AC 2010-1483: EVALUATION OF A SUMMER BRIDGE PROGRAM ON ENGINEERING STUDENTS' PERSISTENCE AND SUCCESS

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Abstract

The College of Engineering (COE) at Southern Illinois University Carbondale (SIUC) received a grant from the National Science Foundation to increase its graduation rate. In order to meet this objective the COE is focusing on improving retention rates at the freshman and sophomore levels because the attrition rate is highest during the first two years. The COE is implementing a holistic program to address common reasons for students leaving the engineering program, including lack of academic preparation; financial difficulties; difficulty in adjusting to college life; lack of a community atmosphere; and disappointment at not being able to experience engineering principles during the first two years. Following an initial planning period, the COE launched seven major initiatives in 2007 to achieve project goals. These initiatives include (1) an Engineering Residential College that forms the foundation of a new living-learning community; (2) a multi-tiered student mentoring program that includes peer-to-peer mentoring, faculty mentoring, and practicing-engineer mentoring; (3) an innovative Introduction to Engineering course; (4) common cohort classes for several courses; (5) a new developmental mathematics course for underprepared students; (6) peer tutoring; and (7) a six-week Summer Bridge Program for at-risk students. This paper focuses on one initiative, the Summer Bridge Program.

The Summer Bridge Program is designed to integrate first-year students into the socio-academic environment of the COE at an early stage. The program consists of non-credit bearing workshops focusing on an intensive pre-calculus math review, an engineering science preview, and a freshmen orientation seminar. Preference has been given to the following: (1) underserved populations; (2) students who would not be ready for Calculus based on math placement test results and/or ACT math sub-scores; and (3) students who have been unconditionally admitted to the College for the following fall term.

This study examines two cohorts of freshman students who participated in the 2007 and 2008 Summer Bridge Program. Evaluation of the program includes a single group pre-post design to measure academic progress and attitude changes from the beginning to the end of the six-week program and follow-up tracking of enrollment status, program progress, and grades for students who participated in the program. Specifically, Math grades were examined to determine student success in their recommended math course placement. An additional evaluation of the program is a comparison of the success (e.g., retention rate) of students who participated in the program to those students who enrolled in the COE during the subsequent fall semester. An overall goal of this project is to evaluate the effectiveness of the Summer Bridge Program in terms of contributing to engineering students' persistence and success.

Introduction

Research on engineering students' persistence and success has received a great deal of attention in the literature. According to the National Academy of Engineering (NAE)[1] "Only 40-60 percent of entering engineering students persist to an engineering degree, and women and minorities are at the low end of that range. These retention rates represent an unacceptable

systemic failure to support student learning in the field." (p. 40). Understanding factors contributing to freshman retention is critical because a high attrition rate occurs during the first-year.[2] Factors examined in the literature include both pre-college characteristics (e.g., high school performance, ACT scores, gender, ethnicity) and first-year college characteristics (e.g., performance, attitude, motivation, confidence). If students' freshman experiences contribute to their persistence and success this may have implications for programmatic planning and policy changes in engineering.

Noteworthy is that research has shown that predictors of retention change throughout the first two years of an engineering program and predictors of graduation vary across universities.[3] Tinto's[4] Student Integration Theory posits that students enter university with varied background characteristics and goal commitments which in turn influences their integration into the institution's environment and thus their performance in college. "Given individual characteristics, prior experiences, and commitments, … it is the individual's integration into the academic and social systems of the college that most directly relates to his continuance in that college" (p. 96).

A summer program represents a transition for targeted students who have been admitted to a university for the fall semester. Programs typically target underserved populations in order to provide remedial skill preparation and an orientation to the academic and social environment on campus.[5]

Summer Bridge Program

The College of Engineering (COE) at Southern Illinois University Carbondale (SIUC) hosted the first Summer Bridge Program for incoming freshman under its new student retention initiative sponsored by the National Science Foundation (NSF) in 2007. The six-week program was designed to integrate first year students into the socio-academic environment of the COE. Table 1 presents the Summer Bridge Program admission requirements and recruitment strategy for 2007, 2008 and 2009. Admission requirements have changed (i.e., become less restrictive) over the past three years to help increase enrollment.

The COE paid for housing, meals, and books for participants in the Summer Bridge Program. However, participants were required to cover the following expenses: (1) transportation to and from campus, (2) weekend meals (though several cookouts were sponsored by the COE) (3) entertainment, and (4) miscellaneous expenses (laundry, school supplies, phone calls, etc.). Participants were also required to sign an agreement which stated that they would comply with all of the rules and guidelines of the Summer Bridge Program. A participant not following the guidelines may be asked to go home for the remainder of the summer session and return at the beginning of the fall semester.

Table 1
Admission Requirements and Recruitment Strategy for the Summer Bridge Program

	2007	2008	2009
Admission Requirements	• Unconditionally admitted to College of Engineering (COE) for the fall semester and selected engineering as a major • Completed the COE math placement test and would be enrolled in pre-Calculus mathematics when the fall semester begins • Have not completed the COE math placement test and achieved an ACT math sub-score of 23 or less • Willing to fully participate in a six-week Summer Bridge Program and follow the rules and guidelines of the program • Students who met these criteria were granted priority consideration for one of 30 slots. If space remained, students who satisfied the first and third bullets but placed into Calculus were considered	• Unconditionally admitted to College of Engineering (COE) for the fall semester and selected engineering as a major • Completed the COE math placement test and would be enrolled in pre-Calculus mathematics when the fall semester begins • Willing to fully participate in a six-week Summer Bridge Program and follow the rules and guidelines of the program • Students who met these criteria were granted priority consideration for one of 30 slots. If space remained, students who placed into Calculus or were pre-majors interested in engineering were considered	• Unconditionally admitted to SIUC for the fall semester and selected engineering as a major • Completed the COE math placement test and would be enrolled in pre-Calculus mathematics or Calculus when the fall semester begins • Willing to fully participate in a six-week Summer Bridge Program and follow the rules and guidelines of the program • Students who met these criteria were granted priority consideration for one of 30 slots. If space remained, students who satisfied the first and third bullets were considered
Recruitment Strategy	• A list was generated from an admissions computer system based on the admission requirements • Students on the list were called and verbally invited (starting in March) to attend the Summer Bridge Program • All students that applied were given acceptance into the program if they met the admission requirements	• A list was generated from an admissions computer system based on the admission requirements • Students on the list were called and verbally invited (starting in March) to attend the Summer Bridge Program • All students that applied were given acceptance into the program if they met the admission requirements	• Due to the implementation of a new computer system at SIUC, the admissions list could not be generated until late May • Recruitment was mainly done by presenting information about the Summer Bridge Program during parent information meetings at the Student Orientation, Advisement, and Registration events held during the months of April, May, and June • Interest in the program increased dramatically from the previous year (28 students applied to the program and 19 students attended) • Book stipends were offered in an effort to increase the number of interested students

Note. The emphasis of this paper is on the first two years of implementation, however details are provided about 2009 to see programmatic changes.

The Summer Bridge Program consists of three non-credit bearing workshops that include an intensive pre-calculus math review, an engineering science preview and a freshman orientation seminar. Table 2 presents additional details about each of the curriculum components.

Table 2
Summer Bridge Program Curriculum

	2007	2008	2009
Math Review	• Taught by the Assistant Director of the Minority Engineering Program • 90 minutes of instruction (5 days/week) • 2 hours of supplemental instruction (5 days/week) • 3 hours of study tables in the evening (Sunday thru Thursday)	• Taught by the Assistant Director of the Minority Engineering Program • 90 minutes of instruction (5 days/week) • 2 hours of supplemental instruction (5 days/week) • 3 hours of study tables in the evening (Sunday thru Thursday)	• Taught by a faculty member from the Math Department • 2 hours of instruction (3 days/week) • 105 minutes of supplemental instruction (5 days/week) • 3 hours of study tables in the evening (Sunday thru Thursday)
Engineering Science	• Taught by Graduate Assistants • 1 hour of instruction (5 days/week)	• Taught by faculty from the COE • 75 minutes of instruction (5 days/week) • Faculty members from Electrical/Computer Engineering, Mechanical Engineering, Mining Engineering, and Engineering Technology volunteered between one day and two weeks of their time to teach topics from their discipline	• Taught by faculty from the COE • 75 minutes of instruction (5 days/week) • Faculty members from Electrical/Computer Engineering, Mechanical Engineering, Mining Engineering, Civil Engineering, and Engineering Technology volunteered between one day and two weeks of their time to teach topics from their discipline
Freshman Orientation	• Taught by the Director of the Minority Engineering Program • 1 hour of instruction (3 days/week)	• Taught by the Director of the Minority Engineering Program • 1 hour of instruction (3 days/week)	• Taught by a Senior Engineering student • 1 hour of instruction (2 days/week)

Note. The emphasis of this paper is on the first two years of implementation, however details are provided about 2009 to see programmatic and personnel changes.

The Summer Bridge Program has the following objectives:

- To help "at risk" students develop a solid foundation of problem solving skills that will facilitate their advancement in the engineering math curriculum.
- To help students gain a deeper appreciation for the role that math and science plays in the engineering field.
- To integrate first year students into the socio-academic environment of the College of Engineering and help smooth their transition to collegiate life.

Methodology

The evaluation design for this program was a single group pre-post design. At the beginning and end of the six-week summer program, students were given an Attitudes Toward Mathematics and Engineering Survey and the ACT Computer-Adaptive Placement Assessment and Support System (COMPASS) Mathematics Placement Test. The post-attitude survey contained additional items to evaluate students' perception of the Summer Bridge Program.

Sample

Twenty-one students participated in the 2007 Summer Bridge Program. Seventeen (81%) were male and 4 (19%) were female. The age range was 17 to 19 years with a mean age of 17.81 (*SD* = 0.60). The participant race/ethnicity was 16 (76%) Black and 5 (24%) White. During week five of the six-week program, a female student withdrew participation due to receiving a scholarship to attend another institution. For the sample of 21 students, the ACT Math scores had a range of 16 to 27 with a mean equal to 21.38 (*SD* = 3.15) and median equal to 21.

Fourteen students participated in the 2008 Summer Bridge Program. Of the participants, 12 (86%) were male and 2 (14%) were female. The age range was 17 to 18 years with a mean age of 17.64 (*SD* = 0.50). The participant race/ethnicity was 1 (7%) Asian/Pacific Islander, 7 (50%) Black and 6 (43%) White. During week five of the six-week program, two male students were sent home due to violations of the rules and guidelines. For the sample of 14 students, the ACT Math scores had a range of 14 to 26 with a mean equal to 21.79 (*SD* = 3.66) and median equal to 21.5.

Measures

The ACT COMPASS Mathematics Placement Test was administered to students at the beginning and end of the six-week Summer Bridge Program. Students received scores on the College Algebra and Trigonometry content domains. Numerical scores have a theoretical range from 1 to 99 representing an estimate of percentage of items that a student would answer correctly if administered all items in a content domain. The ACT COMPASS Reference Manual[6] provides some technical characteristics of the Mathematics Test. For example, the correlation between the College Algebra and Trigonometry tests is $r = .57$ ($n = 956$) based on data from the 1997 – 1998 academic year. Further, descriptive statistics for the College Algebra and Trigonometry Tests given in Table 3 were based on a sample of 27,551 students from four-year colleges who were administered one or more COMPASS tests in the summer and fall of 2004.

Table 3
Descriptive Statistics for College Algebra and Trigonometry Tests from Reference Manual

COMPASS Test	*n*	*M*	*SD*
College Algebra	6,127	52.2	17.8
Trigonometry	3,488	44.6	16.9

Note. *n* = sample size, *M* = mean, *SD* = standard deviation.

The pre and post Attitudes Toward Mathematics and Engineering Survey included the 40 item Attitudes Toward Mathematics Inventory (ATMI).[7] [8] Based on a sample of high school students, the ATMI has an internal consistency (Cronbach alpha) equal to .97 and four subscales (i.e., Self Confidence, Value, Enjoyment, and Motivation) measuring underlying dimensions of attitudes toward mathematics. The Cronbach alpha values for the four subscales were .95, .89, .89, and .88, respectively.[8]

Results

Mathematics Placement Test

The ACT COMPASS Mathematics Placement Test was used to assess a change in math performance from the beginning to end of the six-week program. Table 4 gives descriptive statistics for the pre and post Mathematics Placement Test (College Algebra and Trigonometry) for the 2007 and 2008 cohorts. Paired (i.e., repeated measures) *t*-tests showed statistically significant changes from pre to post on College Algebra and Trigonometry for both cohorts using a Bonferroni adjusted alpha level of .025 (see Table 5). Furthermore, Cohen's *d*, a standardized effect size, indicates that the change from pre to post was more than a standard deviation apart for the 2008 cohort with smaller gains observed for the 2007 cohort (see Table 5).

Table 4
Pre/Post Descriptive Statistics for the Mathematics Placement Test

Measure		**Pre**				**Post**			
	n	*M*	*SD*	Min/Max	Median	*M*	*SD*	Min/Max	Median
2007									
Algebra	21	45.19	16.61	19 / 75	47	56.10	24.90	23 / 97	65
Trigonometry	21	35.95	13.77	16 / 59	35	48.05	13.16	21 / 78	50
2008									
Algebra	12	40.92	13.82	21 / 61	42	56.42	16.21	29 / 74	59
Trigonometry	12	36.67	13.51	17 / 56	38	52.33	11.33	31 / 72	54

Note. *n* = sample size, *M* = Mean, *SD* = standard deviation, Min = minimum score, Max = maximum score.

Table 5
Repeated Measures *t*-tests on the Mathematics Placement Test

Measure	*df*	*t*-test	*p*-value	Mean diff	Cohen's *d*
2007					
Algebra	20	3.62	.0017	10.91	0.52
Trigonometry	20	4.26	.0004	12.10	0.90
2008					
Algebra	11	5.43	.0002	15.50	1.03
Trigonometry	11	4.58	.0008	15.66	1.26

Note. Mean diff = Mean difference (post – pre);

$$\text{Cohen's } d = \left.\bar{X}_{post} - \bar{X}_{pre}\right/ s_p \quad \text{where } s_p = \sqrt{\left.s_{post}^2 + s_{pre}^2\right/ 2}$$

Math Course Placement

To further assess the Summer Bridge Program with regards to math preparation, students were assigned a math course placement at the beginning of the summer program and at the end of the six-week program. At the end of the 2007 Summer Bridge Program, 86% of students (n = 18) were placed into a higher math course placement. More specifically, 62% of students (n = 13) showed a movement of one course level and 24% (n = 5) showed a movement of two course levels. Only 3 students (14%) showed no change in recommended math course placement as a result of participating in the summer program. On the other hand, for the 2008 Summer Bridge Program, 57% of students (n = 8) were placed into a higher math course placement. Specifically, 21% of students (n = 3) showed a movement of one course level and 36% (n = 5) showed a movement of two course levels. Six students (43%) showed no change in recommended math course placement as a result of participating in the summer program.

Fall Semester Math Performance

To evaluate the follow-up success of the summer program, subsequent fall semester math grades were examined. A letter grade equal to or above a C is defined as a Pass and a letter grade of D or F is defined as a Fail. For the 19 students in the 2007 cohort that enrolled in the fall semester, 11 (58%) passed their first math course, 5 (26%) failed, and 3 (16%) withdrew from their respective math course. For the 13 students in the 2008 cohort, 6 (46%) passed their first math course, 4 (31%) failed, and 3 (23%) withdrew from their respective math course.

Attitudes Toward Math

To examine whether there was any change in attitudes toward mathematics over the course of the six-week summer program, only those students who completed both the pre and post ATMI were examined (see Tables 6 and 7 for the descriptive statistics for the 2007 and 2008 cohorts, respectively). The change from pre to post for the Total scale score and the four subscales was not statistically significant for both cohorts. For the 2007 cohort (see Table 6), the results show a slight decrease in attitude toward mathematics, albeit the means remain on the positive side of a 5-point scale. For the 2008 cohort (see Table 7), the results show a slight increase in attitude toward mathematics on all subscales except Enjoyment. Attitudes on the Enjoyment subscale remained positive despite their slight decrease. It is noteworthy that student attitudes on the Value subscale were higher (i.e., more positive) than on the other scales. This subscale intends to "measure students' belief on the usefulness, relevance and worth of mathematics in their life now and in the future" (p. 2).[8]

Table 6
Pre/Post Descriptive Statistics for the Attitudes Toward Mathematics Inventory (2007 Cohort)

2007	**Pre**						**Post**				
Scale	*n*	*M*	*SD*	Min/Max	Median		*n*	*M*	*SD*	Min/Max	Median
Total	12	3.85	0.44	3.15/4.88	3.85		12	3.69	0.51	2.95/4.68	3.65
Self Conf	12	3.70	0.61	2.80/5.00	3.77		12	3.54	0.64	2.33/4.80	3.53
Value	12	4.37	0.32	3.60/4.80	4.30		12	4.25	0.53	3.20/4.90	4.45
Enjoyment	12	3.61	0.60	2.90/5.00	3.55		12	3.44	0.59	2.30/4.40	3.40
Motivation	12	3.72	0.40	3.00/4.40	3.70		12	3.48	0.50	2.80/4.40	3.40

Note. *n* = sample size, *M* = mean, *SD* = standard deviation, Min = minimum score, Max = maximum score. Self Conf = Self Confidence. Sample sizes (*n*) vary due to missing item responses. Items were coded on a 1-5 scale (1 = Strongly Disagree to 5 = Strongly Agree).

Table 7
Pre/Post Descriptive Statistics for the Attitudes Toward Mathematics Inventory (2008 Cohort)

2008	**Pre**						**Post**				
Scale	*n*	*M*	*SD*	Min/Max	Median		*n*	*M*	*SD*	Min/Max	Median
Total	12	3.89	0.48	3.10/4.58	3.99		12	3.93	0.37	3.18/4.35	4.04
Self Conf	10	3.66	0.57	2.60/4.60	3.73		10	3.75	0.43	2.87/4.13	3.90
Value	12	4.32	0.37	3.80/4.90	4.25		12	4.39	0.43	3.50/5.00	4.40
Enjoyment	11	3.83	0.56	3.10/4.70	3.80		11	3.75	0.59	2.50/4.40	3.90
Motivation	12	3.78	0.67	2.60/4.80	3.70		12	3.88	0.57	2.80/4.60	4.00

Note. See Note from Table 6.

Perception of Summer Bridge Program

Table 8 presents items to assess students' overall perception of the 2007 Summer Bridge Program. Noteworthy, from Table 8 include the following:

- 86% of respondents agreed that "Participating in the Summer Bridge Program has increased [their] interest in the engineering major" (item 1) with mean 4.14 (*sd* = 0.66)
- 93% of respondents agreed that "The Summer Bridge Program helped [them] gain a greater appreciation for the role that math plays in the engineering field" (item 2) with mean 4.50 (*sd* = 0.65)
- 57% of respondents agreed that "The Summer Bridge Program helped [them] gain a greater appreciation for the role that science plays in the engineering field" (item 3) with mean 3.71 (*sd* = 0.91)
- 86% of respondents agreed that "The Summer Bridge Program has improved [their] opinion of SIUC" (item 5) with mean 4.14 (*sd* = 0.66)

Table 8
Perception of the 2007 Summer Bridge Program

				Percent of Reponses (n = 14)					
#	**Item**	***M***	***sd***	**SA**	**A**	**N**	**D**	**SD**	**NR**
1	Participating in the Summer Bridge Program has increased my interest in the engineering major.	4.14	0.66	28.6	57.1	14.3	0.0	0.0	0.0
2	The Summer Bridge Program helped me gain a greater appreciation for the role that math plays in the engineering field.	4.50	0.65	57.1	35.7	7.1	0.0	0.0	0.0
3	The Summer Bridge Program helped me gain a greater appreciation for the role that science plays in the engineering field.	3.71	0.91	21.4	35.7	35.7	7.1	0.0	0.0
4	The Summer Bridge Program has helped me to approach problem solving with more creativity.	3.93	0.73	21.4	50.0	28.6	0.0	0.0	0.0
5	The Summer Bridge Program has improved my opinion of SIUC.	4.14	0.66	28.6	57.1	14.3	0.0	0.0	0.0

Note. *M* = mean, *sd* = standard deviation, SA = Strongly Agree, A = Agree, N = Neutral, D = disagree, SD = Strongly Disagree, NR = No Response.
Items were coded on a 1-5 scale (1 = Strongly Disagree to 5 = Strongly Agree).

Table 9 presents items to assess students' overall perception of the 2008 Summer Bridge Program. It is noteworthy that none of the respondents disagreed with any of these items. For example:

- 92% of respondents agreed that "Participating in the Summer Bridge Program has increased [their] interest in the engineering major" (item 1) with mean 4.25 (*sd* = 0.62)
  (up 6% from summer 2007)
- All respondents agreed that "The Summer Bridge Program helped [them] gain a greater appreciation for the role that math plays in the engineering field" (item 2) with mean 4.42 (*sd* = 0.51)
  (up 7% from summer 2007)
- 75% of respondents agreed that "The Summer Bridge Program helped [them] gain a greater appreciation for the role that science plays in the engineering field" (item 3) with mean 4.08 (*sd* = 0.79)
  (up 18% from summer 2007)
- 83% of respondents agreed that "The Summer Bridge Program has improved [their] opinion of SIUC" (item 5) with mean 4.33 (*sd* = 0.78)
  (down 3% from summer 2007)

Table 9
Perception of the 2008 Summer Bridge Program

				Percent of Reponses (n = 12)					
#	Item	*M*	*sd*	SA	A	N	D	SD	NR
1	Participating in the Summer Bridge Program has increased my interest in the engineering major.	4.25	0.62	33.3	58.3	8.3	0.0	0.0	0.0
2	The Summer Bridge Program helped me gain a greater appreciation for the role that math plays in the engineering field.	4.42	0.51	41.7	58.3	0.0	0.0	0.0	0.0
3	The Summer Bridge Program helped me gain a greater appreciation for the role that science plays in the engineering field.	4.08	0.79	33.3	41.7	25.0	0.0	0.0	0.0
4	The Summer Bridge Program has helped me to approach problem solving with more creativity.	4.25	0.62	33.3	58.3	8.3	0.0	0.0	0.0
5	The Summer Bridge Program has improved my opinion of SIUC.	4.33	0.78	50.0	33.3	16.7	0.0	0.0	0.0

Note. See Note from Table 8.

Table 10 presents students' overall confidence in their choice to attend SIUC and complete the engineering program. All students from the 2007 cohort with the exception of one felt positively (i.e., *agree* or *strongly agree*) in their choice to attend SIUC because of their interaction with faculty and staff (item 7) and because of their participation in the Summer Bridge Program (item 8). The majority of students also felt positively in their ability to successfully complete the engineering program because of their participation in the summer program (item 9). Furthermore, when asked if they would recommend the Summer Bridge Program to others interested in an engineering major (item 10), all students responded *agree* or *strongly agree* to this item.

Table 10
Confidence in Attending SIUC and Recommendation of 2007 Summer Bridge Program

				Percent of Reponses (n = 14)					
#	Item	*M*	*sd*	SA	A	N	D	SD	NR
6	I am more confident in my choice to attend SIUC as a result of staying in the residence hall during the Summer Bridge Program.	3.86	0.86	21.4	50.0	21.4	7.1	0.0	0.0
7	I am more confident in my choice to attend SIUC as a result of my interactions with faculty and staff during the Summer Bridge Program.	4.21	0.58	28.6	64.3	7.1	0.0	0.0	0.0
8	I am more confident in my choice to attend SIUC because of my participation in the Summer Bridge Program.	4.21	0.58	28.6	64.3	7.1	0.0	0.0	0.0
9	I am more confident in my ability to successfully complete the engineering program because of my participation in the Summer Bridge Program.	4.00	0.78	21.4	64.3	7.1	7.1	0.0	0.0
10	I would recommend the Summer Bridge Program to other students interested in an engineering major at SIUC.	4.43	0.51	42.9	57.1	0.0	0.0	0.0	0.0

Note. See Note from Table 8.

Table 11 presents students' overall confidence in their choice to attend SIUC and complete the engineering program for the 2008 cohort (item 11 was added to the 2008 post-survey). Students

expressed stronger agreement for all confidence items in 2008 compared to 2007 (i.e., means above four on a 5-point scale). The following are some noteworthy observations from Table 11. All students agreed that:

- They are "more confident in [their] ability to successfully complete the engineering program because of [their] participation in the Summer Bridge Program" (item 9) with mean 4.50 (*sd* = 0.52)
  (up 14% from summer 2007)
- They "would recommend the Summer Bridge Program to other students interested in an engineering major" (item 10) with mean 4.58 (*sd* = 0.51).
- They are "more confident in [their] choice to study engineering because of [their] participation in the Summer Bridge Program" (item 11) with mean 4.50 (*sd* = 0.52)

Table 11
Confidence in Attending SIUC and Recommendation of 2008 Summer Bridge Program

				Percent of Reponses (*n* = 12)					
#	**Item**	***M***	***sd***	**SA**	**A**	**N**	**D**	**SD**	**NR**
6	I am more confident in my choice to attend SIUC as a result of staying in the residence hall during the Summer Bridge Program.	4.42	0.67	50.0	41.7	8.3	0.0	0.0	0.0
7	I am more confident in my choice to attend SIUC as a result of my interactions with faculty and staff during the Summer Bridge Program.	4.33	0.78	50.0	33.3	16.7	0.0	0.0	0.0
8	I am more confident in my choice to attend SIUC because of my participation in the Summer Bridge Program.	4.42	0.67	50.0	41.7	8.3	0.0	0.0	0.0
9	I am more confident in my ability to successfully complete the engineering program because of my participation in the Summer Bridge Program.	4.50	0.52	50.0	50.0	0.0	0.0	0.0	0.0
10	I would recommend the Summer Bridge Program to other students interested in an engineering major at SIUC.	4.58	0.51	58.3	41.7	0.0	0.0	0.0	0.0
11	I am more confident in my choice to study engineering because of my participation in the Summer Bridge Program	4.50	0.52	50.0	50.0	0.0	0.0	0.0	0.0

Note. See Note from Table 8.

Summer Bridge participants were also asked about their attitudes toward interpersonal relationships and perception of living in the residence hall (see Tables 12 and 13 for 2007 and 2008 cohorts, respectively). Students in the 2008 Summer Bridge Program expressed stronger agreement on the attitude items compared to the 2007 cohort (i.e., all means greater than or equal to four on a 5-point scale). Of particular note are the following:

- 75% of 2008 respondents agreed that they were "satisfied with the Summer Bridge Program social activities" (item 13) with mean 4.00 (*sd* = 0.95)
  (up 11% from summer 2007)

- 92% of 2008 respondents agreed that their "experience in the residence hall during the Summer Bridge Program has improved [their] opinion of SIUC" (item 17) with mean 4.42 (*sd* = 0.67)
  (up 21% from summer 2007)
- All 2008 respondents agreed that "Living in the residence hall helped [them] form a sense of community with [their] fellow Summer Bridge Program students" (item 16) with mean 4.67 (*sd* = 0.49)
  (up 7% from summer 2007)

Table 12
Attitudes Toward Interpersonal Relationships and Living in the Residence Hall (2007 Cohort)

				Percent of Reponses (*n* = 14)					
#	**Item**	***M***	***sd***	**SA**	**A**	**N**	**D**	**SD**	**NR**
12	My interactions with faculty and staff make it more likely that I would recommend SIUC to a friend considering an engineering major.	4.21	0.70	35.7	50.0	14.3	0.0	0.0	0.0
13	I was satisfied with the Summer Bridge Program social activities.	3.57	1.16	21.4	42.9	7.1	28.6	0.0	0.0
14	It has been easy for me to meet and make friends with other students during the Summer Bridge Program.	4.07	0.73	28.6	50.0	21.4	0.0	0.0	0.0
15	Living in the residence hall helped me to adjust to university life.	4.36	0.50	35.7	64.3	0.0	0.0	0.0	0.0
16	Living in the residence hall helped me form a sense of community with my fellow Summer Bridge Program students.	4.29	0.61	35.7	57.1	7.1	0.0	0.0	0.0
17	My experience in the residence hall during the Summer Bridge Program has improved my opinion of SIUC.	3.93	0.73	21.4	50.0	28.6	0.0	0.0	0.0

Note. See Note from Table 8.

Table 13
Attitudes Toward Interpersonal Relationships and Living in the Residence Hall (2008 Cohort)

				Percent of Reponses (*n* = 12)					
#	**Item**	***M***	***sd***	**SA**	**A**	**N**	**D**	**SD**	**NR**
12	My interactions with faculty and staff make it more likely that I would recommend SIUC to a friend considering an engineering major.	4.25	0.75	41.7	41.7	16.7	0.0	0.0	0.0
13	I was satisfied with the Summer Bridge Program social activities.	4.00	0.95	33.3	41.7	16.7	8.3	0.0	0.0
14	It has been easy for me to meet and make friends with other students during the Summer Bridge Program.	4.50	0.67	58.3	33.3	8.3	0.0	0.0	0.0
15	Living in the residence hall helped me to adjust to university life.	4.50	0.52	50.0	50.0	0.0	0.0	0.0	0.0
16	Living in the residence hall helped me form a sense of community with my fellow Summer Bridge Program students.	4.67	0.49	66.7	33.3	0.0	0.0	0.0	0.0
17	My experience in the residence hall during the Summer Bridge Program has improved my opinion of SIUC.	4.42	0.67	50.0	41.7	8.3	0.0	0.0	0.0

Note. See Note from Table 8.

One Year Retention

Out of 21 students participating in the 2007 Summer Bridge Program, 19 enrolled in the COE in the fall 2007 semester. One year later at the start of the fall 2008 semester, 6 students remained enrolled in the COE, 3 switched majors, 7 left the university for academic reasons and 3 left the university for non-academic reasons.

Out of 14 students participating in the 2008 Summer Bridge Program, 13 enrolled in the COE in the fall 2008 semester. One year later at the start of the fall 2009 semester, 9 students remained enrolled in the COE and 5 left the university for academic reasons.

For the 2007 Summer Bridge cohort only 32% (6/19) of students were retained in the COE in the following year compared to a 69% (9/13) retention rate for the 2008 Summer Bridge cohort. Average freshman retention rates from 1997 to 2004 were 64% in the COE. Following two years of implementing project initiatives, overall freshman retention rates are 71% and 74%, respectively.

Summary

With support from the National Science Foundation, the College of Engineering hosted Summer Bridge Programs in 2007, 2008, and 2009 under its new student retention initiative. The six-week program is one component of a set of innovative student centered academic and nonacademic programs to improve the retention rate in the College of Engineering. The Summer Bridge Program had the following three overall objectives: (a) "to help at risk students develop a solid foundation of problem solving skills that will facilitate their advancement in the engineering math curriculum," (b) "to help students gain a deeper appreciation for the role that math and science plays in the engineering field," and (c) "to integrate first year students into the socio-academic environment of the College of Engineering and help smooth their transition to collegiate life." Achievement of the objectives was evaluated with pre and post survey data collection and math performance measures.

Achievement of Objectives

One objective of the Summer Bridge Program was "to help at risk students develop a solid foundation of problem solving skills that will facilitate their advancement in the engineering math curriculum." Overall students showed a positive mean change in math scores from pre to post on the COMPASS Math Placement Test (College Algebra and Trigonometry). Furthermore, 57% of students placed into a higher recommended math course at the end of the 2008 Summer Bridge Program (down 29% from summer 2007) compared to their recommended math placement at the start of the summer program. Pass rates for their first math course in the subsequent fall semester were higher for the 2007 cohort (58% passing) compared to the 2008 cohort (46% passing). Based on the aforementioned math performance indices it appears that the Summer Bridge Program has helped facilitate students' advancement in the engineering math curriculum over the course of the six-week program. However, the follow-up success rate (i.e., passing grades) in their fall math courses is lower than expected given their gains in math performance from beginning to end of the six-week summer program. Perhaps a closer

examination of the criteria that forms the basis of the recommended math course placement is needed to ensure a higher success rate for students.

Another objective of the Summer Bridge Program was "to help students gain a deeper appreciation for the role that math and science plays in the engineering field." Results of the Attitudes Toward Mathematics and Engineering Survey indicated that students started the summer program with an overall positive attitude toward mathematics with the highest mean positive attitude on items measuring the usefulness, relevance and worth of mathematics (i.e., Value subscale). More specifically, two items on the post attitude survey directly asked whether the Summer Bridge Program helped students: (a) "gain a greater appreciation for the role that math plays in the engineering field" and (b) "gain a greater appreciation for the role that science plays in the engineering field." All of the 12 students who completed the post survey in 2008 responded *agree* or *strongly agree* to the math item (up 7% from summer 2007), whereas only 75% responded *agree* or *strongly agree* to the science item (up 18% from summer 2007). Thus, it seems that the emphasis on math during the summer program had a positive impact on students' view of the role that math plays in the engineering field. Although, fewer students felt positive that the summer program helped them gain a greater appreciation of the role that science plays in the engineering field, the rate of agreement increased 18% from the previous year.

Lastly, an objective of the Summer Bridge Program was "to integrate first year students into the socio-academic environment of the College of Engineering and help smooth their transition to collegiate life". Based on responses of the students who completed the post survey, students felt overwhelmingly positive that the summer program increased their interest in the engineering major and improved their opinion of SIUC. Students also felt positively about their interactions with faculty and staff and the development of friendships during the summer program. Furthermore, students felt positive that living in the residence hall helped them adjust to university life, develop friendships and form a sense of community with their fellow summer program students. Students also felt confident in their choice to attend SIUC because of interactions with faculty and staff and participation in the summer program. Most notable is that when asked whether they would "recommend the Summer Bridge Program to other students interested in an engineering major at SIUC" all students responded *agree* or *strongly agree* to this item. Based on students' positive attitudes, the summer program appears to have helped make the transition to university life easier by integrating the participants into the socio-academic environment at SIUC.

Conclusion

In conclusion, the most effective elements of the Summer Bridge Program include the students' gains in math achievement, students' positive attitudes about the summer program and the university in general and students' opinion that living in the residence hall helped them acclimate to collegiate life. Students felt less positive about gaining a deeper appreciation of the role that science plays in the engineering field compared to math, albeit the rate of agreement for the science component was higher in 2008 than the previous year's cohort of participants. This is particularly noteworthy because one of the non-credit workshops during the summer program was an engineering science preview. Programmatic and personnel changes to the science component of the Summer Bridge Program may explain the positive attitude change.

The one year retention rates were dramatically different for the 2007 and 2008 cohorts (i.e., 32% and 69%, respectively). The retention rate for the summer 2007 cohort is substantially lower, whereas the rate for the summer 2008 cohort is similar to the overall COE retention rates for the 2007 and 2008 freshman cohorts. At this time, small sample sizes for the Summer Bridge Program preclude running additional analyses to explore possible influences on retention rates.

The Summer Bridge Program was under-utilized for summer 2008 because only 14 out of 30 slots were filled compared to 21 out of 30 slots for the summer 2007 program. Programmatic changes were implemented to increase recruitment for the 2009 Summer Bridge Program which had 19 participants. Although it is too soon to evaluate the one year retention rate for the 2009 Summer Bridge cohort, 18 participants remain enrolled in the COE for the spring 2010 semester.

Follow-up of Summer Bridge Program

Evaluation of the Summer Bridge Program will continue by tracking the enrollment status, program progress and grades for students who participated in the program. A further evaluation of the Summer Bridge Program will be a comparison of the success (e.g., grades and retention rate) of students who participated in the program to those students who may have been eligible for the program but who did not enroll.

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