Bridge Program Participation and Undergraduate Academic Performance

NAZARBAYEV UNIVERSITY

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1. Bridge Programs: Closing the Gap in Academic Preparation

Academic preparation plays a key role in students' transition to and successful progression through post-secondary education. Unfortunately, many students who begin post-secondary education do not have the knowledge and skills needed to succeed at the undergraduate level. In the US, for instance, 40% to 60% of students who begin post-secondary education require remedial instruction (Sablan, 2014). To close the gap in academic preparation and facilitate secondary school graduates' transition to higher education, many institutions around the world have established preparatory programs.

These programs are referred to as "foundation," "preparatory," or "bridge" programs. They differ in terms of components and implementation (Cabrera, Miner, & Milem, 2013), focus and student population served (Raines, 2012), as well as duration (Wathington, Pretlow, & Barnett, 2016). Researchers and university administrators have become particularly interested in assessing the impact of these programs on student success. Understanding this impact is important for planning resources and enhancing educational outcomes (Johnson-Weeks & Superville, 2014).

2. Previous Research on the Impact of Bridge Programs: An Overview

Study	Context	Design/Methods	Outcome studied	Bridge Participation Impact/Difference
Experimental studies:				
Wathington et al. (2011)	US: 8 colleges in Texas (1332 students)	Random assignment to treatment and control conditions	Attempt/pass first math course Attempt/pass first writing course	Positive impact Positive impact
Barnett et al. (2012); Wathington, Pretlow, & Barnett (2016)	US: 8 colleges in Texas (1318 students)	Random assignment to treatment and control conditions	Pass first math/writing course 1 year after Pass first math/writing course 2 years after Credits attempted 2 years after Reading course completion 2 years after Persistence	Positive impact No impact No impact No impact No impact
Quasi-experimental studies:				
Douglas & Attewell (2014)	US: representative sample of institutions (5580 students)	Propensity score matching	First-year retention Timely graduation	Positive impact Positive impact
Allen & Bir (2012)	USA: Single institution (3046 students)	Post-test only control group design; Structural Equation Modeling	First-Year Cumulative GPA Persistence to second year	Positive impact Positive impact
Walpole et al. (2008)	USA: single institution (191 students)	Matched control design based on SAT scores; longitudinal surveys	GPA Retention Academic and social engagement	No impact Positive impact Positive impact
Hansen & Williams (2007)	US: Single institution (3 freshmen cohorts)	Matched control group design	First-term GPA First-year retention	Positive impact Positive impact
Other multivariate studies:				
Murphy, Gaughan, Hume, & Moore (2010)	US: Single institution (2200 minority students)	Survival analysis	Graduation	Positive impact
Johnson-Weeks & Superville (2014)	US: Single institution (202 students)	t-test, ANOVA, regression	GPA Math course grade English course grade	No impact No impact No impact
Cabrera, Miner, & Milem (2013)	USA: Single institution (6570 students)	Hierarchical regression	GPA Retention	Positive impact Positive impact
Bivariate studies:				
Bir & Myrick (2015)	USA: Single institution (1891 students)	ANOVA	Retention GPA Graduation	Positive impact Positive impact No impact
Anderson (2013)	USA: Single institution (72 students)	*t*-test and *eta*-squared	GPA Graduation	No impact Positive impact
Koljatic & Silva (2013)	Chile: Single institution (191 students)	Bivariate statistics	First-semester GPA Second-year GPA Second-year retention	Negative impact Negative impact No impact
Treviño, Scheele, & Flores (2014)	Chile: Single institution (74 students)	Simple regression	First-year GPA	Negative GPA

3. Characteristics of Research on the Impact of Bridge Programs

- Inconsistent/inconclusive findings—maybe due to differences in study designs and methodologies, structure and focus of bridge programs, institutional contexts, etc.
- Scarcity of robust empirical research (Johnson-Weeks & Superville, 2014; Koljatic & Silva, 2013; Walpole et al., 2008)
  - ✓ Need for longer follow-up periods to asses the impact of bridge participation more accurately (Cabrera et al., 2013; Raines, 2012; Wathington et al., 2016)
  - ✓ Need for accurate comparison groups (Cabrera et al., 2013; Treviño et al., 2014) and for addressing selection bias (Douglas & Attewell, 2014)

4. Study Purpose and Research Question

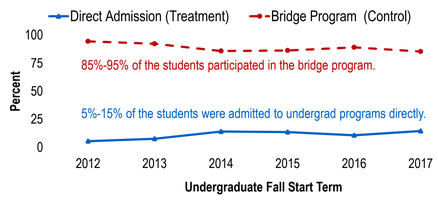
The purpose of this study is to examine the relationship between bridge program participation and academic performance within the context of an elite research university in the Republic of Kazakhstan.

Basic research questions: *Is there a difference in undergraduate academic performance between directly-admitted students (non-bridge participants) and bridge program participants? If yes, does this difference depend on students' undergraduate fields?*

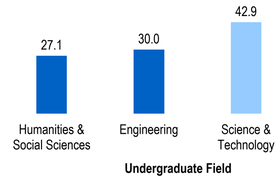
5. Study Context and Sample Description

- **Institutional Context**:
  - Nazarbayev University (NU): An elite research university in Kazakhstan
  - Institutional size: > 4,200 students (18% preparatory, 61% undergraduate, and 21% graduate)
  - Medium of instruction: English
  - Faculty: around 450 (78% international; 67% male)
- **Sample**: 3,618 first-time, full-time students who started undergraduate studies at NU from Fall 2012 to Fall 2017 and had been admitted to undergraduate programs either directly (11.4%) or after completing NU's yearlong bridge program (88.6%).

Percent of Students by Undergraduate Admission Type



Percent Distribution of Students by Field (N = 3,618)



6. Comparing Groups on Pre-Entry Characteristics

Covariates	Proportion/Mean for Directly-admitted students	Proportion/Mean for bridge program participants	Mean difference	Statistics used to test for equality	*p* value of comparison for equality
Demographic characteristics					
Male	0.51 (0.50)	0.53 (0.50)	-0.02	chi-square	0.561
Less than 18 years old during admission	0.67 (0.47)	0.80 (0.40)	-0.13	chi-square	**0.000*** **
2012 cohort	0.06 (0.24)	0.14 (0.35)	-0.08	chi-square	**0.000*** **
2013 cohort	0.10 (0.30)	0.15 (0.36)	-0.05	chi-square	**0.003****
2014 cohort	0.19 (0.40)	0.15 (0.36)	0.04	chi-square	**0.029***
2015 cohort	0.19 (0.39)	0.16 (0.36)	0.03	chi-square	0.069
2016 cohort	0.18 (0.39)	0.20 (0.40)	-0.01	chi-square	0.548
2017 cohort	0.27 (0.45)	0.21 (0.40)	0.07	chi-square	**0.002****
Pre-entry academic characteristics					
Had a perfect secondary school GPA	0.65 (0.48)	0.57 (0.49)	0.08	chi-square	**0.001****
Attended Kazakh-Turkish school	0.23 (0.42)	0.29 (0.45)	-0.06	chi-square	**0.012***
Attended Nazarbayev Intellectual school	0.38 (0.49)	0.29 (0.45)	0.09	chi-square	**0.000*****
Attended other secondary school	0.39 (0.49)	0.42 (0.49)	-0.03	chi-square	0.187
Entry-level English proficiency score	7.07 (0.55)	6.31 (0.57)	0.76	t test	**0.000*****

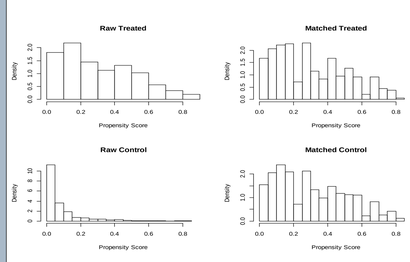
*** p < 0.001; **p < 0.01; *p < 0.05. Standard errors are in parentheses.

7. Analytical Procedures

- **Estimate Propensity Score**: Estimate the probability of being admitted directly (rather than through the bridge program) as a function of students' pre-entry characteristics (demographics, academic preparation, English proficiency, etc.).
- **Implement Full Matching**: Implement *full matching* (Rosenbaum 1991) using the MatchIt package (Ho et al. 2011, 2007) in the R software (R Core Team, 2013).
- **Assess Covariate Balance**: Assess covariate balance using histograms (Ho et al., 2011) and the *standardized difference, i.e.,* the mean difference as a percentage of the average standard deviation (Rosenbaum & Rubin 1985).
- **Run Regression**: Run regression analysis on matched samples, using an OLS model for term GPA and Cumulative GPA.
- **Simulate Treatment Effects**: Simulate average treatment effects, using regression results and 1,000 simulations in the Zelig Package (Imai et al. 2007).
- **Conduct Sensitivity Analysis**: Conduct sensitivity analysis using Rosenbaum's (2002) bounds, via a STATA procedure developed by Becker and Caliendo (2007).

8. Results of Propensity Score Matching: Covariate Balance

Distribution of Propensity Scores before and after Matching



Covariate Balance: Standardized Difference in Percent

Covariate	Before Matching	After Matching
Gender (Male)	13.9	3.2
Age (pre-admission)	28.3	3.0
Secondary school GPA	16.7	9.8
Secondary school type 1	21.6	5.4
Secondary school type 2	22.4	1.5
English admission test score	145.9	4.3
Cohorts 2012/2013	57.1	5.7
Cohort 2014	11.6	4.5
Cohort 2015	9.1	3.0
Cohort 2016	25.0	5.2

<= 10% | > 10% and <= 20 | > 20%

Balance summary: Treatment and control groups differed substantially before matching, as illustrated by the histograms in the "raw treated" and "raw control" groups and by large values of the *standardized difference in percent.* After matching, however, the distribution of propensity scores was similar in the "matched treated" and "matched control" groups. Also, values of the standardized difference in percent became much smaller after matching: treatment and control groups differed by less than 10% of a standard deviation (along each covariate).

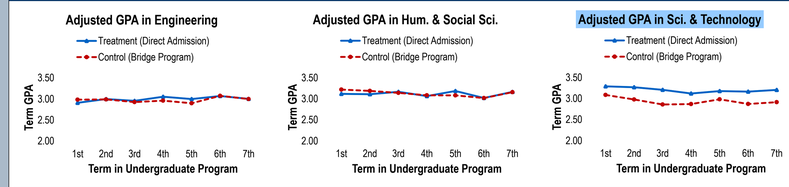
9. Post-Matching Analyses: Average Treatment Effects

	Engineering		Humanities & Soc. Sciences		Science & Technology	
	ATT	ATU	ATT	ATU	ATT	ATU
Term GPA						
Term 1	-0.08	-0.08	-0.10	-0.10	**0.21*** **	**0.21*** **
Term 2	0.01	0.01	-0.09	-0.08	**0.29*** **	**0.29*** **
Term 3	0.03	0.03	0.03	0.03	**0.35*** **	**0.35*** **
Term 4	0.10	0.09	-0.02	-0.01	**0.26****	**0.25****
Term 5	0.10	0.10	0.11	0.11	**0.19***	**0.20***
Term 6	0.00	0.00	-0.07	-0.07	**0.30****	**0.29****
Term 7	0.01	-0.01	0.00	0.00	**0.29****	**0.29****
Cum. GPA						
Year 1	-0.05	-0.05	-0.10	-0.10	**0.29*** **	**0.29*** **
Year 2	0.04	0.03	-0.02	-0.02	**0.30*** **	**0.30*** **
Year 3	0.00	0.00	0.01	0.02	**0.22****	**0.22****

*** p < 0.001; **p < 0.01; *p < 0.05

The ATT, or *Average Treatment Effect on the Treated,* is the average effect of being admitted directly rather than through the bridge program for students who actually were admitted directly.
The ATU, or *Average Treatment Effect on the Untreated*, is the average effect of being admitted directly rather than through the bridge program for students who actually were not admitted directly.

10. Post-Matching Results: Adjusted Term GPA Estimates



Science and Technology was the only field in which directly-admitted students and bridge participants differed in terms of undergraduate performance.

11. Sensitivity Analysis for Treatment Effect in Science & Technology

Unobserved covariates that affect treatment assignment and the outcome variable simultaneously may lead to a hidden bias, against which matching estimators are not robust (Rosenbaum, 2002). The sensitivity parameter (Γ) below estimates the odds ratio for differential treatment assignment due to unobserved variables that would be needed to render spurious our conclusion about the impact of admission type on academic performance for students in Science and Technology.

Sensitivity parameter

	Γ
First-Year Cum GPA	2.7
Second-Year Cum GPA	2.6
Third-Year Cum GPA	1.6

E.g.: For first-year cumulative GPA in Science and Technology, a Γ value of 2.7 means that the treatment effect may no longer be significant if:

1. an unobserved variable caused the odds ratio of treatment assignment to differ between treatment and control groups by a factor of 2.7; ***and***
2. this variable was so strong as to almost perfectly determine whether first-year GPA would be higher for the treated subject or the control subject in each pair of matched cases.

12. Summary of Findings

The relationship between bridge participation and undergraduate academic performance depends on students' undergraduate field:

- ✓ Being admitted directly rather than through the bridge program (or vice versa) had no impact on GPA in Engineering and Humanities/Social Sciences.
- ✓ In Science and Technology, being admitted directly was associated with a net gain of 30 percentage points in cumulative GPA in the first two years and 22 percentage points in the third academic year. These gains corresponded to 40%-50% of a standard deviation (or a medium-size effect).

13. Implications

The finding that directly-admitted students performed just as well as—and in some fields better than—bridge participants does not necessarily imply that the bridge program was not effective. It is possible, as Cabrera et al. (2013) observed, that the impact of bridge participation is indirect. Nevertheless, these findings suggest that direct admission is a viable option for the institution. Considering that over 85% of undergraduate students go through the yearlong bridge program and that institutional resources are limited, these findings also raise the question whether or not the University should increase the number of directly-admitted students and decrease the number bridge participants. There is probably no doubt that most students need a yearlong bridge program to enhance their chance of undergraduate success. However, it is also highly plausible that some students who go through this program are capable of succeeding at the undergraduate level even without participating in the bridge program. Identifying and admitting such students directly may help reduce costs and time to degree. In addition, some students might benefit from a shorter preparatory program (such as an intensive summer program), which can also help reduce costs and time to degree. An institution in this situation might wish to re-assess its admission policies and procedures and make admission and resource allocation decisions accordingly.

14. References

References can be found in the scholarly paper (downloadable from the conference website and also available upon request).