Supplemental Instruction Outcomes

Spring 2019

BMCC

Office of Institutional Effectiveness and Analytics

April 8, 2019

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Executive Summary

As part of an effort to help students succeed in challenging courses, BMCC has introduced a program of "supplemental instruction" (SI) in selected sections where an in-class tutor follows along with the students in the class and offers support in or outside of class sessions to help students with the topics covered. This report looks first at the outcomes for the class sections where this is offered compared to other sections of the course that do not have SI. Next, the individual students become the unit of analysis, and the results are compared within these classes for students to take advantage of the outside of class sessions compared to those who do not. This portion of the report also looks at effect of the number of times a student attends the sessions with the SI tutor. In this case, students who attend at a given frequency are paired with classmates in that course who are at a similar level in terms of credits and starting GPA, but who do not attend any SI sessions.

Significant effects for the SI program were found for remedial courses using it, and in spring 2018 the overall effects for SI instruction sections and for SI in remedial courses could be more readily confirmed because of the number of sections involved. However, once we were able to control for other significant variables affecting outcomes at the individual level, the impact of SI on the fall performance levels was actually slightly higher than in the spring. Within these SI sections, results showed that attending even once predicted better results for the student compared to similar students in the class, and there is some evidence of a relationship between the frequency of attending SI sessions and course pass rate.

The number of students involved is most often small, so finding significant differences does not happen in every instance. It is also important to remember that students who are more motivated to succeed may be more likely to seek out the additional help. At the same time, students who are struggling less with the material may not feel the need for this support and may prefer to learn on their own. The faculty and individual tutors will not all have the same relationship or style of working.

This study cannot take into account all the factors that will color the outcomes for the students or the pass rate for the section. However, using the data available, we can construct models that take into account some of the variation that occurs and can help determine the strength of the program's effect on students' semester GPA at the end of the semester and on the probability of the student passing the SI requested course.

Distribution of Supplemental Instruction

Supplemental instruction participant size of each term was listed below:

- 197 students in the fall term of 2016
- 289 students in the spring term of 2017
- 453 students in the fall term of 2017
- 479 students in the spring term of 2018.

Original SI visit times produced a right skewed distribution shown in charts 1 and 2. Raw data of visit times were not directly included into the regression model because skewed SI visit times made hypothesis testing easy to be rejected and biased the decision. This report recoded SI visit times into three categories, one to two times, three to four times, and more than four times, for pass rate comparison in the following tables.

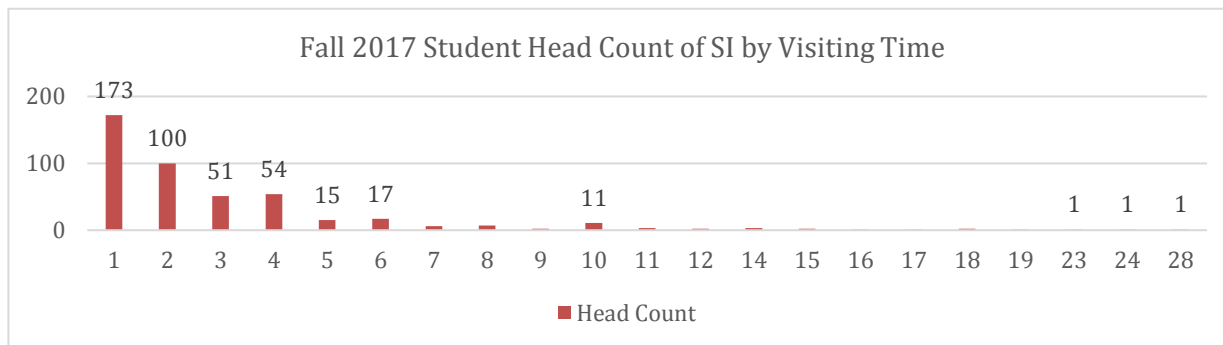*Chart 1. Fall 2017 SI Visit Times Distribution*

Fall 2017 Student Head Count of SI by Visiting Time

Chart 2. Spring 2018 SI Visit Times Distribution

Spring 2018 Student Head Count of SI by Visiting Time
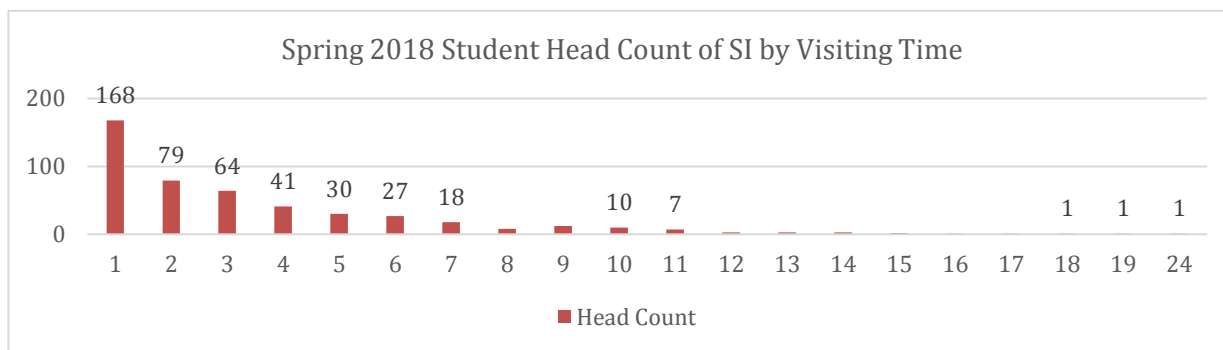
Table 1. Recoded Fall 2017 SI Visit Distribution

Recoded Frequency	Head Count	Percentage
Attended SI 1-2 Times	273	60.3%
Attended SI 3-4 Times	105	23.2%
Attended More Than 4 Times	75	16.6%
Total	453	100.0%

Table 2. Recoded Spring 2018 SI Visit Distribution

Recoded Frequency	Head Count	Percentage
Attended SI 1-2 Times	247	51.6%
Attended SI 3-4 Times	105	21.9%
Attended More Than 4 Times	127	26.5%
Total	479	100.0%

Evaluation method

This report investigated supplemental instruction (SI) effects on students' academic performance using a modified matching method and regression analysis. This modified matching method is introduced in Appendix I; it allows for the comparison of students receiving SI and similar students who do not. The sample size of those receiving SI in fall 2016 and spring 2017 was not large enough to break down outcomes

by semester, with 486 participants for the whole year, compared to 453 in fall 2017 and 479 in spring 2018 after data cleaning. Thus, in the following tables, results by term are only presented for the 2017-18 academic year.

Not every section of a course was assigned with SI tutors, so classes with SI should be compared to the other classes in the same course series that did not have SI. For example, in the fall term 2017, only section 1200 of MAT 14 was assigned with SI, and the other 4 sections of MAT14 courses were not with SI. Thus, this report evaluated classes with SI only compared to the classes with the same course code created by department code combined with course number.

Table 1 compared outcomes for those sections that had SI with those in the same course type that did not. These data were simply overall rates, and while significant differences were found, we could not be certain that the SI sections had better results because of SI.

I. Sections as Analysis Unit

Table 3. Course Pass Rate Average Comparison among Subjects

	Group	Sections	Fall 2016 & Spring 2017	Sections	Fall 2017	Sections	Spring 2018
SI and no SI matched courses	SI	75	61.2%	42	59.3%	47	68.9%**
	Non SI	1,359	63.5%	574	63.2%	445	59.3%
Remedial All Subjects	SI	48	54.3%*	23	49.5%*	23	59.8%**
	Non SI	904	45.6%	386	41.7%	322	46.0%
MATH (compared to the same course)	SI	7	57.3%	9	55.2%	19	56.7%
	Non SI	252	39.1%	154	45.9%	305	55.4%
Non-Remedial MATH	SI	1	88.6%	2	75.2%	10	65.5%
	Non SI	3	87.5%	35	59.3%	166	66.5%
Remedial MATH	SI	6	52.1%	7	49.5%	9	47.0%
	Non SI	249	38.5%	119	41.9%	139	42.0%
ESL	SI	37	53.9%	15	49.6%	14	68.0%
	Non SI	67	56.7%	35	47.8%	25	61.9%

Note. T-test * $p < .05$, ** $p < .01$

II. Student as Analysis Unit

For the analysis of this section, each student who attended any SI session(s) was paired with a classmate who had a similar cumulative GPA and had a similar level of credits/hours but did not attend Supplemental Instruction. Pass rates for both groups were reported and averaged compared for statistical significance.

Table 4. Course Outcome Comparison between SI Participants and Paired Classmates

All Course	Fall 2017			Spring 2018		
	Total in group	Pass Rate	Semester GPA	Total in group	Pass Rate	Semester GPA
Students attending SI sessions (SI Group)	453	67.3%*	2.76*	497	74.7%*	2.81
Matched Group	453	60.0%	2.55	497	68.5%	2.67

Note. T-test * $p < .05$

All Course Pass Rate

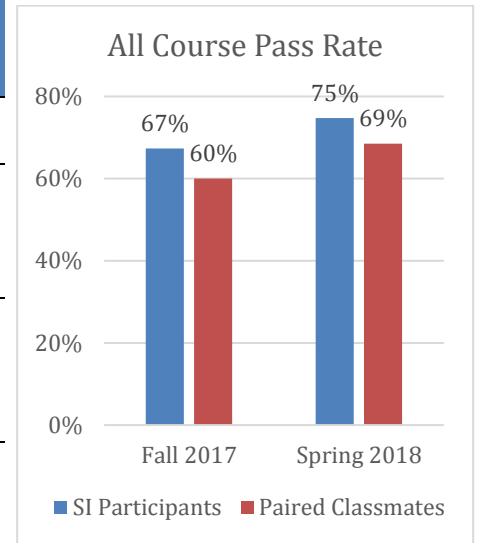|	Fall 2017	Spring 2018
SI Participants	67%	75%
Paired Classmates	60%	69%

■ SI Participants ■ Paired Classmates

Table 5. Course Outcomes Based on Frequency of Attending SI Sessions

Overall SI	Group		Attended SI 1-2 Times	Attended SI 3-4 Times	Attended SI 5 Times or More
Fall 2017	SI Group	Pass Rate	63.4%	65.7%	84.0%*
	Matched Group	Pass Rate	58.6%	59.0%	66.7%
		Sample Size	273	105	75
	SI Group	S, B or Better [1]	54.6%	59.0%	72.0%
	Matched Group	S, B or Better	51.6%	56.2%	60.0%
Spring 2018	SI Group	Pass Rate	74.1%	71.4%	78.7%
	Matched Group	Pass Rate	67.6%	70.5%	68.5%
		Sample Size	247	105	127
	SI Group	S, B or Better	60.3%	60.0%	71.7%
	Matched Group	S, B or Better	54.3%	61.0%	61.4%

Note. T-test * $p < .05$

1. B or Better included A, A-, B, and B+, but did not include B-.

Table 6. Math Course Pass Rates for All SI Participant and Paired Classmates

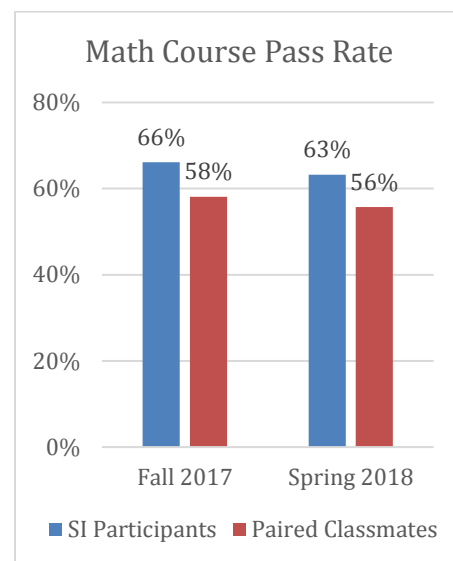| MATH	Fall 2017			Spring 2018		
	Total in group	Pass Rate	Semester GPA	Total in group	Pass Rate	Semester GPA
Students attending SI sessions	124	66.1%	2.73	185	63.2%	2.57
Matched Group	124	58.1%	2.92	185	55.7%	2.36

Math Course Pass Rate

Table 7. Math Course Outcomes Based on Frequency of Attending SI Sessions.

MATH	Group		Attended SI 1-2 Times	Attended SI 3-4 Times	Attended SI 5 Times or More
Fall 2017	SI Group	Count pass %	48.8%	68.8%	82.9%
	Matched Group	Count pass %	56.1%	54.2%	65.7%
		Sample Size	41	48	35
	SI Group	S, B or Better	39.0%	68.8%	71.4%
	Matched Group	S, B or Better	46.3%	54.2%	57.1%
Spring 2018	SI Group	Count pass %	62.0%	53.5%	70.4%
	Matched Group	Count pass %	54.9%	58.1%	54.9%
		Sample Size	71	43	71
	SI Group	S, B or Better	39.4%	37.2%	63.4%*
	Matched Group	S, B or Better	35.2%	44.2%	46.5%

Note. T-test * $p < .05$

Table 8. Remedial Math Course Pass Rates for All SI Participant and Paired Classmates

Remedial MATH	Fall 2017		Spring 2018	
	Total in group	Pass Rate	Total in group	Pass Rate
Students attending SI sessions	100	62.0%	82	48.8%
Matched Group	100	53.0%	82	50.0%

Remedial Math Pass Rate

(Bar chart: Fall 2017 — SI Participants 62%, Paired Classmates 53%; Spring 2018 — SI Participants 49%, Paired Classmates 50%)
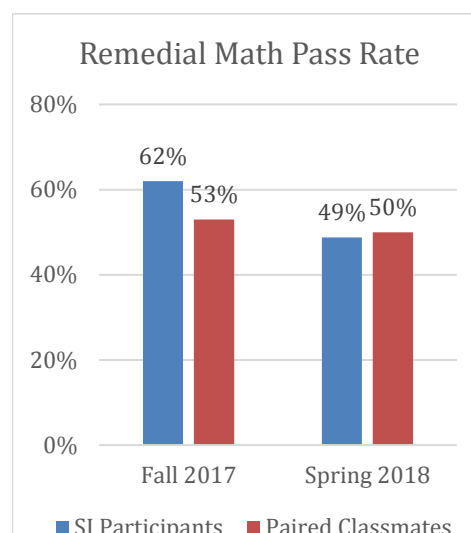
■ SI Participants ■ Paired Classmates

Table 9. Remedial Math Course Outcomes Based on Frequency of Attending SI Sessions.

Remedial MATH	Group		Attended SI 1-2 Times	Attended SI 3-4 Times	Attended SI 5 Times or More
Fall 2017	SI Group	Count pass %	36.7%	69.6%	79.2%
	Matched Group	Count pass %	53.3%	52.2%	54.2%
		Sample Size	30	46	24
Spring 2018	SI Group	Count pass %	36.0%	52.6%	55.3%
	Matched Group	Count pass %	56.0%	42.1%	50.0%
		Sample Size	25	19	38

Note. 1. Students taking Remedial MATH receive "Satisfactory" or "Repeat" (S or R) grades and no GPA credits, so the calculation for outcome comparison was only based on the enrolled courses passed or not.

2. The p value of fall 2017 SI compared to the matched group with 5 times or more was 0.066.

Table 10. Math 56 Pass Rate for SI Participants and Paired Classmates

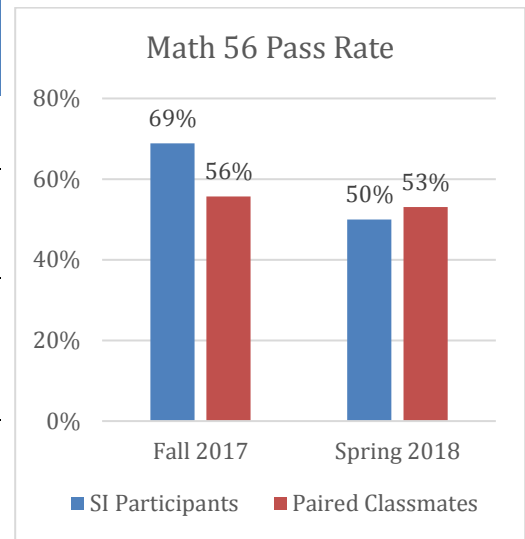| MATH 56	Fall 2017		Spring 2018	
	Total in group	Pass Rate	Total in group	Pass Rate
Students attending SI sessions	61	68.9%	64	50.0%
Matched Group	61	55.7%	64	53.1%

Math 56 Pass Rate

Table 11. Math 56 Course Outcomes Based on Frequency of Attending SI Sessions.

MATH56	Group		Attended SI 1-2 Times	Attended SI 3-4 Times	Attended SI 5 Times or More
Fall 2017	SI Group	Count pass %	30.8%	77.8%	83.3%
	Matched Group	Count pass %	46.2%	61.1%	50.0%
		Sample Size	13	36	12
Spring 2018	SI Group	Count pass %	41.2%	46.2%	55.9%
	Matched Group	Count pass %	70.6%	46.2%	47.1%
		Sample Size	17	13	34

III. SI predictive modeling for improved GPA and success rate: controlling for other factors

Based on previous research, some factors other than SI that have been found to have a significant effect on students' outcomes include cumulative GPA before tutoring, full time/part time status, ethnicity, age, and previous tutoring experience. We included these variables in the regression model to compare their strength to predict successful outcomes with the strength of just being in an SI section.

After the significant variables affecting student outcomes were analyzed, it was found that improved academic performance in fall was a bit higher than in spring, and larger effect sizes were found for math courses than were found for the other SI subjects. The regression model and controlled variables are listed in Appendix III, and technical explanation of statistics for SI effects are explained in Appendix IV.

Table 12 provides two measures of success related specifically to SI.

> Increase in Semester GPA Predicted by SI: Using All Courses with SI Available as an example, the coefficient value of SI participation in the model was 0.15. That means that SI Participation had a predicting effect on a student's semester GPA, related to an average increase of 0.15 points for these students.

> Probability of Passing Courses Related to SI: Again, using All Courses with SI Available as an example, the probability of passing related to SI participation, 67.3%, means that if a student participated in SI, he/she would have a 67.3% chance to pass a certain class with assigned SI assistance, and this chance was greater than randomness (50.0%).

Table 13 provides three measures of success related specifically to SI.

> Odds Ratio: Take the odds ratio of overall SI participants for example. Odds ratio with a value of 1.37 meant for every 100 students without participating in SI passing their courses, there would be 137 SI participants who passed their courses.

> Odds Related to SI: Take the odds of overall SI participants for example. Odds related to SI with a value of 2.06 meant that for every SI participant who failed his/her course, there would be 2 SI participants who passed their courses.

> SI Participation Effect Size: Take mathematics courses with SI assistance for example. The value of the standardized coefficient, 0.22, meant that the SI effect on assisting students to pass their math courses was around medium level. In addition, mathematics courses were the only course found with significant SI effect.

Table 12. Comparison among Groups for SI Effects on Increased Semester GPA and Probability of Passing Courses

Analysis Group / Subject	Semester GPA mean difference (SI versus paired classmate)	Increase in Semester GPA Predicted by SI	Probability of Passing Courses Related to SI [1]
Fall 2017			
All Courses with SI Available	2.76 versus 2.55*	0.15	67.30%
ESL Courses	2.93 versus 2.63*	0.04	53.29%
Remedial Courses	2.46 versus 2.27 (Imputed GPA[2])	0.22	57.79%
Mathematics Courses	2.69 versus 2.31	0.52	60.06%
Remedial MATH	2.49 versus 2.12 (Imputed GPA)	0.49	57.65%
MAT 56	2.69 versus 2.29 (Imputed GPA)	0.59	61.40%
Spring 2018			
All Courses with SI Available	2.81 versus 2.67	0.12	59.15%
ESL Courses	3.01 versus 2.83	0.07	72.30%
Remedial Courses	2.77 versus 2.57 (Imputed GPA [2])	0.22	52.96%
Mathematics Courses	2.56 versus 2.38	0.21	60.06%
Remedial MATH	2.42 versus 2.34 (Imputed GPA)	0.29	54.83%
MAT 56	2.50 versus 2.49 (Imputed GPA)	0.32	56.60%

Note. * $p < .05$
1. Passing Probability Related to SI = Odds related to SI /(1+ Odds related to SI). Please refer to Appendix IV for explanation and formula of odds related to SI.
2. Because developmental or remedial courses do not count toward the GPA, the analyses imputed GPA based on the course outcome (pass or not pass) and number of hours of instruction.

Table 13. Comparison among Groups for SI Effects on SI Effect Size and Odds Ratio

Analysis Group / Subject	SI Participation Effect Size (Standardized Coefficient)	Odds Ratio	Odds Related to SI
Fall 2017			
All Courses with SI Available	0.07	1.37*	2.06
ESL Courses	0.02	1.18	1.14
Remedial Courses	0.09	1.37	1.31
Mathematics Courses	0.22*	1.50	1.95
Remedial MATH	0.19	1.36	1.63
MAT 56	0.23	1.59	2.21
Spring 2018			
All Courses with SI Available	0.06	1.45*	2.96
ESL Courses	0.07	1.33	2.61
Remedial Courses	0.09	1.17	1.77
Mathematics Courses	0.09	1.50	1.72
Remedial MATH	0.11	1.21	0.95
MAT 56	0.13	1.30	1.00

Note. * $p < .05$

Appendix

I. Data preparation and matching method for supplemental instruction (SI) evaluation

Before evaluation, the analytic data set was sorted by course ID (created by subject, catalog, section, and term) and each student's cumulative GPA at the beginning of that term. Before sorting, this report recoded students' cumulative GPAs prior to receiving SI into a five category GPA ranking variable with.

- Missing GPA as Level 1
- 0 to 0.9 as Level 2
- 0.9 to 1.9 as Level 3
- 1.9 to 2.9 as Level 4
- 2.9 to 4.0 as Level 5.

Then, students were ranked by this previous term cumulative GPA level, and students within the same category of GPA level were sorted again by their enrolled credits plus hours shown records. This approach was to assure that after this sorting, students having similar academic baselines ranked one case below or above students receiving SI. After conducting this sorting, this report created another variable to identify matching classmates, which was the case ranked one case (previous term cumulative GPA) above the student who received SI. In this report, the student identified as a matched classmate was the closest in academic baseline to the student receiving SI. The assumption is that the level of academic performance at the beginning of the term is the most critical factor to control for. Using the matching student ranked just above the level of the SI student should help avoid overestimating the intervention effect of SI, which could happen if we matched with students who ranked one case below those receiving SI.

The matching method was based on ranking by cumulative GPA and enrolled credits/hours. Some students in the pool were matched to two SI participants due to similar academic levels after ranking. These students were marked out and controlled in the model. After the above data preparation process, the data set used for evaluating SI effect consisted of students who received SI and paired classmates of SI participants.

II. Comparison units

Sections as Analysis Unit

Two variables from the instructor course file, subject and catalog number, were combined into an identification key. Within an identification key, each section of a class was labeled as SI or non-SI class. Then the number of students who passed each section of a class was aggregated to compute the pass rate.

Student as Analysis Unit

A student participating in SI was paired with a classmate of one case higher in the ranking by his/her cumulative GPA level at the beginning of the SI term and enrolled credits plus hours shown records. Then the course grade file merged to SI list was sorted, and an SI participant was paired with a student located within the similar academic level with him/her.

III. Controlled variables for effect size calculation

Modeling for SI effect size must be conducted on cases in pairs. Before modeling, cases were filtered by the examined subject. Then the data set confirmed that each SI participant for the modeling was paired with a classmate, and unmatched students were excluded.

Logistic regression modeling was used to compute the likelihood of passing the course. This is based on the official pass rate of those who passed as a percentage of all enrolled students. Regression modeling was used to compute effect size of SI and students' improved GPAs. This is based on the semester GPA achieved at the end of the term. Investigated categories for SI effect evaluation were Subjects of SI courses, remedial courses with SI, and students' ethnicity.

Controlled background variables in logistic and regression models for table 10 and 11 of Section III are introduced below:

- Ethnicity: Dummy coded background variables into Asian, Black, Hispanic, and White

- Gender: Male (1) or not (0)

- Age: Under19 (1) or not (0)

- Fulltime: Enrolled in full time (1) or not (0)

- The Cumulative GPA at the beginning of the term of SI participation

- Major

- New Freshmen: Whether a student was a Cohort 2017 new freshman (1) or not (0)

- Previous experience of SI participation in year 2016.

IV. Supplemental Instruction Effects: Explaining the Statistics Used

The following is explanation for statistics described in prediction modeling for semester GPA ad success rate not mentioned in Section III.

Increase in Semester GPA Predicted by SI: Improved GPA predicted by SI reflects how much higher the GPA was for SI participants compared to paired classmates without SI from the unstandardized regression coefficient (See Table 12 of Section III).

Probability of Passing Related to SI: Passing Probability predicted by SI reflects the possibility of passing a course with SI participation (See Table 12 of Section III). This was calculated using the odds of the logistic regression to predict course passing or not.

SI Participation Effect Size: Effect size was the index computed from the standardized regression coefficient used to understand which subjects with SI had greater effects on students' final grade (See Table 13 of Section III). Since the value of this index has been standardized, they could be compared across subjects regardless of unit difference. Conventionally, the value not larger than 0.1 was treated as a small effect, 0.1 to 0.3 was treated as a medium effect, and 0.3 to 0.5 was treated as a large effect.

Take math courses with SI assistance for example. The value of the standardized coefficient, 0.22, meant that the SI effect on assisting students to pass their math courses was around medium level.

Odds Ratio: It was calculated from a natural exponential function with a base of e and a power of the coefficient of a logistic regression model. It meant that the odds of receiving SI to pass one class divided by the odds of "not" receiving SI to pass the same class (See Table 13 of Section III).

Take the odds ratio of overall SI participants for example. Odds ratio with a value of 1.37 meant that for every 100 students without participating in SI passed their courses, there would be 137 SI participants who passed their courses.

Odds Related to SI: It was calculated from the exponent of the coefficient plus the constant of a logistic regression model of SI to predict being passed or failed in one class. It meant that the chance of one student who received SI to pass one class compared to the chance of being failed in the same class (See Table 13 of Section III). The statistics was used to compute passing probability related to SI in Table 12 of Section III.

Take the odds of overall SI participants for example. Odds related to SI with a value of 2.06 meant that there would be around 2 SI participants who passed their courses with one SI participant who failed his/her course.