Board 24: Sustainable Bridges from Campus to Campus: Progress after Year 2

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Sustainable bridges from campus to campus: Progress after Year 2

(NSF IUSE #1525367)

Abstract

Purpose: The purpose of the *Sustainable Bridges from Campus to Campus* study (NSF IUSE #1525367) is to increase the number of underrepresented students (i.e., African American, Native American, Hispanic American students) in undergraduate Engineering majors. By doing so we strive to address the urgent need to expand the pool of undergraduates who earn a Science, Technology, Engineering, and Math (STEM) degree. This paper describes progress in Year 2 of the project with a focus on Cohort 2.

Goals: To improve retention in Engineering, this study conducts academic enrichment programs for racially underrepresented Engineering students at three points in their career at the Pennsylvania State University—entering first-year students, rising sophomores, and rising juniors. The goals of the study are to (a) increase retention in Engineering among racially underrepresented students in the Pennsylvania State University system, (b) develop long-term sustainability plans for these enrichment programs, and (c) compare retention rates in Engineering depending on whether students attended a summer academic enhancement program at the regional campus they attend in the fall or at a different campus and whether they transfer between campuses within the University system (native students vs. 2+2 students).

Method: Students in the summer bridge programs for incoming first-year students and rising sophomores attend 4- or 6-week summer programs that provide math-intensive curriculum, the application of Engineering concepts, and the development of a cohort learning community. The summer bridge programs for incoming first-year students consist of 5 summer bridge programs across 4 campuses in the University system. For the summer bridge program for rising sophomores, Engineering students from any campus in the University system go to the flagship campus. To assess the effectiveness of these academic enhancement programs for undergraduate Engineering majors, we examine math course grades, fall semester grade point average, and enrollment status for students who participated in our programs and a matched sample of students who did not participate. To date, we are tracking the academic progress of two cohorts of first-year students from summer 2016 and 2017 and one cohort of rising sophomores from summer 2017.

Results: There were 94 first-year bridge students in 2017. Students who participated in the math-intensive summer bridge programs earned statistically higher grades, by half a letter grade, in their first college math course compared to the matched comparison sample. Summer bridge students were significantly more likely to earn a C or better in their first college math course (66%) than the comparison sample (52%). High school grade point average and SAT Math scores independently and significantly predicted the first math course grade in a positive direction for the summer bridge students but not for the comparison sample.

Overview of the Project Goals and Objectives

The current research seeks to accomplish three goals: (1) Increase retention in Engineering among racially underrepresented engineering students by extending a successful summer bridge model and transition program to regional campuses in the Penn State system, (2) Develop long-term sustainability plans for these programs, and (3) Compare the efficacy of three different bridge models. The **primary outcome measure is retention in baccalaureate Engineering majors following the Entrance to Major process at the beginning of the junior year** (i.e., enrollment in a specific major). Secondary outcome measures are retention in STEM majors and retention at the University. This research is generously funded by the National Science Foundation (NSF IUSE #1525367). Please note that any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

The **Intellectual Merit** of this research is two-fold: examine variation in Engineering retention for three models of bridge programs and produce a series of workshops on Engineering bridge leadership, funding, and sustainability strategies for Engineering summer bridge programs. The goal of each math-intensive bridge program is to provide academic, social, and geographic exposure for groups of 15 to 30 incoming students. The three models differ by students' transfer status (native or transfer student) and bridge location (assigned campus or campus different from assigned campus). For Model 1, incoming students at the flagship University Park campus attend the summer bridge at that campus (~25 students) and do not make a campus transition. For Model 2, incoming students (~30 students) from approximately 16 regional campuses attend a summer bridge at the University Park campus, complete the first two years at their regional campus, and transition to University Park as juniors. For Model 3, incoming students at 3 regional campuses attend a summer bridge at their own campus (~15 students per campus), complete the first two years at that campus, and then transition to University Park as juniors. The three models are applied to five bridges. As part of a comprehensive program, all participants will also be offered professional development seminars during the freshman year, an additional math-intensive 4-week summer bridge for rising sophomores (Calculus II, Differential Equations, Physics II), and transition programming to assist in acclimating to the University Park campus for rising juniors. Bridge programs are successful for only as long as they exist. Sustainability of summer bridge programs is a significant challenge because of their annual expense and the ongoing need to raise university, industry or external funds to support them. We propose to develop a learning community among the regional campus Engineering bridge leaders and conduct a series of workshops on fund-raising and sustainability strategies for the 3 regional campuses with new summer bridge programs for incoming underrepresented Engineering students.

The **Broader Impact** of increasing the retention of students in baccalaureate Engineering majors is derived from the urgent need to expand the pool of STEM graduates, especially racially underrepresented students (African American, Hispanic American, Native American). That need is documented in a series of monographs by major government and scientific councils. Penn State is comprised of the flagship University Park campus and 19 regional undergraduate campuses. About 60% of Penn State students opt for the "2+2 plan" by completing the first two years of their education at a regional campus and then transitioning to the University Park

campus for the last two years. For over 20 years, Penn State has offered a traditional Engineering bridge program for underrepresented students who start their education at the University Park campus. For 11 years, a second Engineering bridge program at the University Park campus has served underrepresented Engineering students who will start their Penn State education at one of 19 regional undergraduate campuses. Historically, the regional campuses have not offered local summer bridge programs. Based on preliminary success starting STEM bridge programs with predominantly white, first generation populations at 3 regional campuses (NSF-STEP Toys'n MORE project #0756992), the research implements 3 new bridge programs at the regional campuses with the largest populations of underrepresented Engineering students in the Penn State system. Because these regional campuses have not had summer bridge programs, they do not have a sustainability plan or bridge program staff. Long-term improvements in the pipeline of a diverse STEM workforce starts with sustaining effective bridge programs that can produce more Engineering baccalaureates. Sustainability starts with understanding the funding process at each campus.

The Data to Date

The purpose of this interim progress report is to document the performance of the Cohort 2 summer bridge students and the matched comparison sample of incoming first-year Engineering students in Year 2 of the Project. Based on the academic performance of Cohort 1, two additional interventions were implemented for Cohort 2. First, the number of weeks for the Academic Summer Experience and Pre-First Year in Engineering and Science bridge programs were increased from 4 to 6 weeks. Second, a 1-credit fall semester first-year experience course was initiated for the bridge students in the PSU Abington, Altoona, and Berks programs so the program faculty could continue to engage with and monitor the bridge students through the first semester of college. The course content of the first-year experience courses focused on college success skills. Please note that the data are not yet mature enough to address the research questions outlined in the grant proposal.

Method

Participants

The 2017 summer bridge participants were 94 incoming undergraduate students in Engineering or Science at Penn State. To have a benchmark against which to evaluate the first-semester performance of the summer bridge students, we compared them against a matched comparison sample. We matched the bridge students with 94 incoming Engineering or Science majors from their Penn State campus who were similar on gender, race/ethnicity, and SAT Math scores (within one standard deviation). Table 1a shows the aggregated demographic characteristics of the bridge students and the comparison sample. (Table 1b shows the demographic characteristics for each bridge program.) Sixty-five percent of the sample was male (n = 122). Participants and comparison students described themselves as Native American or Pacific Islander (n = 4), African American (n = 70), Asian American (n = 12), Hispanic American (n = 48), White (n = 50), and International (n = 4). For the purposes of this study, 65% were underrepresented students in Engineering (defined as Native American or Pacific Islander, African American, or Hispanic American). Twenty-nine percent of the summer bridge students (n = 27) indicated they

were first-generation college students, whereas 15% of the comparison students were first-generation college students (n = 14).

Summer bridge participants were recruited with letters mailed to their homes describing the programs sent to students admitted to Penn State. Recruitment focused on students who were racially underrepresented in Engineering, female, and first-generation college students.

Procedure

The five first-year summer bridge programs commenced at the end of June 2017 and ran for either 4 weeks or 6 weeks. The summer bridge participants provided informed consent to allow examination of their background characteristics and academic performance using information in the Penn State Data Warehouse.

Table 1a. Background Characteristics for Cohort 2 Bridge Students and the Matched Comparison Sample

	Bridge Students		Matched Comparisons	
Variables	N	%	N	%
Gender				
Male	61	65	61	65
Female	33	35	33	35
Ethnicity				
African American	35	37	35	37
Asian	6	6	6	6
Hispanic	24	26	24	26
Native Am/Pacific Islander	2	2	2	2
White	25	27	25	27
International	2	2	2	2
First-Generation College Student	27	29	14	15
# Dropped Math Course Fall Semester	12	13	19	20

Note: N = 188.

Table 1b. Background Characteristics of the 2017 Summer Bridge Students by Program

	Summer Bridge Program											
	PSU Abington		PSU Altoona		PSU Berks		Academic Summer Experience		Pre-First Year in Engineering and Science		Grand Total	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Gender												
Male	15	83	7	47	14	67	8	73	17	59	61	65
Female	3	17	8	53	7	33	3	27	12	41	33	35
Ethnicity												
African Am	6	33	2	13	3	14	8	73	16	55	35	37
Asian	3	17	1	7	1	5	0	0	1	3	6	6
Hispanic	2	11	2	13	6	29	2	18	12	41	24	26
Native Am	1	6	0	0	0	0	1	9	0	0	2	2
White	6	33	8	53	11	52	0	0	0	0	25	27
International	0	0	2	13	0	0	0	0	0	0	2	2
First-Generation College Student	7	39	3	20	7	33	4	36	6	21	27	29

Note: $N = 94$.

Results

Pre-College Academic Indicators

Academic performance data for high school and for the first semester of college are shown in Tables 2 to 5 for the summer bridge students and matched comparison sample. As shown in Table 2, the bridge students and matched comparison students were very similar on pre-college academic indicators. On average, the Cohort 2 summer bridge students scored 582 on the SAT Math exam and earned a 3.5 high school grade point average. Incoming students are required to take a math-placement exam based on ALEKS, which is web-based educational software for assessment and learning originally developed using NSF funding. Scores on the math-placement exam can range from 0 to 100 and are used to assign the math course that students enroll in for the first semester of college. It is optional to take the ALEKS math-placement exam more than once. Forty-five summer bridge participants (48%) took the math-placement exam a second time. Five students (5%) took the exam a third time. By comparison, 20 in the matched sample (21%) took the math placement exam a second time, and 4 took it a third time. The average ALEKS math-placement score (first-time taken) for the 94 participants was 68, which corresponds to placement in college Trigonometry. As intended, there was no statistical difference in SAT Math

scores between the bridge participants and the comparison sample. Similarly, the two groups did not differ statistically on high school grade point average or their first ALEKS math score, suggesting that the two groups were similar academically prior to the summer bridge programs.

First-Semester College Academic Performance

Cohort 2 is in their second semester of college as of this writing. Thus, there is limited college academic performance and retention data for them. However, we examined several objective indicators that were available: fall semester math course grades, fall semester grade point average, and spring semester enrollment at the University. The data are shown in Table 2 for the bridges combined and in Tables 5a and 5b for the programs separately. Math course letter grades were converted to a numeric grade point equivalent using a standard scale (e.g., A = 4.0, F = 0.0). Students who participated in the math-intensive summer bridge programs earned statistically higher grades, by half a letter grade, in their first college math course compared to the matched comparison sample (see Table 2, lower portion). On average, summer bridge participants earned between a C+ and a B- (M = 2.5) versus the comparison sample that earned a C (M = 2.0) in their first math course. To further examine differences in first college math course grades between the two groups, students were coded as either earning a C or better or earning a D/F/W (withdraw) from the course. Table 3 shows the cross tabulation. A Chi-square analysis indicated a significant effect such that summer bridge students were more likely to earn a C or better in their first college math course (66%) than the comparison sample (52%) [$\chi^2(1) = 3.72$, $p = .05$]. Because dropping a math course has implications for progressing through the Engineering major successfully, we conducted a similar analysis that examined whether the two groups of students differed in their likelihood of dropping their first-semester college math course. Table 4 shows the number of students who dropped their first college math course. Twelve of the bridge students versus 19 of the comparison students dropped their first math course. That difference was not statistically significant [$\chi^2(1) = 1.89$, *ns*].

Tables 5a and 5b show students' academic indicators broken down by summer bridge program for the bridge students and the comparison students, respectively. Tables 5a, 5b, and 6 also show the number of students that returned to campus for the spring semester. The cross tabulation is shown in Table 6. Six out of 94 summer bridge participants and 3 out of 94 comparison students did not register for the spring semester. The two groups did not differ statistically on whether students left the University after the fall semester [$\chi^2(1) = 1.05$, *ns*].

Table 2. Academic Performance Indicators to Date for Cohort 2 and the Matched Comparison Sample

	Bridge Students		Matched Comparisons			
Variables	*M*	*SD*	*M*	*SD*	*t*(186)	*p*
			Pre-College			
GPA HS	3.5	0.5	3.5	.41	1.02	*ns*
SAT Math	582	73	583	64	< 1	*ns*
ALEKS Math	68	19	69	18	< 1	*ns*
			College First Semester			
Fall Math Course Grade[1]	2.5	1.2	2.0	1.2	2.65	.01
GPA Fall Semester	2.8	0.9	2.6	1.0	1.42	*ns*

Note: *N* = 188. *M* = Mean. *SD* = Standard Deviation. *ns* = Not significant. [1]df = 155 because 31 students dropped their fall math course.

Table 3. Did summer bridge students differ from the comparison sample on whether they earned a C or better in their first math course?

	Did students earn a C or better in their first college math course?	
Type of Student	No	Yes
Summer Bridge Participant	32	62
Matched Comparison	45	49

Note: N = 188.

Table 4. Did summer bridge students differ from the comparison sample on whether they dropped their first math course?

	Did students drop their Fall 2017 math course?	
Type of Student	No	Yes
Summer Bridge Participant	82	12
Matched Comparison	75	19

Note: N = 188.

Table 5a. Pre-College and College First Semester Academic Performance for Cohort 2 Bridge Students by Program

	Summer Bridge Program											
	PSU Abington		PSU Altoona		PSU Berks		ASE		PreF		Grand Total	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
	Pre-College											
GPA HS	3.4	.4	3.6	.4	3.5	.5	3.2	.5	3.8	.3	3.5	.4
SAT Math	551	71	604	74	574	83	558	57	604	63	582	73
ALEKS Math	64	18	72	15	64	21	67	19	72	18	68	19
	College First Semester											
Fall Math Course Grade	2.0	1.5	2.6	1.1	3.0	1.0	2.5	1.3	2.2	1.2	2.5	1.2
GPA FA2017	2.6	.9	2.8	1.0	3.1	.8	2.5	.9	2.7	.7	2.8	.9
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
# in Bridge Program FA2017	18	100	15	100	21	100	11	100	29	100	94	100
# Dropped Fall Math Course	2	11	3	20	0	0	0	0	7	24	12	13
# Enrolled SP2018	17	94	14	93	19	90	11	100	27	93	88	94

Note: *N* = 94. GPA = Grade point average. ASE = Academic Summer Experience. PreF = Pre-First Year in Engineering & Science. *M* = Mean. *SD* = Standard Deviation. FA2017 = Fall semester 2017. SP2018 = Spring semester 2018.

Table 5b. Pre-College and College First Semester Academic Performance for Cohort 2 Matched Comparison Students by Program

	Matched Comparison Sample											
	PSU Abington		PSU Altoona		PSU Berks		ASE		PreF		Grand Total	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
	Pre-College											
GPA HS	3.3	0.4	3.4	0.3	3.5	0.4	3.1	.4	3.7	.3	3.5	.4
SAT Math	551	63	603	74	573	70	564	37	606	55	583	64
ALEKS Math	62	21	70	16	67	18	65	22	75	13	69	18
	College First Semester											
Fall Math Course Grade	1.8	1.3	2.0	1.1	2.5	1.1	1.5	1.1	1.8	1.1	2.0	1.2
GPA FA2017	2.8	0.7	2.8	1.0	2.9	0.9	2.0	1.0	2.3	0.9	2.6	1.0
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
# Comparisons FA2017	18	100	15	100	21	100	11	100	29	100	94	100
# Dropped Fall Math Course	4	22	2	13	2	10	0	0	11	38	19	20
# Enrolled SP2018	17	94	14	93	21	100	10	91	29	100	91	97

Note: *N* = 94. GPA = Grade point average. ASE = Academic Summer Experience. PreF = Pre-First Year in Engineering & Science. *M* = Mean. *SD* = Standard Deviation. FA2017 = Fall semester 2017. SP2018 = Spring semester 2018.

Table 6. Did summer bridge students differ from the comparison sample on whether they returned for the Spring 2018 semester?

	Did students return for the Spring 2018 semester?	
Type of Student	No	Yes
Summer Bridge Participant	6	88
Matched Comparison	3	91

Note: N = 188.

Associations Between the Study Variables

Table 7 shows the bivariate correlations between the study variables for the summer bridge students and the matched comparison sample. There were consistent results for the different measures of math aptitude such that higher SAT Math scores were associated with higher scores on the ALEKS math placement test and higher course grades in students' first college math course. For the bridge students, a higher high school grade point average was significantly associated with higher math course grades and grade point average in the first semester of college. To put the correlations in context, high school grade point average accounted for a modest 6 and 15% of the variance in the first semester college grade point average for the matched comparison sample and the bridge students, respectively. Thus, although the association between high school and first semester college grade point average is statistically significant, much of the variance in first semester college grade point average is not explained by high school grade point average.

Multiple regression analysis was used to test if pre-college academic indicators (high school grade point average, SAT Math score, ALEKS score) significantly predicted grades in students' first college math course. Student status (bridge student vs. comparison student) was also included as a predictor of the first college math course grade. The regression analysis indicated that the four predictors explained 17% of the variance in first math course grades [$R^2 = .17$, $F(4,152) = 7.81$, $p < .001$]. There was a significant result for student status ($\beta = -.18$, $p < .05$), which indicated the results of the regression were different for the summer bridge students and the matched comparison sample. Separate analyses were conducted for each group. The regression analysis for the bridge students indicated that the three predictors explained 19% of the variance in first college math course grades [$R^2 = .19$, $F(3,78) = 5.97$, $p < .001$]. High school grade point average ($\beta = .22$, $p < .05$) and SAT Math scores ($\beta = .40$, $p < .01$) independently and significantly predicated the first math course grade. The regression analysis for the matched comparison sample indicated that the three pre-college academic indicators did not predict first college math course grades [$R^2 = .09$, $F(3,71) = 2.33$, *ns*]. It is not clear why pre-college academic indicators were not associated with first math course grades for the matched comparison students.

Table 7. Correlations Between the Study Variables for Cohort 2

Summer Bridge Students

		High School GPA	SAT Math Score	ALEKS Math Placement	Fall semester math course grade	Fall semester GPA
High School GPA	*r*	--				
	n					
SAT Math Score	*r*	.11	--			
	n	94				
ALEKS Math Placement	*r*	.15	.50***	--		
	n	94				
Fall semester math course grade	*r*	.24*	.37**	.16	--	
	n	82	82	82		
Fall semester GPA	*r*	.39***	.33**	.15	.83***	--
	n	94	94	94	82	

Matched Comparison Sample

		High School GPA	SAT Math Score	ALEKS Math Placement	Fall semester math course grade	Fall semester GPA
High School GPA	*r*	--				
	n					
SAT Math Score	*r*	.27**	--			
	n	94				
ALEKS Math Placement	*r*	.35***	.55***	--		
	n	94	94			
Fall semester math course grade	*r*	.21	.26*	.22	--	
	n	75	75	75		
Fall semester GPA	*r*	.24*	.17	.26*	.78***	--
	n	92	92	92	75	

Notes: *r* = Correlation. *n* = Sample size. *$p < .05$. **$p < .01$. ***$p < .001$.

Secondary Analyses

To better understand performance in the first college math course, we conducted secondary exploratory analyses on ALEKS math placement scores and SAT math scores.

ALEKS math placement scores and success in the first college math course. The ALEKS math placement exam can be taken more than once if a student wishes. A higher score on a repeat administration of the test that results in scoring above a cut-off point allows a student to enroll in the corresponding math course in the fall semester. Table 8 shows that students enrolled in our first-year bridge program took the ALEKS exam more than once more frequently than the comparison sample.

Table 8. Math course placement and ALEKS math placement test taking patterns for Cohort 2

	Bridge Students		**Comparison Sample**	
Math Course Placement and ALEKS Math Test Status	**N**	**%**	**N**	**%**
Math course placement based on taking ALEKS 1 time	49	52	74	79
Math course placement not affected by taking ALEKS more than once	16	17	3	3
Math course placement higher after taking ALEKS more than once	29	31	17	18

The next question is whether taking the ALEKS math placement exam more than once, scoring higher, and moving into a more advanced math course affected grades in students' first college math course. Table 9 shows first college math course grades as a function of ALEKS test taking and math placement. Visual inspection of Table 9 shows that of those who took the ALEKS placement test more than once and moved into a more advanced first math course than their original placement, 34% of the bridge students earned a D, F, or withdrew from the course (D/F/W) and 59% of the comparison students earned a D/F/W. That result suggests that there was a significant portion of students whose college academic record was marred by re-taking the math placement exam and placing into a higher math course.

Table 9. Math course outcomes based on ALEKS test status

		Math Course Outcome: Bridge students				
Math Course Placement and ALEKS Math Test Status	**N**	**A or B**	**C**	**D**	**F**	**Withdrew from course**
Math course placement based on taking ALEKS 1 time	49	21 43%	9 18%	4 8%	7 14%	8 16%
Math course placement not affected by taking ALEKS more than once	16	13 81%	3 19%	0	0	0
Math course placement higher after taking ALEKS more than once	29	12 41%	7 24%	3 10%	3 10%	4 14%

		Math Course Outcome: Comparison students				
Math Course Placement and ALEKS Math Test Status	**N**	**A or B**	**C**	**D**	**F**	**Withdrew from course**
Math course placement based on taking ALEKS 1 time	74	23 31%	19 26%	9 12%	6 8%	17 23%
Math course placement not affected by taking ALEKS more than once	3	0	1 33%	1 33%	1 33%	0
Math course placement higher after taking ALEKS more than once	17	3 18%	4 24%	3 18%	5 29%	2 12%

SAT Math scores and success in the first college math course. Students' first college math course grades were examined as a function of their SAT Math scores in Tables 10a and 10b. (Course grades were combined in Table 10b for greater clarity.) Visual inspection indicated that higher proportions of bridge students with SAT Math scores 500 and above earned As and Bs compared to the matched sample. The greater likelihood of earning As and Bs in the first math course was particularly pronounced for bridge students with SAT Math scores of 600 and above. This pattern is consist with the finding that being academically strong is not a sufficient condition for success among underrepresented students in undergraduate science majors [1]. They compared academically strong underrepresented students in science majors in the Meyerhoff Scholars Program against similar students who did not participate in the program. Students in the Scholars program performed better than matched students on college grade point average and the likelihood of going to graduate school in a SEM field.

Table 10a. Math course outcomes based on SAT Math scores

Math Course Outcome: Bridge students

SAT Math Score	N	A or B	C	D	F	Withdrew
300s	1	1 100%	0	0	0	0
430 to 490	5	1 20%	1 20%	1 20%	1 20%	1 20%
500 to 550	27	10 37%	7 26%	3 11%	5 19%	2 7%
560 to 590	26	11 42%	5 19%	3 12%	3 12%	4 15%
600 to 650	21	10 48%	5 24%	1 5%	1 5%	4 19%
660 to 690	8	7 88%	0	0	0	1 12%
700 to 800	6	6 100%	0	0	0	0

Math Course Outcome: Comparison students

SAT Math Score	N	A or B	C	D	F	Withdrew
300s	0	0	0	0	0	0
430 to 490	5	1 20%	0	2 40%	2 40%	0
500 to 550	26	7 27%	7 27%	5 19%	2 8%	5 19%
560 to 590	26	9 35%	6 23%	3 12%	4 15%	4 15%
600 to 650	22	3 14%	7 33%	3 14%	2 9%	7 33%
660 to 690	11	4 36%	4 36%	1 9%	0	2 18%
700 to 800	4	2 50%	0	0	1 25%	1 25%

Table 10b. Math course outcomes based on SAT Math scores (grades combined)

Math Course Outcome: Bridge Students

SAT Math Score	N	A/B	C	D/F/W
300s	1	1 100%	0	0
430 to 490	5	1 20%	1 20%	3 60%
500 to 550	27	10 37%	7 26%	10 27%
560 to 590	26	11 42%	5 19%	10 39%
600 to 650	21	10 48%	5 24%	6 29%
660 to 690	8	7 88%	0	1 12%
700 to 800	6	6 100%	0	0

Math Course Outcome: Comparison Students

SAT Math Score	N	A/B	C	D/F/W
300s	0	0	0	0
430 to 490	5	1 20%	0	4 80%
500 to 550	26	7 27%	7 27%	12 46%
560 to 590	26	9 35%	6 23%	11 42%
600 to 650	22	3 14%	7 33%	12 56%
660 to 690	11	4 36%	4 36%	3 27%
700 to 800	4	2 50%	0	2 50%

Discussion and Conclusions

This paper presents an update on the Sustainable Bridges study (NSF IUSE #1525367) and data for the second cohort of students who enrolled in the 2017 summer bridge programs for incoming undergraduate Engineering students. The goal of the study is to increase retention and graduation among underrepresented students in Engineering. After we have gathered longitudinal data on 3 cohorts of students we will examine retention in Engineering, STEM, and the University as a function of (a) students' transfer status within the University (completed degree at one campus vs started at regional campus and transferred to flagship campus) and (b) bridge location (at campus where matriculate in the first semester of college vs at a different campus than matriculation in the first semester).

We recently completed the second year of this five-year project. The second cohort of students in the five bridge programs for incoming freshmen also recently completed their first semester of college. We focus on passing math course grades (C or better) because they are crucial for successful progression in the Engineering major. The significantly higher math course grades for the Cohort 2 bridge students compared to the matched comparison students suggests that the bridge programming and the improvements we implemented for this cohort benefitted the students. We are currently preparing for the third cohort of incoming first-year Engineering summer bridge students.

At this point, it is too early in the study to draw any conclusions about the success of the interventions toward increasing the number of underrepresented students who successfully enroll in an Engineering major in their junior year. We are exploring associations between SAT Math scores and the ALEKS math placement scores and success in the first college math course. One challenge we are trying to tackle is the balance between the most financially efficient and most academically effective way of offering summer bridge programs at small regional campuses. On the one hand, it may be more cost effective to bring incoming Engineering students from various regional campuses to the flagship campus for summer academic enhancement. In this case, students primarily benefit from academic enrichment but do not garner some of the other advantages of bridge programs. On the other hand, students may have better long-term academic success if they participate in a bridge program at their regional campus where they also benefit from acclimating to the campus they will be attending in the fall, establishing relationships with faculty, and building a supportive learning cohort among their peers attending the same campus in addition to the academic enrichment.

References

[1] K. Maton, F. Hrabowski, and C. Schmitt, (2000). “African American college students excelling in the sciences: College and postcollege outcomes in the Meyerhoff Scholars Program,” *Journal of Research in Science Teaching*, *37*, 629-654.