Board 30: Sustainable Bridges from Campus to Campus: Outcomes for Two Cohorts of Jump Start Second-year Bridge Participants (#1525367)

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Dr. Peter J. Shull is an associate professor of engineering at Penn State University. He received his undergraduate degree from Bucknell University in mechanical engineering and his graduate degrees from The Johns Hopkins University in engineering science. Dr. Shull's research has two main foci—nondestructive evaluation methods as applied to process control (NDE) and pedagogical methodology. Dr. Shull's pedagogical efforts include meta-cognitive strategy learning to improve student academic success, an interest in women's issues within the engineering environment, integrated, experiential techniques to improve engineering students' social emotional development as applied to teamwork and communication, and program assessment methods that minimize stakeholders' efforts while maximizing the effectiveness of the measurement tool.

Dr. Peter J Butler, Pennsylvania State University, University Park
Mrs. Helen Edson, The Pennsylvania State University

For the past 22 years, Helen has been a student advocate in Penn State's College of Engineering. The majority of those years she has spent in the Engineering Outreach and Inclusion office with a strong focus on recruitment and retention of underrepresented and high risk students. A great deal of focus has been as a scholarship steward assisting all students in obtaining financial assistance. She has been a long time advisor to both the National Society of Black Engineers and the Society of Hispanic Professional Engineers. For the past two years, she has served as the Director of Campus Outreach serving a large population of engineering students starting at one of Penn State's 24 regional campuses and transitioning to the much larger University Park campus in their junior year to complete their degree. Helen oversees several retention programs including the Jump Start second-year bridge.

Sustainable bridges from campus to campus: Outcomes for two cohorts of Jump Start second-year bridge participants (#1525367)

Abstract

Purpose and Goals: The purpose of the *Sustainable Bridges from Campus to Campus* study (NSF IUSE #1525367) is to increase the retention of racially underrepresented students (i.e., African American, Native American, and Hispanic students) in undergraduate Engineering majors. We strive to address the urgent need to expand and diversify the pool of undergraduates who earn a Science, Technology, Engineering, and Math (STEM) degree. To achieve this goal, the Sustainable Bridges project consists of a comprehensive series of interventions at three points in students' career at the Pennsylvania State University (Penn State)—entering first-year students (Engineering Ahead), rising second-year students (Jump Start), and a transition program for rising juniors changing from a Penn State regional campus to the Penn State University Park flagship campus. As of this writing, we are beginning Year 4 of the 5-year project. Previous papers described outcomes for the Engineering Ahead first-year bridge program. This paper is an interim report that describes outcomes for two cohorts of students who participated in the *Jump Start* second-year summer bridge intervention.

Method: The *Jump Start* summer bridge is a 4-week residential program on the Penn State University Park (flagship) campus for rising second-year Engineering students throughout the Penn State system to prepare them for Calculus II, Differential Equations, Physics I or Physics II. Cohort building is also a significant focus. Enrollment priority is given to racially underrepresented students, those who participated in the Engineering Ahead first-year bridge program, and those from a Penn State regional campus. To assess the effectiveness of Jump Start for the first two cohorts (N = 93), we will compare participants to a sample of students who did not participate in Jump Start who were matched on sex, race/ethnicity, major, campus assignment, and SAT Math scores, for a total sample of 186 students. We compare the two groups on fall-semester math and physics course grades, fall semester grade point average, and enrollment status. We also examine the entrance-to-major status for Cohort 1 for retention in Engineering, retention in STEM, and retention at Penn State.

Results and Conclusions: The preliminary results are promising for the rising second-year bridge program, particularly for Cohort 1. Compared to a matched comparison sample, Cohort 1 Jump Start students had higher grades in their math courses and were more likely to earn a grade of C or higher in the fall semester of their sophomore year following the summer bridge program. Cohort 1 Jump Start students were followed into the fall of their junior year. They were significantly more likely than the comparison students to be retained at Penn State. In 2019, we will continue to follow Cohorts 1 and 2 and enroll Cohort 3.

Sustainable bridges from campus to campus: Outcomes for two cohorts of Jump Start second-year bridge participants (#1525367)

The purpose of this interim progress report is to document the performance of the Jump Start students in Cohort 1 (2017) and Cohort 2 (2018) and a matched comparison sample of similar

students who did not participate in Jump Start. (Jump Start is part of the broader Sustainable Bridges project, which also includes a bridge program for entering first-year Engineering students and a transition program for juniors.) The Jump Start summer bridge program prepares rising sophomores in Engineering for the second year of core courses required for successful completion of the Engineering pre-major. To enter the Engineering major, students must receive a C or better in core courses and achieve certain GPAs to allow entrance into enrollment-controlled majors. The intention is that this academic support and cohort building will increase the retention of second-year Engineering students, particularly those at Penn State regional campuses who expect to transfer to the Penn State University Park (flagship) campus (2+2 students). Jump Start participants spend the month of May at the Penn State University Park campus before the sophomore year at their regional campus. Many undergraduate students enter the second year with an academic performance that reflects the "sophomore slump." Strong performance in Calculus, Physics and Differential Equations is necessary for a successful second-year Engineering student. If a student struggled through Calculus I with a C, those academic struggles might carry over to Calculus II or Calculus III.

The challenges for Penn State students who participate in the "2+2" model (attend the first two years at a regional campus and the second two years at another Penn State location to finish their degree) are similar to some of the challenges of community college students. Since their creation, regional and community colleges have played a significant role in providing access to higher education for many Americans (Cohen & Brawer, 2003). Community colleges have disproportionately been the primary access point to higher education for underrepresented groups, such as multicultural, female, first-generation, nontraditional, and low-income students. Factors contributing to the selection of community colleges as the access point to higher education include affordability and less competitive admissions requirements (Bailey & Morest, 2006). Extensive research sheds light on low graduation rates of transfer students (Graham & Hughes, 1994). Nationally, 80% of first-year college students at community colleges express an initial desire to transfer to a four-year institution. Out of this initial group, only 40% achieve their desired goal of even being eligible to transfer. Of the transfer-eligible students, only 10% eventually transfer to a four-year institution (Berger & Malaney, 2003). Finally, community college transfer students have a lower likelihood of graduation than students who start at four-year institutions (National Center for Education Statistics, 2008).

Tinto performed a number of studies from 1975 through 2008 on the effectiveness of the learning communities when applied to a wide range of students including those who were new to the college environment (Tinto, 1975; Tinto, 2007; Tinto & Love, 1995). The learning community principle is based on the idea that students and faculty sharing multiple classes and experiences will assist each other in building positive academic strategies and social relationships. Tinto applied the learning community philosophy to targeted student populations that were underprepared and from low-income backgrounds, and found to be equally effective. In addition, precollege academic preparation also increased the persistence of students (Engstrom & Tinto, 2008; Tinto, 2007). The learning community principle is a core feature of bridge programs to ease some of the adjustment problems into college.

The Jump Start bridge program starts in May ("MayMester"), a week after the completion of the first year. MayMester is an academic window at Penn State that allows students to take short

courses in the month of May, right after the spring semester ends. The goal is to give rising sophomore Engineering students the opportunity to carefully think through math and physics concepts, repair mistakes, and get better at problem-solving skills. Completion of the bridge in May allows Jump Start participants to do paid work, internships, or summer school starting in June. Additional objectives are for regional campus Engineering pre-major students to become familiar with the University Park campus and to build friendships with peers and connections with staff. The goals are that the Jump Start bridge experience will increase retention in Engineering and ease the adjustment of campus transition in the fall semester of the junior year.

To enroll in Jump Start, students must have completed Calculus 1 by the end of the first year. Students participating in Jump Start are in one of two tracks: Track 1 is for students who have completed Calculus 1 and wish to complete an introductory review of Calculus 2 and Physics 1. Track 2 is for students who have completed Calculus 2 and Physics 1 in the first year and wish to review Differential Equations and Physics 2. All students participate in professional development activities and team projects. There is no cost to the students to participate. Their room and board in a University residential hall is covered. To offset the loss in summer income that some participants will experience, participants received a $250 stipend.

Method

Participants

Jump Start students were recruited through emails sent to students who had participated in the first-year Engineering Ahead bridge programs and to all Engineering students at regional campuses who would be entering Calculus 2 and Physics 1 or Differential Equations and Physics II the next fall semester. Recruitment focused on racially underrepresented students, female students, those at a regional campus. To establish a benchmark against which to evaluate the efficacy of the Jump Start program, we built a matched control sample. Each Jump Start student was matched with a non-participant who was similar on date of entry to the University, sex, race/ethnicity, SAT Math scores (within 1 standard deviation), and regional campus location. In some cases, a match could not be identified at a participant's regional campus. In that case, a match was identified at a different regional campus. Regional campus students were never matched with a University Park campus student. There were 46 and 47 Jump Start participants in Cohorts 1 (summer 2017) and 2 (summer 2018), respectively. When we include the matched comparison students, there was a total of 92 students in Cohort 1 and 94 students in Cohort 2.

Because these are interim analyses, data are reported for the two cohorts separately and not aggregated at this point to allow inspection of each group. Background characteristics for each cohort are shown in Tables 1a and 1b. Interestingly, exactly half of the Jump Start participants in Cohort 1 were women. One third of the participants were women in Cohort 2. Female Engineering students in Jump Start were overrepresented compared to the current proportion of 20% among pre-majors in the College of Engineering. Half of the students in Cohort 1 and 38% in Cohort 2 were underrepresented in Engineering (defined as Native American or Pacific Islander, African American, or Hispanic American). Racially underrepresented students in Jump Start were overrepresented compared to 13% of pre-majors in the College of Engineering. In Cohort 1, 24% of the Jump Start students and 33% of the comparison students were first-generation college students. In Cohort 2, 38% of the Jump Start students and 32% of the

comparison students were first-generation college students. First-generation students in Jump Start were overrepresented compared to 22% of pre-majors. The two groups did not differ on the proportion of first-generation students for either cohort respectively, $\chi^2(1) = 1.85$, *ns*; $\chi^2(1) < 1$, *ns*. As intended, Jump Start participants and the matched comparison students did not differ on SAT Math scores (see top portion of Tables 2a and 2b). Also supporting the premise that the Jump Start students and comparison students did not differ on pre-college academic indicators, there were no differences between the two groups for high school grade point average or the University math-placement exam scores (ALEKS), as shown in Tables 2a and 2b.

Procedure

The four-week Jump Start program commenced in May 2017 (Cohort 1) and 2018 (Cohort 2). The summer bridge participants provided informed consent to allow examination of their background characteristics and academic performance using information in the institutional data base for matriculating students. The informed consent approval included examination of academic data for the matched comparison sample.

Results

A central research question is whether the Jump Start Engineering students, who received math and physics preparation and cohort building in the summer before their sophomore year, would demonstrate better academic outcomes in the subsequent semester compared to similar Engineering students who did not receive that academic support program. Fall semester math course grades, physics course grades, and semester grade point average are shown in the lower portion of Tables 2a and 2b. (Course letter grades were converted to the numerical equivalent.) Cohort 1 Jump Start students had a statistically higher sophomore fall semester grade point average (2.9) than the comparison students (2.5). The two groups did not differ on fall math course grades or physics course grades for either cohort.

To dig a little deeper into the sophomore fall semester math course grades, students were coded as receiving a C or better in their math course versus receiving a grade lower than a C or dropping the course. Tables 3a and 3b show the cross tabulations for the two groups of students in the two cohorts. Chi square analyses indicated that Cohort 1 Jump Start participants were more likely to earn a C or better in their fall semester math course than the comparison sample, $\chi^2(1) = 8.59$, $p < .01$. There was no difference between the groups for Cohort 2, $\chi^2(1) < 2.23$, *ns.*

Further retention analyses were conducted on Cohort 1, who started at Penn State as first-year students in fall 2016. Additional research questions were whether they were retained at the University in higher rates (Table 4) and whether they were retained in Engineering in higher rates (Table 5). When we examined enrollment in the fall semester of their junior year (FA2018), a significant Chi square analysis indicated that more Jump Start students were retained at the University into their junior year than the comparison students, $\chi^2(1) = 3.90$, $p < .05$; see Table 4. Students typically move into a specific Engineering major in the fall of the junior year. Table 5 shows which majors students moved into after the entrance-to-major process. As of this writing, 10 Cohort 1 students are still in pre-major status. Table 5 will be updated when all students have declared a major. However, visual inspection of the preliminary data look promising for

retaining a greater proportion of students in the Engineering majors a year after participation in the Jump Start program, $\chi^2(1) = 8.59$, *ns*.

Conclusions

We are grateful to the National Science Foundation for supporting the Sustainable Bridges project. 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 data presented here on the first two cohorts of the Jump Start second-year bridge program for pre-major Engineering students is part of the larger Sustainable Bridges project (#1525367). The preliminary results are promising for the rising second-year bridge program, particularly for Cohort 1. Compared to a matched comparison sample, Cohort 1 Jump Start students had higher grades in their math courses and were more likely to earn a grade of C or higher in the fall semester of their sophomore year following the summer bridge program. Cohort 1 Jump Start students were followed into the fall of their junior year. They were significantly more likely than the comparison students to be retained at the University. In 2019, follow-up will continue for Cohorts 1 and 2 to examine their retention at the University in their junior year and retention in the Engineering and STEM majors. Cohort 3 Jump Start students will enroll in May 2019. After all three cohorts have been enrolled and tracked through the entrance to major, future analyses can examine whether the program had a differential effect on students as a function of gender, race/ethnicity, and first-generation status.

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Table 1a. Background Characteristics for Cohort 1 (2017) Jump Start Students and the Matched Comparison Sample

	Bridge Students		Matched Comparisons	
Variables	N	%	N	%
Gender				
Male	23	50	23	50
Female	23	50	23	50
Ethnicity				
African American	14	30	14	30
Asian	6	13	6	13
Hispanic	8	17	8	17
Native Am/Pacific Islander	2	4	2	4
White	10	22	10	22
International	6	13	6	13
First-Generation College Student	11	24	15	33
# Dropped Math Course Fall Semester	5	11	21	46

Note: *N* = 92. Twenty-one participants (46%) were matched to students at another regional campus.

Table 1b. Background Characteristics for Cohort 2 (2018) Jump Start Students and the Matched Comparison Sample

	Bridge Students		Matched Comparisons	
Variables	N	%	N	%
Gender				
Male	31	66	31	66
Female	16	34	16	34
Ethnicity				
African American	11	23	11	23
Asian	5	11	5	11
Hispanic	7	15	7	15
Native Am/Pacific Islander	0	0	0	0
White	19	40	19	40
International	5	11	5	11
First-Generation College Student	18	38	15	32
# Dropped Math Course Fall Semester	4	9	13	28

Note: *N* = 94. Eight participants (17%) were matched to students at another regional campus.

Table 2a. Academic Performance Indicators to Date for Cohort 1 (2017) and the Matched Comparison Sample

	Bridge Students		Matched Comparisons			
Variables	*M*	*SD*	*M*	*SD*	*t*(90)	*p*
			Pre-College			
High School GPA	3.6	.4	3.5	.5	< 1	*ns*
SAT Math	595	78	594	74	< 1	*ns*
ALEKS Math	69	16	66	16	< 1	*ns*
			College Fall Semester Sophomore Year			
Fall Math Course Grade[1]	2.6	1.2	2.1	1.3	1.69	*ns*
Fall Physics Course Grade[2]	2.5	1.2	1.9	1.2	1.60	*ns*
GPA Fall Semester	2.9	.7	2.5	1.0	2.25	.05

Note: *N* = 92. *M* = Mean. *SD* = Standard Deviation. *ns* = Not significant. [1]df = 64 because 26 students dropped their fall math course. [2]df = 51 because 39 students did not have a physics grade in the fall semester.

Table 2b. Academic Performance Indicators to Date for Cohort 2 (2018) and the Matched Comparison Sample

	Bridge Students		Matched Comparisons			
Variables	*M*	*SD*	*M*	*SD*	*t*(92)	*p*
			Pre-College			
High School GPA	3.5	.5	3.5	.4	< 1	*ns*
SAT Math	598	74	596	69	< 1	*ns*
ALEKS Math	68	18	72	17	-1.25	*ns*
			College Fall Semester Sophomore Year			
Fall Math Course Grade[1]	2.5	1.1	2.3	1.3	< 1	*ns*
Fall Physics Course Grade[2]	2.5	1.1	2.4	1.2	< 1	*ns*
GPA Fall Semester	2.9	.8	2.7	1.1	1.16	*ns*

Note: *N* = 94. *M* = Mean. *SD* = Standard Deviation. *ns* = Not significant. [1]df = 75 because 17 students dropped their fall math course. [2]df = 65 because 29 students did not have a physics grade in the fall.

Table 3a. Did students (Cohort 1) differ on whether they earned a C or better in their fall semester sophomore-year math course?

	Earned a C or better in their fall-semester sophomore-year math course		
Type of Student	No	Yes	Total
Jump Start Participant	14	32	46
Matched Comparison	28	18	46
Total	42	50	92

Note. N = 92. $\chi^2(1) = 8.59$, $p < .01$.

Table 3b. Did students (Cohort 2) differ on whether they earned a C or better in their fall semester sophomore-year math course?

	Earned a C or better in their fall-semester sophomore-year math course		
Type of Student	No	Yes	Total
Jump Start Participant	14	33	47
Matched Comparison	21	26	47
Total	35	59	94

Note. N = 94. $\chi^2(1) < 2.23$, *ns.*

Table 4: Did students (Cohort 1) differ on whether they were enrolled in the fall semester of their junior year?

	Enrolled in fall semester of junior year		
Type of Student	No	Yes	Total
Jump Start Participant	4	42	46
Matched Comparison	14	32	46
Total	18	74	92

N = 92. $\chi^2(1) = 3.90$, $p < .05$.

Table 5: Entrance to Major Results for Jump Start Cohort 1

	Major after Entrance to Major					
Type of Student	Science	Technology	Engineering	Non-STEM	Not Enrolled	Total
Jump Start Participant	2	2	31	3	4	42
Matched Comparison	3	2	17	4	14	40
Total	5	4	48	7	18	82

Note. 10 students are still in pre-major status. N = 82. $\chi^2(1) = 8.59$, *ns*.