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The University of Hartford, Hillyer College Summer Bridge Program: A Model and Case Study for Improving Student Academic Performance

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Abstract

This study follows student performance in math from student entry into the University of Hartford Summer Bridge Program to the final grade of the first academic semester math course in Hillyer College. Based on the results, a model has been developed which maps and quantifies the critical path for academic success. Program effectiveness was assessed in two dimensions: (1) Bridge Program students: (a) determination of progress made during the Bridge Program; (b) determination of relationships between the first regular semester math course grade with Δ (difference between Pre- and Post-Program test results) Math SAT scores Bridge and Non-Bridge students; (2) Comparison between Bridge and Non-Bridge students of regular semester final grades. Results show that for students who complete the Summer Bridge Program: (1) the overall mean score on the post-Program assessment is statistically significantly greater than the pre-Program assessment mean score; (2) the degree of individual student improvement demonstrated over the course of the Summer Bridge Program correlates significantly with individual first semester final grades in math;(3) the overall mean score of the first semester final grades in math for the Bridge Program cohort is statistically significantly greater than the mean score for non-Bridge students who completed the same first semester math course; the enhanced performance is equivalent to approximately a full letter grade.

Keywords: University of Hartford, Hillyer College, Bridge Program, academic performance, mathematics, improvement

1. Introduction

The Summer Bridge Program at Hillyer College of the University of Hartford is an intensive five-day experiential learning program designed to prepare academically at-risk incoming freshmen for the challenges of college life. The program covers multiple disciplines, including mathematics which is the subject of this study, and provides a set of academic strategies as well as social activities. Key features which promote student learning and acclimation to a rigorous academic environment include (a) extensive student-faculty interaction, (b) cooperation among students, (c) active learning with prompt feedback, (d) clear standards and high expectations, (e) emphasis on respect for diversity in talents and learning styles, and (f) utilization of math-specific computer software. The program week is highly structured, with an hour-by-hour daily schedule alternating discipline-specific classroom instruction, software-based exercises, and practice in study skills, followed in the evening by homework assignments and on/off-campus social activities and events. Academic assessments are conducted at the beginning and at the end of the week to determine student progress during the program and used to provide feedback for further program development and improvement. The program schedule is shown in Exhibit 1. The present study utilizes the data collected during the program as well as students' grades achieved in their first semester math course in order to quantify academic performance in terms of (a) progress over the course of the program and (b) as compared with students who did not participate in the program.

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Objectives of the study were to: (1) determine the effectiveness of the Summer Bridge Program in improving student performance; (2) quantify academic performance improvement; (3) quantify factors related to improved student performance; (4) develop a model for performance improvement and tracking which can be replicated for any academic discipline.

Bridge Program Schedule of Activities	
Day	**Activities**
Sunday	• Students Check In • Complete Early Assessment • Meet with Resident Assistant / Mentor • Meet the Dean of the College: "A Vision for the Week and Year Ahead" • Dinner with Faculty • Pre-Test
Monday-Thursday	• College life/campus activities (all) • Two hours covering math topics (cohort 1) • Two hours of study skills (cohort 2) • Lunch with Specialist and free time • Two hours covering math topics (cohort 2) • Two hours of study skills (cohort 1) • On-campus activity • Dinner/completion of assignments / off campus activities
Friday	• Selected activity • Post-Program Assessment; feedback /discussions • Post-Test • Lunch • Awards presentation • Adjourn

Exhibit 1: Schedule of Activities

2. Research Questions

1. Did students who participated in the Summer Bridge Program demonstrate improved math skills by the end of the Program?
2. Did computer-based learning contribute to improved math skills?
3. Did the Bridge Program students demonstrate greater math skills than students who did not participate in the Bridge Program?

4. Null and Alternate Hypotheses

1. Ho: Post-Program assessment score mean is not statistically significantly greater than the initial Pre-Program assessment score.
   Ha: Post-Program assessment score mean is statistically significantly greater than the initial Pre-Program assessment score mean.
2. Ho: There is no statistically significant relationship between computer-based learning scores and assessment scores.
   Ha: There is a statistically significant relationship between computer-based learning scores and assessment scores.
3. Ho: The mean final grade of the first semester math course for the Bridge students is not statistically significantly greater than the mean final grade for non-Bridge Program students who took the same math course.
   Ha: The mean final grade of the first semester math course for the Bridge students is statistically significantly greater than the mean final grade for non-Bridge Program students who took the same math course.

4. Methodology

4.1. Study Populations

(a) Students participating in the Summer Bridge Program, n=19;
(b) Non-Bridge program students who completed the same first semester math course as the Bridge students, n=13.

4.2. Data

(a) Individual student scores of assessment tests administered (a) at the beginning of the program (Pre-Test) and (b) at the conclusion of the Summer Program (Post-Test), prior to beginning the fall semester.(b) Individual student final grades, in numerical form, for the first semester math course taken by both Bridge Program and non-Bridge Program students.

(c) Differences between the Pre-Test and Post-Test were calculated and utilized as a potential predictor in regression analysis.
(d) Math SAT scores were utilized as a potential predictor in regression analysis.

4.3. Statistical techniques

(a) 2 sample t-Tests for comparing means of Pre-Program vs. Post-Program assessments, and for comparing first semester math final grades of Bridge Program vs. non-Bridge Program students.
(b) Multiple and simple linear regression to develop predictive model for final grades as the response variable.
(c) Box Plots were created to display data spread and central tendency for (i) Bridge student Pre-Test vs. Post-Test; (ii) Bridge student vs. non-Bridge student final math grades.
(d) Scatter plots with regression lines to accompany regression analysis.

5. Results

Figure 1 presents a model for improving at-risk student academic performance based on the results of this study. As shown, progressive involvement and interaction between students and faculty culminate in quantitative improvement over the course of the program and carries over into the first regular semester math course. Exhibit 2 shows a statistically significant increase in Post-Test scores vs. Pre-Test scores, suggesting the content and delivery of the Summer Program is effective in promoting student performance during this period.

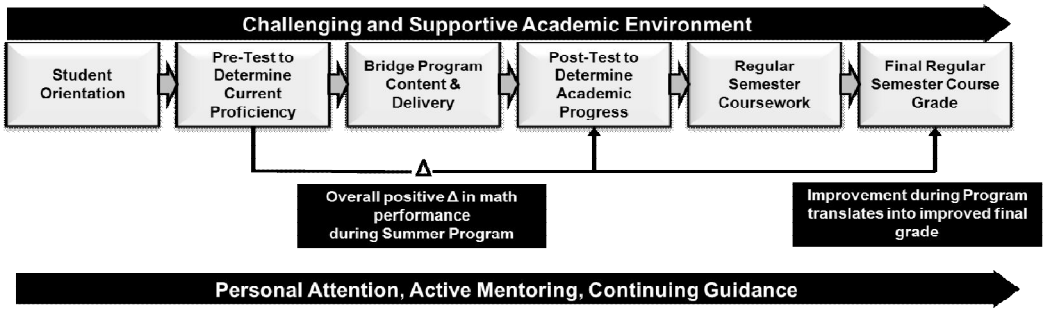

Figure 1: The University of Hartford Model for Improving Student Academic Performance

Comparison of Means for Pre-Test vs. Post-Test
2 Sample t-Test
August, 2014

Sample	n	Mean	Std. Dev.	p
Post-Test	18	80.3	18.2	0.041
Pre-Test	18	68.4	22.4	

Exhibit 2: Pre-Test vs. Post-Test Mean Comparison; 2 Sample t-Test 95% CL; Ho: Post-Test Score Mean ≤ Pre-Test Score Mean; Ha: Post-Test Score Mean > Post-Test Score Mean

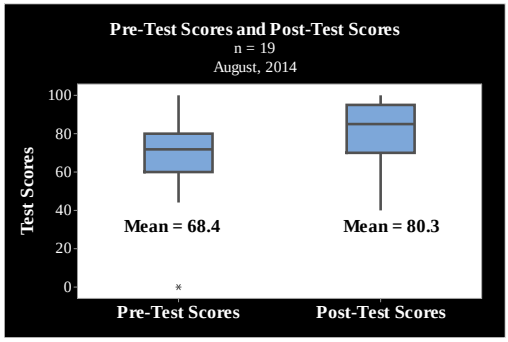

Figure 2: Distributions of Pre-Test and Post-Test scores

To better understand potential drivers of improvement during the Bridge Program, regression analysis was performed to determine the effect of exercises completed in My Math Lab (MML), on the Post-Test scores. MML is a computer-based learning tool with pre-loaded problems which can be selected by the instructor to match curriculum requirements, and tailor for classroom assignments. Utilization of this tool fosters student discipline, personal instructor attention and mentoring, and course-specific content mastery, all of which are key components of the Bridge Program. As shown in Figure 3, students who more successfully completed the MML assignments tended to be more likely to achieve higher Post-Test scores. Exhibit 3 shows MML scores to be a statistically significant predictor of Post-Test scores.

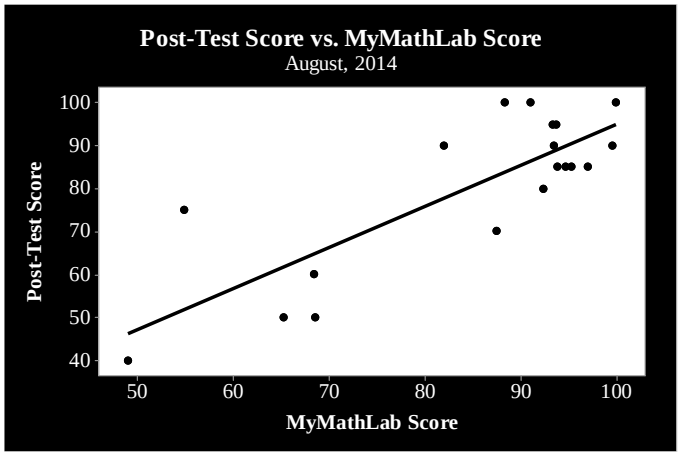

Figure 3: Scatter plot with Regression Line for Post-Test Score as a Function of MMM score

Simple Linear Regression Analysis: Post-Test Score vs. MML Score August, 2014	
Regression Equation Post-Test Score = -0.6 + 0.956 MML Score	
Predictor	**p**
Constant	0.967
MML scores	0.000
R-sq(adj) 66.1%	

Exhibit 3: Regression Statistics for Post-Test vs. MML Scores

With initial results suggesting that significant improvement in academic performance occurs over the course of the Bridge Program itself, further analysis was performed to determine if this improvement translates into improved classroom performance during the first academic semester math course. In Exhibit 4, multiple linear regression analysis shows that Δ, the difference between Pre-Test and Post-Test scores, is a moderate predictor of academic performance in the classroom, as measured by the final course grade. Also of note is that SAT scores do not correlate with either Δor with final course grades, as shown in Exhibit 5, further supporting the Bridge Program as the main effect in improved student performance.

Multiple Regression Analysis: Final Grade vs. Δ (Pre/Post Bridge) & Math SAT Score August-December, 2014	
Predictor	p
Constant	0.027
Δ (Pre/Post Bridge)	0.013
Math SAT Score	0.981
R-Sq(adj) 29.9%	

Exhibit 4: Multiple Linear Regression Statistics for Final Grade vs. Δ and Math SAT Score

Pearson Correlation Coefficients for Final Grade, Math SAT Scores, and Δ (Pre/Post Bridge) August-December, 2014		
Factor	Δ (Pre/Post Bridge)	Math SAT Score
Final Grade	0.625	0.060
	p = 0.007	p = 0.827
Math SAT Score	0.087	
	p = 0.749	

Exhibit 5: Pearson Correlation Coefficients

Simple linear regression analysis was performed with only Δ as a predictor to validate the multiple regression results. Exhibit 6 shows Δ to be a statistically significant predictor of final individual course grades; Figure4 depicts the relationship between course final grade and Δ.

Simple Linear Regression Analysis: Final Grade vs. Δ (Pre/Post Bridge) August-December, 2014	
Regression equation: Final Grade = 83.4 + 0.785 Δ(Pre/Post Bridge)	
Predictor	p
Constant	0.000
Δ (Pre/Post Bridge)	0.007
R-sq(adj) 35.1%	

Exhibit 6: Regression Statistics for Final Grade vs. Δ

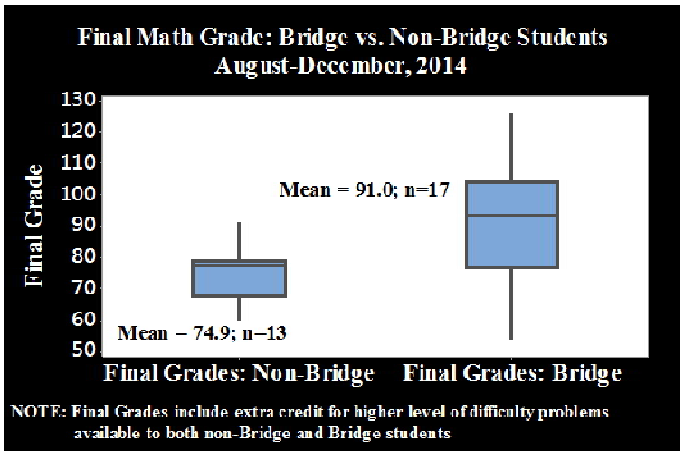

Figure 5: Distributions of Final Grades

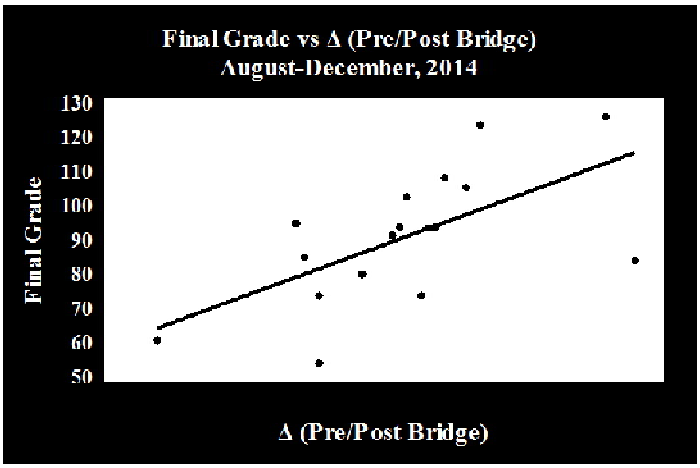

Figure 4: Scatter Plot with Regression line for Final Grade vs. Δ

To further determine the effectiveness of the Summer Bridge Program, the means of Final Grades for the first semester math course were compared for two groups: (1) Bridge Program students and (2) Non-Bridge students who completed the same math course. Exhibit 7 shows the Bridge Program students who completed the math course averaged approximately 1.5 letter grade higher than the Non-Bridge students who took the same course. Figure 5 displays the spread and central tendency for the two groups of final course grades.

Comparison of Means for Final Grades in First Semester Math Course
2 Sample t-Test
August-December, 2014

Sample	n	Mean	Std. Dev.	p
Final Grade Bridge	17*	91.0	19.4	0.003
Final Grade Non-Bridge	13	74.9	8.7	

Exhibit 7: Comparison of Mean Final Grades

*Note: 2 of original 19 students did not complete the full track from Bridge through first semester course.

6. Summary of Hypothesis Testing

1. Null hypothesis 1 is rejected

   The Post-Program assessment score mean was found to be statistically significantly greater than the initial Pre-Program assessment score mean.

2. Null hypothesis 2 is rejected

   The relationship between My Math Lab scores and Post-Test scores was found to be statistically significant.

3. Null hypothesis 3 is rejected

   The mean final grade of the first semester math course for the Bridge students was found to be statistically significantly greater than the mean final grade for non-Bridge Program students who took the same math course.

7. Additional Findings

For the 17 students who completed both the summer Bridge Program and the first semester math course:

1. The relationship between Δ, the difference between Pre-Test and Post-Test scores, and the Final Grade of the first semester math course is statistically significant.
2. Math SAT score is not a statistically significant predictor of the first semester course Final Grade.
3. Eleven of the seventeen students (64.7%) who completed the Bridge program and the following regular semester math course achieved either University of Hartford President's List or Hillyer College Dean's List, with no Bridge students on academic probation.

8. Conclusions

1. The Summer Bridge Program is effective in improving math performance over the course of the program irrespective of Math SAT scores of incoming students, and this improvement results in higher performance in the regular semester as compared to non-Bridge students.
2. Students who show greater progress during the Bridge program are more likely to show higher grades in regular semester courses.
3. Utilization of My Math Lab is a significant contributor to student success.
4. Further research is warranted to identify additional variables contributing to the success of Bridge Program students in order to provide increased focus on those specific success factors.