

Academic Performance in Times of Disruption: The Impact of COVID-19 and of a Grading Policy Intervention

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Study Purpose

Examine the extent to which (1) COVID-19 disruption and (2) implementation of an optional/alternative grading system impacted undergraduate students' academic performance at Nazarbayev University (NU).





Institutional Context

- * Elite public research university established in Kazakhstan (2010), to be a model for higher education reform and modern research
- Special law granting NU full autonomy •
- Programs created through strategic partnerships with top US, UK, and Singapore universities
- Use of English as medium of instruction





Institutional Context

- Fall 2020 enrollment: >6,200 students (64% undergraduate, 24% graduate, and 12% preparatory)
- Faculty members predominantly international (>75%)
- Switch to remote learning/instruction in Spring 2020
- Introduction of an optional grading system in Spring 2020 (was discontinued in Spring 2021)





Previous Research on the Impact of COVID-19 on Student Performance

Study	Context	Sample	Method	COVID	Notes
				Disruption	
				Impact	
Gonzalez et al. (2020)	Autonomous University of Madrid (Spain)	458 students in 3 course modules	 "Experimental Design" (however, no evidence of random assignment being used) Means comparison (Kruskal-Wallis Test) 	Positive	Better student performance on tests after the beginning of the confinement (compared to pre-Covid period)
Aucejo et al. (2020)	Arizona State University (USA)	1,446 undergraduate students	Survey Counterfactual model of causal inference (subjective treatment effect estimation)	Negative	Semester GPA decreased by 17 percentage points.



Previous Research on the Impact of COVID-19 on Student Performance

Study	Context	Sample	Method	COVID Disruption Impact	Notes
Aristovnik et al. (2020)	Worldwide (62 countries)	30,383 students	Survey Descriptive statistics, t- test, ANOVA, chi- square	Mixed	Overall, students reported a decrease in academic performance; however, graduate students and social science students reported improvement in performance
Son et al. (2020)	University of Texas System (USA)	195 students	Semi-structured interview surveys Descriptive statistics	Unclear	82% expressed increase concerns on academic performance.
Mahdy (2020)	Worldwide (92 countries)	1,392 veterinary students	Survey Descriptive statistics	Unclear	48% indicated that COVID had "greatly affected" their academic performance.



Research Questions



(1) To what extent does taking classes during the COVID-19 period impact students' academic performance?

Does this impact vary by study field or by how far the student is in the program?



Research Questions



(2) To what extent does the introduction of an alternative (optional) grading system impact students' academic performance?

Does this impact vary by study field or by how far the student is in the program?

SD: Satisfactory Disruption (A, B, C, D, and P grades were eligible for conversion). UD: Unsatisfactory Disruption (F grades were eligible for conversion).



Study Sample

N = 5,717

Undergraduate students who took classes any time during a seven-semester period:

SP18	FA18	SP19	FA19	SP20	FA20	S

PRE-COVID PERIOD

COVID PERIOD



NAZARBAYEV UNIVERSITY

Study Sample Description

	Mean /		
	Proportion	Minimum	Maximum
Demographic characteristics			
Gender (male)	0.502	0	1
Less than 18 years old during NU application	0.693	0	1
Pre-entry academic preparation			
Had a perfect secondary school GPA	0.580	0	1
Graduated from Kazakh-Turkish school	0.183	0	1
Graduated from Nazarbayev Intellectual school	0.443	0	1
Graduated from other secondary school	0.374	0	1
Overall entry-level English proficiency score	6.583	4	8.5
Undergraduate characteristics			
Admitted to undergraduate program directly	0.257	0	1
Engineering and Technology (ET) major	0.454	0	1
Humanities and Social Science (HSS) major	0.264	0	1
Life and Physical Science (LPS) major	0.228	0	1
Undeclared major	0.054	0	1
Covid-19 study experience			
Took classes during the Covid-19 period	0.486	0	1
Switched course grades to SD/UD in Spring 2020	0.616	0	1
Switched course grades to SD/UD in Fall 2020	0.472	0	1



Conceptual Framework



Astin's (1970a, 1970b) Input-Environment-Output Model

Inputs: personal qualities that students bring to higher education

Environment: students' actual experiences at the

Outputs: developmental aspects that the college seeks to influence



Variables of Interest

Environmental variables:

- Whether the student took classes during or before the Covid pandemic
- Whether or not the student converted any grades to the optional (SD/UD) grading system



Undergraduate admission route



Output:

Term GPA (before and after SD/UD conversion



Analytical Approach: Data Pre-processing for Covariate Balance



Data pre-processing, using a quasi-experimental design, was used to eliminate the relationship between observed inputs and the environment variables (relationship **A**), in order to estimate relationship **B** more accurately.







Data Processing for Covariate Balance: Entropy Balancing

Entropy balancing (Hainmueller, 2012)

- Generates weights that make individuals in the control group similar (on observed background) characteristics) to those in the treatment group.
- Targets covariate balance directly (means, variances, and skewness) and achieves a high degree of balance (unlike conventional matching methods).
- All observations are retained in the analysis (unlike propensity matching).
- A Has been found to perform exceptionally well in simulation studies (e.g., Amusa, Zewotir, & North, 2019; Zhao & Percival, 2017).



Covariate Balance Assessment

Standardized difference in percent (Rosenbaum & Rubin, 1985)

- Mean difference as a percentage of the average standard deviation (Rosenbaum & Rubin, 1985).
- Absolute values greater than 10% denote problems that require analytical adjustment (Rosenbaum & Rubin, 1985).
- Good properties in assessing balance (Austin, 2008; Imai, King, & Lau, 2008).



$100(\bar{x}_1 - \bar{x}_{0R}) / [(s_1^2 + s_{0R}^2)/2]^{1/2}$

 $\bar{x_1}$ and $\bar{x}_{0\textit{R}}\text{:}$ sample means for treatment and control groups

 s_1^2 and s_{0R}^2 : sample variances for treatment and control groups



Post-Matching Analyses: Basic Estimation Model

Δ_i (TGPA) = TGPA_i (D = 1) - TGPA_i (D = 0)

 Δ_i (*TGPA*): Difference in term GPA for student *i*

 $TGPA_i(D = 1)$: Term GPA for student *i*, in the presence of the treatment

 $TGPA_i$ (D = 0): Term GPA for student *i*, in the absence of the treatment

Note: Estimation was done using regression adjustment on the pre-processed dataset (for double robustness). Analyses were conducted by semester, field of study and year in the program.

Average Treatment Effect on the Treated (ATT)

"Mean effect for those who actually participated in the program [i.e., received the intervention]" (Wooldridge, 2002, pp. 604-605)



Software Implementation

STATA 16 (StataCorp, 2019), also including:

- kmatch package (Jann, 2017) for entropy balancing and post-matching estimations •
- rbounds package (Gangl, 2004) for sensitivity analysis



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Covariate Balance: Standardized Difference in % before Entropy Balancing

	Engineering & Technology	Humanities & Social Sciences	Life & Physical Sciences	
Direct admission	30.1	28.8	46.0	
Male	4.2	6.5	12.4	
Age when applying for entry	28.4	30.0	37.2	
Perfect secondary school GPA	15.9	8.3	19.9	
Nazarbayev Intellectual School graduate	28.7	30.3	28.8	
Graduate from other secondary schools	13.0	18.0	17.1	
English proficiency (Overall IELTS score)	34.7	24.4	44.9	010

Legend:

Raw Sa	>=20	>=15 to <20	>=10% to <15%	>5% to <10%	<=5%
betweer					
Treatme					

Imples: Systematic differences n treatment and control groups! ent and control groups not similar.

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Covariate Balance: Standardized Difference in % after Entropy Balancing

	Engineering & Technology	Humanities & Social Sciences	Life & Physical Sciences
Direct admission	0.0	0.0	0.0
Male	0.0	0.0	0.0
Age when applying for entry	0.0	0.0	0.0
Perfect secondary school GPA	0.0	0.0	0.0
Nazarbayev Intellectual School graduate	0.0	0.0	0.0
Graduate from other secondary schools	0.0	0.0	0.0
English proficiency (Overall IELTS score)	0.0	0.0	0.0

_egend:				
<=5%	>5% to <10%	>=10% to <15%	>=15 to <20	>=20

Matched Samples: No more systematic differences between treatment and control groups! Treatment and control groups very similar on observed covariates (and more comparable).



Average Treatment Effect on the Treated (ATT) for the Impact of Taking Classes during COVID-19: GPA before SD/UD Conversion

	1st-year	2nd-year	3rd-year	4th-year
Engineering & Technology (ET)				
Spring 2020	0.291 (0.043) ***	0.222 (0.050) ***	0.145 (0.049) **	0.121 (0.048) *
Fall 2020	0.040 (0.041)	0.330 (0.049) ***	0.194 (0.051) ***	0.102 (0.044) *
Spring 2021	0.161 (0.049) **	0.185 (0.058) **	0.100 (0.048) *	0.018 (0.051)
Life & Physical Sciences (LPS)				
Spring 2020	0.016 (0.064)	0.067 (0.067)	0.219 (0.076) **	0.048 (0.065)
Fall 2020	0.301 (0.065) ***	0.120 (0.060) *	-0.079 (0.075)	0.175 (0.072) *
Spring 2021	0.071 (0.079)	-0.066 (0.102)	-0.010 (0.088)	-0.015 (0.069)
Humanities & Social Sciences (HSS)				
Spring 2020	0.151 (0.048) **	0.075 (0.055)	0.010 (0.061)	0.095 (0.058)
Fall 2020	NA	0.077 (0.053)	0.185 (0.056) **	-0.023 (0.065)
Spring 2021	0.142 (0.054) **	0.224 (0.065) ***	- 0.119 (0.060) *	-0.099 (0.064)

*** p < 0.001; ** p < 0.01; * p < 0.05; . p < 0.1. Standard errors are shown in parentheses.



Adjusted Term GPA before SD/UD Conversion: Engineering & Technology Example



Spring 2020

Fall 2020



Adjusted Term GPA before SD/UD Conversion: Engineering & Technology Example







Average Treatment Effect on the Treated (ATT) for the Impact of Taking Classes during COVID-19: GPA after SD/UD Conversion

	1st-year	2nd-year	3rd-year	4th-year
Engineering & Technology (ET)				
Spring 2020	0.582 (0.040) ***	0.504 (0.048) ***	0.411 (0.047) ***	0.273 (0.046) ***
Fall 2020	0.201 (0.038) ***	0.517 (0.048) ***	0.373 (0.050) ***	0.235 (0.042) ***
Life & Physical Sciences (LPS)				
Spring 2020	0.357 (0.064) ***	0.346 (0.061) ***	0.441 (0.069) ***	0.256 (0.063) ***
Fall 2020	0.514 (0.061) ***	0.338 (0.055) ***	0.098 (0.070)	0.336 (0.066) ***
Humanities & Social Sciences (HSS)				
Spring 2020	0.359 (0.045) ***	0.380 (0.052) ***	0.244 (0.058) ***	0.298 (0.053) ***
Fall 2020	NA	0.283 (0.049) ***	0.326 (0.055) ***	0.135 (0.063) *

*** p < 0.001; ** p < 0.01; * p < 0.05; . p < 0.1. Standard errors are shown in parentheses.



Adjusted Term GPA after SD/UD Conversion: Engineering & Technology Example



Spring 2020

Fall 2020



Sensitivity Analysis

	Γ ^a value for treatment without SD/UD adjustment	Γ ^α value for tre with SD/UD
Engineering & Technology	2.15	5.6
Life & Physical Sciences	1.98	4.6
Humanities & Social	1.96	4.
Sciences		

Note: Γ is the odds of differential assignment to treatment due to unobserved factors. The Γ value is the level at which the treatment effect would cease to be statistically significant. Γ values displayed in this table are for effects that were found to be statistically significant. To simplify things, values are averaged across cohorts (first-year to fourth-year) and across terms (Spring 2020, Fall 2020, and Spring 2021).

Estimated ATT values that were statistically significant were also robust against omitted variable bias.

eatment effect adjustment

60

64

54





Impact of SD/UD Grade Conversion on Term GPA

Undergraduate students who switched grades to SD/UD



The number of courses grades eligible for SD/UD switch was unlimited in Spring 2020 and limited to 2 in Fall 2020. SD/UD grades were excluded from GPA computation.

Average number of course grades switched to SD/UD







Original term GPA = Term GPA before SD/UD grade conversion (in Spring and Fall 2020)



Impact of SD/UD: Trend in Original and SD/UD Term GPA





Average Treatment Effect on the Treated (ATT) for the Impact of SD/UD Grade Conversion

	Spring 2020		Fall 2020
Year in the program	ATT	Cohen's d	ATT
1 st Year	0.44 (0.01) ***	0.97	0.41 (0.01) ***
2 nd Year	0.45 (0.02) ***	0.86	0.36 (0.01) ***
3 rd Year	0.39 (0.01) ***	0.68	0.33 (0.01) ***
4 th Year	0.38 (0.02) ***	0.67	0.32 (0.01) ***

*** p < 0.001; ** p < 0.01; * p < 0.05; . p < 0.1. Standard errors are shown in parentheses.

Switching course grades to SD/UD resulted in a substantial increase in term GPA (for students who actually opted for the SD/UD system).





Average Term GPA Before and After Switching Grades to SD/UD

Spring 2020 4.00 4.00 After SD/UD Grade Conversion 3.50 3.50 3.00 3.00 Before SD/UD Grade Conversion 2.50 2.50 2.00 2.00 1.50 1.50 1.00 1.00 1st 2nd 3rd 4th 1st Year in the Program





Summary: Question #1

Impact of taking classes during Covid-19 on academic performance

Taking courses during the pandemic was associated with a net gain in academic performance.

- Finding consistent with Gonzalez et al. (2020).
- Finding contradicts studies that rely on student perceptions (e.g., Aucejo et al., 2020).

This impact varied across fields (and was more pronounced in Engineering and Technology).

The impact became much more substantial (across groups) when GPA was adjusted for SD/UD grade conversion.



Summary: Question #2

Impact of SD/UD grade conversion on final GPA

- Switching course grades to the SD/UD grading system led to a substantial increase in term GPA.
- The increase was consistent across groups (study fields and years in the program).





Implications and Issues for Discussion/Consideration

Possible factors explaining better academic performance during the COVID period:

- Increased student effort (during the confinement)?
- Better time management and study skills?
- Changes to curriculum, instruction, and assessment during the switch to online instruction?
- Drop in quality (e.g., faculty relaxing expectations, to help students cope better)?
- Student academic misconduct (e.g., cheating on remote assessments)?

Impact of SD/UD grade conversion on final GPA

- SD/UD: A pastoral response to the disruption (given concerns that performance might suffer)
- A motivating or demotivating factor (for students)?
- Artificial grade inflation for students who used this option?



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