Alien	60	23	83	27.7%	2.02	2.82	60.0%	73.9%	2.61	3.29	90.0%	87.0%	0.80	13.9%	0.68	-3.0%
<b>URM (Under-represented minority)</b>																
Non-URM	1,072	224	1,296	17.3%	2.26	2.71	69.6%	82.1%	2.60	3.12	85.9%	90.6%	0.45	12.6%	0.52	4.7%
URM	1,280	297	1,577	18.8%	1.90	2.48	60.2%	78.5%	2.33	2.86	84.8%	90.9%	0.58	18.3%	0.53	6.1%
Unknown	255	77	332	23.2%	2.11	2.79	64.3%	83.1%	2.55	3.14	83.1%	83.1%	0.67	18.8%	0.59	0.0%
<b>FGS (First generation status)</b>																
CGS	721	175	896	19.5%	2.30	2.85	69.2%	86.3%	2.60	3.18	85.4%	90.9%	0.55	17.1%	0.58	5.4%
FGS	1,785	393	2,178	18.0%	1.98	2.48	62.4%	77.6%	2.41	2.90	85.0%	89.6%	0.51	15.2%	0.50	4.5%
Unknown	101	30	131	22.9%	2.09	2.77	66.3%	83.3%	2.46	3.11	84.2%	86.7%	0.67	17.0%	0.65	2.5%
<b>English remediation status</b>																
Not requiring	1,414	290	1,704	17.0%	2.33	2.77	69.9%	84.1%	2.64	3.13	84.1%	86.6%	0.44	14.2%	0.48	2.5%
Requiring	1,193	308	1,501	20.5%	1.77	2.45	57.9%	76.9%	2.25	2.87	86.3%	92.9%	0.68	19.0%	0.62	6.5%
<b>Math remediation status</b>																
Not requiring	1,638	364	2,002	18.2%	2.26	2.81	69.3%	82.7%	2.59	3.14	85.2%	89.3%	0.55	13.4%	0.55	4.1%
Requiring	969	234	1,203	19.5%	1.75	2.30	56.2%	76.9%	2.25	2.77	85.0%	90.6%	0.55	20.7%	0.52	5.6%
<b>HS GPA group</b>																
0-1.99		2	2	100.0%		2.00		50.0%		1.90		50.0%	2.00	50.0%	1.90	50.0%
2-2.99	541	85	626	13.6%	1.63	1.95	52.3%	63.5%	2.05	2.52	79.1%	91.8%	0.32	11.2%	0.46	12.7%
3+	1,849	441	2,290	19.3%	2.20	2.76	67.9%	84.4%	2.58	3.11	87.9%	90.7%	0.55	16.4%	0.53	2.8%
Unknown	217	70	287	24.4%	2.01	2.47	65.0%	77.1%	2.51	2.87	76.5%	82.9%	0.46	12.2%	0.36	6.4%
<b>SAT_COMP group</b>																
400-799	397	113	510	22.2%	1.60	2.29	54.4%	76.1%	2.12	2.74	86.1%	92.9%	0.69	21.7%	0.61	6.8%
800-999	1,006	222	1,228	18.1%	1.98	2.61	61.9%	82.9%	2.42	3.03	86.0%	89.2%	0.64	21.0%	0.61	3.2%
1000+	731	116	847	13.7%	2.54	3.29	75.2%	94.0%	2.75	3.40	85.4%	92.2%	0.75	18.7%	0.65	6.9%
Unknown	473	147	620	23.7%	1.94	2.29	61.5%	69.4%	2.40	2.82	82.0%	86.4%	0.35	7.9%	0.42	4.4%
<b>New student type at entry</b>																
First-time freshmen	2,298	495	2,793	17.7%	2.08	2.64	64.5%	81.8%	2.46	3.02	86.3%	91.9%	0.56	17.3%	0.56	5.6%
New undergraduate transfers	309	103	412	25.0%	2.01	2.46	63.8%	73.8%	2.51	2.88	76.1%	79.6%	0.45	10.0%	0.37	3.6%

**TABLE 2**

**SI Participation and Performance by Students' Characteristics in the Beginning of Spring 2013**

Student group	Headcount			SI participation rate	Course performance				Overall performance				Performance Difference (SI - Non-SI)			
	Non-SI	SI	Total		Avg. Course Grade		Course Passing Rate		Avg. Term GPA		Next Term Retention Rate		Avg. Course Grade	Course Passing Rate	Avg. Term GPA	Next Term Retention Rate
					Non-SI	SI	Non-SI	SI	Non-SI	SI	Non-SI	SI				
Grand Total	2,607	598	3,205	18.7%	2.07	2.61	64.4%	80.4%	2.46	2.99	85.1%	89.8%	0.54	16.0%	0.53	4.7%
<b>Full time status</b>																
Part time	144	36	180	20.0%	1.55	2.42	48.6%	75.0%	1.93	2.57	63.2%	66.7%	0.87	26.4%	0.63	3.5%
Full time	2,463	562	3,025	18.6%	2.10	2.62	65.4%	80.8%	2.49	3.02	86.4%	91.3%	0.52	15.4%	0.53	4.9%
<b>Student level</b>																
Freshman	1,029	169	1,198	14.1%	1.85	2.55	58.2%	78.7%	2.32	2.97	83.1%	92.9%	0.70	20.5%	0.65	9.8%
Sophomore	768	163	931	17.5%	2.33	2.82	70.8%	87.1%	2.53	3.08	90.6%	92.6%	0.49	16.3%	0.56	2.0%
Junior	431	133	564	23.6%	2.13	2.54	65.4%	75.9%	2.59	2.98	88.6%	95.5%	0.41	10.5%	0.39	6.9%
Senior	379	133	512	26.0%	2.07	2.48	67.3%	78.9%	2.58	2.93	75.5%	76.7%	0.41	11.7%	0.34	1.2%
<b>Student major (COLLEGE)</b>																
JCAST	287	76	363	20.9%	1.96	2.32	62.7%	72.4%	2.53	2.86	89.9%	89.5%	0.36	9.7%	0.33	-0.4%
COSS	280	47	327	14.4%	2.19	2.96	70.4%	93.6%	2.50	3.04	86.8%	87.2%	0.77	23.3%	0.55	0.4%
CHHS	563	220	783	28.1%	1.97	2.55	62.3%	81.8%	2.49	3.05	83.7%	89.1%	0.58	19.5%	0.56	5.4%
CSB	210	32	242	13.2%	2.43	2.63	71.4%	75.0%	2.62	3.06	87.1%	93.8%	0.20	3.6%	0.44	6.6%
CAH	150	21	171	12.3%	2.05	1.90	62.7%	61.9%	2.63	2.85	80.7%	85.7%	-0.15	-0.8%	0.22	5.0%
KSOEHD	92	10	102	9.8%	2.46	2.60	77.2%	90.0%	2.68	3.03	90.2%	100.0%	0.14	12.8%	0.35	9.8%
LCOE	241	47	288	16.3%	2.24	2.93	68.0%	91.5%	2.39	3.08	80.9%	91.5%	0.69	23.4%	0.68	10.6%
CSM	603	126	729	17.3%	1.85	2.75	57.9%	77.8%	2.30	2.97	85.4%	90.5%	0.90	19.9%	0.66	5.1%
SPE	181	19	200	9.5%	2.25	2.50	68.5%	78.9%	2.43	2.81	82.9%	89.5%	0.25	10.4%	0.38	6.6%
<b>Cumulative GPA group in the beginning of Spring 2013</b>																
0-1.99	268	29	297	9.8%	1.00	2.04	31.0%	69.0%	1.42	2.40	48.1%	86.2%	1.04	38.0%	0.98	38.1%
2-2.99	1,206	212	1,418	15.0%	1.77	2.01	57.6%	67.0%	2.18	2.54	86.7%	83.0%	0.24	9.4%	0.36	-3.7%
3 or higher	1,133	357	1,490	24.0%	2.63	3.01	79.6%	89.4%	3.00	3.31	92.1%	94.1%	0.37	9.7%	0.31	2.0%
<b>Failure experience in the previous semesters</b>																
No failure experience	1,149	326	1,475	22.1%	2.57	3.03	78.2%	89.3%	2.92	3.31	93.2%	93.6%	0.46	11.1%	0.39	0.3%
Failed in one or more classes	1,458	272	1,730	15.7%	1.67	2.10	53.6%	69.9%	2.10	2.62	78.7%	85.3%	0.43	16.2%	0.51	6.6%
<b>Number of enrolled semesters ( including summer sections)</b>																
1	10	6	16	37.5%	2.20	2.83	60.0%	83.3%	2.60	3.25	60.0%	66.7%	0.63	23.3%	0.66	6.7%
2	1,115	212	1,327	16.0%	2.05	2.69	63.3%	81.1%	2.50	3.07	85.8%	93.9%	0.64	17.8%	0.58	8.0%
3 & 4	829	182	1,011	18.0%	2.16	2.70	66.6%	83.5%	2.43	3.03	88.1%	91.2%	0.54	16.9%	0.59	3.2%
5 & 6	333	102	435	23.4%	2.08	2.52	65.8%	75.5%	2.42	2.92	86.2%	91.2%	0.44	9.7%	0.50	5.0%
7, 8, 9 and	320	96	416	23.1%	1.90	2.33	61.6%	78.1%	2.46	2.81	74.7%	78.1%	0.42	16.6%	0.35	3.4%

**TABLE 3**  
**SI Participation and Performance by Course Characteristics**

Student group	Headcount			SI participation rate	Course performance				Overall performance				Performance Difference (SI - Non-SI)			
	Non-SI	SI	Total		Avg. Course Grade		Course Passing Rate		Avg. Term GPA		Next Term Retention		Avg. Course Grade	Course Passing Rate	Avg. Term GPA	Next Term Retention Rate
					Non-SI	SI	Non-SI	SI	Non-SI	SI	Non-SI	SI				
Grand Total	2,607	598	3,205	18.7%	2.07	2.61	64.4%	80.4%	2.46	2.99	85.1%	89.8%	0.54	16.0%	0.53	4.7%
<b>Course Subject</b>																
BIOL	1,466	295	1,761	16.8%	2.54	2.73	75.8%	82.0%	2.63	3.06	87.4%	86.8%	0.19	6.2%	0.42	-0.6%
CHEM	34	31	65	47.7%	0.90	2.53	23.5%	77.4%	2.10	2.92	88.2%	87.1%	1.64	53.9%	0.82	-1.1%
CRIM	20	14	34	41.2%	2.95	3.00	100.0%	100.0%	2.71	2.92	85.0%	85.7%	0.05	0.0%	0.21	0.7%
ECON	75	19	94	20.2%	1.35	1.78	38.7%	52.6%	2.13	2.68	73.3%	89.5%	0.43	14.0%	0.56	16.1%
MATH	489	121	610	19.8%	1.25	2.33	42.7%	72.7%	2.08	2.83	77.3%	92.6%	1.08	30.0%	0.74	15.3%
PHYS	184	38	222	17.1%	1.89	3.08	66.8%	92.1%	2.42	3.27	85.3%	92.1%	1.19	25.3%	0.85	6.8%
PLSI	339	80	419	19.1%	1.56	2.48	53.1%	85.0%	2.38	3.01	88.8%	97.5%	0.92	31.9%	0.62	8.7%
<b>Course Instructors/SI leaders</b>																
BIOL 1A: Intro Biology	213	41	254	16.1%	1.64	2.44	55.4%	78.0%	2.26	2.87	86.4%	85.4%	0.80	22.6%	0.61	-1.0%
BIOL 1B: Intro Biology	117	13	130	10.0%	1.76	2.69	53.0%	84.6%	2.57	3.15	92.3%	100.0%	0.93	31.6%	0.58	7.7%
BIOL 10: Life Science	883	60	943	6.4%	3.09	3.76	90.5%	100.0%	2.78	3.33	89.4%	90.0%	0.67	9.5%	0.55	0.6%
BIOL 20: Intro Microbiol	65	41	106	38.7%	2.23	2.56	73.8%	78.0%	2.82	3.05	73.8%	73.2%	0.33	4.2%	0.23	-0.7%
BIOL 64: Funct Hum Anat	100	70	170	41.2%	1.18	2.43	37.0%	75.7%	2.21	2.96	84.0%	87.1%	1.25	38.7%	0.75	3.1%
BIOL 65: Human Physiology	88	70	158	44.3%	1.69	2.42	53.4%	77.1%	2.53	3.01	77.3%	90.0%	0.73	23.7%	0.48	12.7%
CHEM 8: Elem Org Chem	34	31	65	47.7%	0.90	2.53	23.5%	77.4%	2.10	2.92	88.2%	87.1%	1.64	53.9%	0.82	-1.1%
CRIM 50: Stat + Compr CJ	20	14	34	41.2%	2.95	3.00	100.0%	100.0%	2.71	2.92	85.0%	85.7%	0.05	0.0%	0.21	0.7%
ECON 40: Prin Microecon	75	19	94	20.2%	1.35	1.78	38.7%	52.6%	2.13	2.68	73.3%	89.5%	0.43	14.0%	0.56	16.1%
MATH 45: What Is Math	422	76	498	15.3%	1.27	2.28	44.3%	75.0%	2.08	2.76	76.1%	93.4%	1.01	30.7%	0.69	17.4%
MATH 75: Calculus I	67	45	112	40.2%	1.10	2.41	32.8%	68.9%	2.11	2.93	85.1%	91.1%	1.32	36.1%	0.82	6.0%
PHYS 2A: General Physics	112	24	136	17.6%	1.77	2.96	63.4%	87.5%	2.43	3.21	84.8%	91.7%	1.18	24.1%	0.78	6.8%
PHYS 4A: Mech+Wave Motion	72	14	86	16.3%	2.06	3.29	72.2%	100.0%	2.41	3.38	86.1%	92.9%	1.23	27.8%	0.96	6.7%
PLSI 2: Amer Govt Instit	339	80	419	19.1%	1.56	2.48	53.1%	85.0%	2.38	3.01	88.8%	97.5%	0.92	31.9%	0.62	8.7%
Faculty/SI leader I	193	55	248	22.2%	1.68	2.42	55.4%	83.6%	2.43	2.93	88.1%	96.4%	0.74	28.2%	0.50	8.3%
Faculty/SI leader II	146	25	171	14.6%	1.39	2.60	50.0%	88.0%	2.32	3.17	89.7%	100.0%	1.21	38.0%	0.85	10.3%
<b>Previous SI experience of course instructors</b>																
No SI experience	1,481	237	1,718	13.8%	2.52	2.83	74.9%	82.7%	2.59	3.04	87.9%	89.5%	0.32	7.8%	0.45	1.5%
Had SI experience	1,126	361	1,487	24.3%	1.49	2.46	50.6%	78.9%	2.29	2.97	81.4%	90.0%	0.97	28.3%	0.67	8.6%

**TABLE 4**

**Summary Results from SI Participation Model: Variable in the Equation**

Dependent Variable: SI participation (Participated=1, otherwise=0)

	B	S.E.	Wald	df	Sig.	Exp(B)
Course instructors/SI leaders			220.344	14	.000	
English remediation	.666	.125	28.368	1	.000	1.945
Gender	.505	.114	19.758	1	.000	1.657
Cumulative GPA group			17.838	2	.000	
Student major (College)			10.963	8	.204	
Student level			5.956	3	.114	
Failure experience	-.307	.137	5.034	1	.025	.735
Math remediation	.255	.126	4.095	1	.043	1.290
URM	.203	.107	3.634	1	.057	1.225
Number of term enrolled	-.055	.043	1.651	1	.199	.946
New student type at entry	-.264	.233	1.289	1	.256	.768
FGS	-.088	.114	.589	1	.443	.916
Full Time	.136	.218	.391	1	.532	1.146
Constant	-4.086	.451	82.051	1	.000	.017

**Omnibus Tests of Model Coefficients**

		Chi-square	df	Sig.
Step 1	Step	466.389	36	.000
	Block	466.389	36	.000
	Model	466.389	36	.000

**Model Summary**

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	2618.301 <sup>a</sup>	.135	.219

**TABLE 5**

**Detailed Results from SI Participation Model: Variables in the Equation**

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Gender (Female compared to male)	.505	.114	19.758	1	.000	1.657	1.326	2.070
URM (URM compared to Non-URM)	.203	.107	3.634	1	.057	1.225	.994	1.510
FGS (FGS compared to CGS)	-.088	.114	.589	1	.443	.916	.732	1.146
English remediation (Requiring compared to Not requiring)	.666	.125	28.368	1	.000	1.945	1.523	2.485
Math remediation (Requiring compared to Not requiring)	.255	.126	4.095	1	.043	1.290	1.008	1.651
New student type at entry (FTF compared to new transfers)	-.264	.233	1.289	1	.256	.768	.486	1.212
Student level (Freshman as the comparison group)			5.956	3	.114			
Sophomore	.404	.166	5.926	1	.015	1.497	1.082	2.072
Junior	.353	.244	2.093	1	.148	1.423	.882	2.297
Senior	.478	.338	2.002	1	.157	1.613	.832	3.129
Student major (College, SPE as the comparison group)			10.963	8	.204			
JCAST	.246	.304	.658	1	.417	1.279	.706	2.319
COSS	.239	.319	.561	1	.454	1.270	.680	2.374
CHHS	.592	.276	4.603	1	.032	1.808	1.053	3.104
CSB	.401	.335	1.430	1	.232	1.493	.774	2.881
CAH	.152	.355	.182	1	.669	1.164	.580	2.333
KSOEHD	.054	.435	.016	1	.901	1.056	.450	2.475
LCOE	.514	.334	2.364	1	.124	1.671	.868	3.217
CSM	.294	.288	1.044	1	.307	1.342	.763	2.358
Full time (Full time compared to Part time)	.136	.218	.391	1	.532	1.146	.747	1.758
Course instructors/SI leaders (BIOL 10: Life Science as the comparison group)			220.344	14	.000			
BIOL 1A: Intro Biology	1.191	.239	24.841	1	.000	3.289	2.059	5.252
BIOL 1B: Intro Biology	.455	.344	1.748	1	.186	1.577	.803	3.097
BIOL 20: Intro Microbiol	2.201	.283	60.377	1	.000	9.031	5.184	15.732
BIOL 64: Funct Hum Anat	2.250	.234	92.364	1	.000	9.491	5.998	15.018
BIOL 65: Human Physiology	2.381	.246	93.584	1	.000	10.821	6.679	17.531
CHEM8: Elem Org Chem	2.724	.327	69.424	1	.000	15.247	8.033	28.940
CRIM50: Stat + Compr CJ	2.716	.434	39.139	1	.000	15.126	6.458	35.426
ECON 40: Prin Microecon	1.468	.314	21.849	1	.000	4.342	2.346	8.037
MATH 45: What Is Math	1.046	.203	26.500	1	.000	2.848	1.912	4.241
MATH 75: Calculus I	2.648	.268	97.774	1	.000	14.123	8.356	23.870
PHYS 2A: General Physics	1.324	.293	20.397	1	.000	3.760	2.116	6.679
PHYS 4A: Mech+Wave Motion	1.254	.357	12.322	1	.000	3.506	1.740	7.062
PLSI 2: Amer Govt Instit -Faculty/SI leader I	1.366	.211	41.763	1	.000	3.920	2.590	5.933
PLSI 2: Amer Govt Instit -Faculty/SI leader II	.843	.266	10.029	1	.002	2.323	1.379	3.913
Number of term enrolled	-.055	.043	1.651	1	.199	.946	.870	1.029
Cumulative GPA group (0-1.99 as the comparison group)			17.838	2	.000			
2-2.99	.155	.230	.454	1	.501	1.168	.744	1.834
3 or higher	.684	.248	7.613	1	.006	1.982	1.219	3.223
Failure experience (Having compared to Not have)	-.307	.137	5.034	1	.025	.735	.562	.962
Constant	-4.086	.451	82.051	1	.000	.017		



**TABLE 6**

**Results from SI Effect Model: Tests of Between-Subjects Effects\***

Dependent Variable: Course grade (A=4, B=3, C=2, D=1 and FWU=0)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2959.473	64	46.242	40.884	0.000	.459
Intercept	22.367	1	22.367	19.775	.000	.006
<b>Main effects</b>						
Course instructors/SI leaders	407.686	14	29.120	25.746	.000	.105
Cumulative GPA group	106.980	2	53.490	47.292	.000	.030
Math remediation	34.159	1	34.159	30.201	.000	.010
English remediation	26.730	1	26.730	23.633	.000	.008
Student major (College)	23.036	8	2.879	2.546	.009	.007
Lambda	18.148	1	18.148	16.045	.000	.005
Gender	15.671	1	15.671	13.855	.000	.004
URM	13.695	1	13.695	12.108	.001	.004
Term units enrolled	11.418	1	11.418	10.095	.002	.003
SI Participation	10.293	1	10.293	9.100	.003	.003
Cumulative units earned	3.373	1	3.373	2.982	.084	.001
FGS	2.831	1	2.831	2.503	.114	.001
<b>Interaction effects with SI participation</b>						
SI Participation * Course instructors/SI leaders	30.535	14	2.181	1.928	.020	.009
SI Participation * Student major (College)	7.936	8	.992	.877	.535	.002
SI Participation * Gender	4.907	1	4.907	4.339	.037	.001
SI Participation * Cumulative units earned	3.688	1	3.688	3.260	.071	.001
SI Participation * Cumulative GPA group	2.985	2	1.492	1.319	.267	.001
SI Participation * Math remediation	.377	1	.377	.334	.564	.000
SI Participation * Term units enrolled	.072	1	.072	.063	.801	.000
SI Participation * URM	.039	1	.039	.034	.854	.000
SI Participation * FGS	.012	1	.012	.011	.917	.000
SI Participation * English remediation	.004	1	.004	.003	.955	.000
Error	3489.322	3085	1.131			
Total	21284.000	3150				
Corrected Total	6448.795	3149				

\* R Squared = .459 (Adjusted R Squared = .448)

**TABLE 7**

**Estimated Marginal Means of Course Grade Based on the SI Effect Model<sup>2</sup>**

	SI Participation	Mean	Std. Error	95% Confidence Interval		Mean difference (SI-Non-SI)
				Lower Bound	Upper Bound	
Overall	Non-SI	1.274	.050	1.177	1.371	0.909**
	SI	2.183	.104	1.978	2.387	
<b>SI Participation * Course instructors/SI leaders</b>						
BIOL 10: Life Science	Non-SI	3.153	.075	3.006	3.300	0.809**
	SI	3.962	.177	3.615	4.309	
BIOL 1A: Intro Biology	Non-SI	1.342	.088	1.169	1.515	0.746**
	SI	2.088	.203	1.691	2.486	
BIOL 1B: Intro Biology	Non-SI	1.356	.120	1.121	1.591	0.985**
	SI	2.341	.325	1.704	2.978	
BIOL 20: Intro Microbiol	Non-SI	1.253	.160	.939	1.567	0.834**
	SI	2.087	.231	1.634	2.540	
BIOL 64: Funct Hum Anat	Non-SI	0.534	.140	.259	.809	1.307**
	SI	1.841	.191	1.466	2.215	
BIOL 65: Human Physiology	Non-SI	0.691	.153	.390	.991	1.085**
	SI	1.776	.203	1.377	2.175	
CHEM 8: Elem Org Chem	Non-SI	-0.147	.239	-.615	.321	1.89**
	SI	1.743	.275	1.203	2.282	
CRIM 50: Stat + Compr CJ	Non-SI	2.419	.268	1.894	2.943	-0.169
	SI	2.25	.366	1.532	2.967	
ECON 40: Prin Microecon	Non-SI	0.996	.134	.733	1.258	0.605
	SI	1.601	.284	1.045	2.158	
MATH 45: What Is Math	Non-SI	1.495	.066	1.365	1.624	0.964**
	SI	2.459	.154	2.158	2.760	
MATH 75: Calculus I	Non-SI	0.439	.171	.104	.774	0.76
	SI	1.199	.231	.746	1.652	
PHYS 2A: General Physics	Non-SI	1.214	.114	.991	1.437	1.075**
	SI	2.289	.257	1.785	2.793	
PHYS 4A: Mech+Wave Motion	Non-SI	1.465	.138	1.195	1.736	0.773
	SI	2.238	.333	1.585	2.890	
PLSI 2: Amer Govt Instit - Faculty/SI leader I	Non-SI	1.427	.080	1.269	1.585	0.779**
	SI	2.206	.164	1.885	2.527	
PLSI 2: Amer Govt Instit - Faculty/SI leader II	Non-SI	1.474	.099	1.280	1.668	1.187**
	SI	2.661	.241	2.188	3.134	
<b>SI Participation * Gender</b>						
Female	Non-SI	1.215	.059	1.098	1.331	0.787**
	SI	2.002	.120	1.766	2.237	
Male	Non-SI	1.333	.052	1.231	1.435	1.031**
	SI	2.364	.117	2.135	2.593	
<b>SI Participation * Cumulative GPA group</b>						
0-1.99	Non-SI	0.759	.079	.603	.914	1.156**
	SI	1.915	.229	1.465	2.364	
2-2.99	Non-SI	1.218	.049	1.123	1.314	0.753**
	SI	1.971	.104	1.767	2.176	
3 or higher	Non-SI	1.845	.069	1.711	1.979	0.817**
	SI	2.662	.110	2.446	2.879	

\* Covariates appearing in the model are evaluated at their mean values.

\*\* means that the mean difference is significant at the .05 level.

## APPENDIX

### Methodological Notes On Two-Stage Sample Selection Approach

A common issue in evaluating the effects of SI is self-selection given that students voluntarily choose to participate. That choice may be made based on some reason that is not measured or measurable, such as students' motivation. Without accounting for such factors, an estimate of the effects of SI on students' performance would be biased. In this study, we employed the approach of two-stage sample selection models to handle this issue (which is also called the propensity score adjustment approach). The two-stage sample selection modeling approach consists of two models: SI participation model in the first stage and SI effects model in the second stage. The SI participation model would generate a sample selection correction factor, called Lambda, which is the probability of students participating in SI sessions. This value is then incorporated into the SI effects model to reduce the bias in the estimates of the SI effect.

#### Stage 1: SI participation model

To project the probabilities of students participating in SI, we employed logistic regression using 13 factors including Gender, URM, FGS, English remediation status, Math remediation status, New student type at entry, student level, students' majors (college), Full/part time status, course instructors/SI leaders, number of terms enrolled, cumulative GPA group in the beginning and previous failure experience. The projected probabilities of students participating in SI are saved as the values of the sample selection correction factor, Lambda. These values are then incorporated into the SI effect model (See Table 4-5).

#### Stage 2: SI effect model

The SI effect model estimates the effect of SI in students' course grades after adjusting for the self-selection bias and controlling other factors' influences. Dependent variable (DV) is course grades (A=4, B=3, C=2, D=1 and F/WU=0) and the independent variable (IV) of interest is SI participation status (0 for Non-SI students and 1 for SI students). The model also includes the sample selection correction factor (Lambda) and the other 10 factors (Gender, URM, FGS, English remediation status, Math remediation status, cumulative units earned in the beginning, students' majors (college), term units enrolled, course instructors/SI leaders, cumulative GPA group in the beginning). Furthermore, to identify how the effect of SI participation is moderated by other factors, the interaction terms of 10 factors with SI participation status are added in the model (See Table 5-7).