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# Academic Performance of Face-to-Face and Online Students in an Introductory Economics Course and Determinants of Final Course Grades

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## Abstract

The purpose of this study is twofold. We first test if there is a significant difference in the means of final course completion grades between two instructional modalities, face-to-face and online, in a required Introductory Economics course at a large, public, southeastern university. We then examine various determinants as potential predictors of student academic performance. To this end, we investigate the effects of students' gender, age, major, semester choice and prior GPA on academic performance in both instructional modalities. In our initial analysis, our hypothesis testing results show that there is no statistically significant difference in the final course completion grade means between the two modalities. Regression results further indicate that students' gender, age, major (STEM and Business), semester choice (Traditional and Accelerated), and prior GPA have a significant effect on final course completion grades in face-to-face classes, with prior GPA, semester choice, and STEM major being the strongest predictors of academic performance. Students' prior GPA, gender, and major (STEM) are also the strongest predictors of final course completion grades in online classes. However, semester choice and major (Business) do not significantly affect final course completion grades in the online instructional modality.

## Introduction

Even before the SARS-CoV-2 (COVID-19) pandemic forced most universities to almost exclusively switch to an online instructional modality, online courses had become increasingly popular. The latest data from the National Center for Education Statistics' Integrated Postsecondary Education Data System (IPEDS, 2021) shows that in the fall of 2018 more than 6.9 million students, or 35.3% of students in the United States, were enrolled in online college classes. The asynchronous online instructional modality offers students the flexibility to work remotely at their own pace and thus provides a great alternative to face-to-face (F2F) instruction. It essentially removes the constraints of time and place from traditional on-campus programs (Swart et al., 2020).

While online courses have become increasingly popular, not all students thrive in this environment. Asynchronous online courses require students to be self-disciplined and organized to successfully

complete their coursework within the imposed deadlines. Some students may not have the discipline needed to regulate their progress in online classes, which may impact their academic performance. In fact, Oh and Reeves (2014) determined that the students' lack of self-regulation significantly influences academic outcomes. This may be especially true for traditional students who usually enroll in F2F classes, yet choose to take an occasional online class. In our data set, as described in Wakeling et al. (2018), all online and F2F sections follow the same instructor-regulated teaching format. Under this format, instructors set a schedule through which students' progress, commonly organized as a linear series of individual assessments, is measured.

In this study, we consider the performance of a broad group of students who are required to take an introductory economics course as part of their General Education Core Curriculum requirements. This group of students is a sample of the general student population. It is very varied and representative of all majors across all campuses. In the 2018-2019 academic years, students had the choice of enrolling in either F2F classes or online sections administered asynchronously through a learning management system. Whether F2F or online, students in all 42 sections in our data set matriculated under the same university entrance standards and registered during open enrollment (Wakeling et al., 2018).

Our intent in this paper is twofold. We first use hypothesis testing to initially investigate whether there is a statistical difference in the aggregate grade average of F2F and online sections by comparing final course completion grade class means. We then rely on regression analysis to examine how various student characteristics such as age, gender, major, semester choice, and prior GPA affect final course completion grades in both instructional modalities.

The remainder of the paper is organized as follows: Section I provides a literature review; Section II describes methods used for our investigation along with the data collections, sample descriptive information, and our research questions; Section III summarizes the findings and the results of our analysis; Section IV describes limitations and discusses the implications of our paper; Section V provides future potential research ideas based on our findings in this study.

## **I. Literature Review**

Providing students with a choice of instructional modality, F2F or online, contributes to overall student satisfaction (Beetham et al., 2009). Therefore, most universities offer some form of online instructional modality. However, online pedagogy may have negative effects on students' academic performance when compared to the performance of students in F2F classes (Bir, 2019). In fact, according to Dendir (2019), a great proportion of researchers found that subpar learning takes place in the online instructional modality. Yet a few studies have found that there is no significant difference in academic performance between F2F and online economics classes (Dendir, 2016). Motii and Sanders (2014) determined that student performance in the online instructional modality was at least as good as student performance in traditional F2F classes based on overall semester grades.

Tanyel and Griffin (2014) tracked the performance of students in an online versus F2F course for a period of ten years. Semester grades were used to measure performance outcomes. While they concluded that students performed better in F2F classes, they also noted that there were other factors which impacted performance outcomes. Taking into account other characteristics, such as age and GPA, Tanyel and Griffin (2014) found that those performance differences were eliminated.

While several studies have shown that female students perform less well than male students in introductory economics courses (Williams et al., 1992; Allgood & Walstad, 1999; Ballard & Johnson, 2005), Johnson et al. (2014) observed that the gender gap in economics performance from 1980 to 2013 seemed to be diminishing.

Age may have a strong correlation to student performance in the classroom. Some research has identified that older and more mature students are more likely to earn better grades (Dille & Mezack, 1991; Laanan, 1999; Popovic & Green, 2012). Addus et al. (2007) reported that 56% of the freshmen in their School of Business and Economics had a GPA below 2.0, compared to 14% for sophomores, 16% for juniors and 4% for seniors. Conversely, in their study of factors affecting final grades in a Principles of Economics class, Kara et al. (2009) reported that being a junior had statistical significance but being a senior did not.

Majors are a reflection of students' strengths and interests, and most majors are either qualitative or quantitative in nature. Economics is one of those subjects that contains both qualitative and quantitative elements. Walstad and Bosshardt (2019) studied economics GPAs and overall GPAs by major in the 2007–2008 academic year. They determined that about 39% of college graduates who were not economics or business majors completed at least one economics course. The authors concluded that the economics GPAs ranged from a low of 2.40 for general studies majors to a high of 3.18 for engineering majors. Quantitative majors had higher GPAs (3.13 for math, science, and biology majors) while qualitative majors had lower GPAs (2.79 for humanities majors). Walstad and Bosshardt (2019) also concluded that economics GPAs for business majors was higher than most other majors and were influenced by the quantitative nature of the major.

Swope and Schmidt (2006) found that good math skills resulted in higher GPA scores during the study of economics. Since STEM majors must possess stronger math skills than other majors, we can hypothesize that they would also have higher final course grades in an introductory economics class. Yet a study by Mumford and Ohland (2011) concluded that STEM majors performed slightly worse in a Principles of Microeconomics course than economics majors on average.

Brasfield et al. (2013) found that college GPA was a significant predictor of achievement in both macroeconomics and microeconomics classes. Likewise, Jensen and Owen (2003) determined that students with high GPAs relative to the average class GPA found economics to be a more relevant subject, were more self-confident in their abilities to understand economic matters and received higher class grades in conventional lecture-based introductory economics courses. Jost et al. (2012) concluded that GPA was in fact the strongest predictor of students' final class grades in online classes delivered by two-year colleges.

Much of the literature points to the fact that there is little or no student performance variation between full semester and abbreviated semester courses (Scott & Conrad, 1992; Daniel, 2000; Kucsera & Zimmaro, 2010; Simunich, 2016). Yet in his study, Anastasi (2007) suggests that, while abbreviated courses present new content at a much faster pace, students are better able to absorb new knowledge because they typically take fewer courses over accelerated semesters and the average classroom size is smaller, which is more conducive to learning. Walsh et al. (2019) posit that abbreviated courses are usually offered at times during the year when both faculty and students have fewer commitments such as committee meetings, student organization activities and sports, thus allowing them to focus on those courses and perform better.

## **II. Method**

We used Final Course Completion Grades (FCCG) as a proxy to assess students' academic performance in F2F and online sections, and we investigated the effects of students' gender, age, major, semester choice and prior grade point average (PGPA) on academic performance in both instructional modalities. Ordinary Least Squares (OLS) regression modeling and descriptive statistics were used to analyze the collected data. Gretl and Microsoft Excel were utilized for data manipulation and analysis. Final Course Completion Grades are based on letter grades A, B, C, D and F as follows:

GPA – Letter Grade	Grade Points	Grade Scale (%)
A	4	90 - 100
B	3	80 - 89
C	2	70 - 79
D	1	60 - 69
F	0	59 and less

**Table 1**  
*Descriptive Statistics*

		Total Sample	Course Delivery Modalities	
			Face-to-Face	Online
<b>Total (# of students)</b>		3180	2184	996
	(%)		68.7%	31.3%
<b>Male (# of students)</b>		1865	1448	417
	(%)		77.7%	22.3%
<b>Female (# of students)</b>		1315	736	579
	(%)		56%	44%
<b>Age (mean)</b>			20.8	25.0
<b>Prior GPA (mean)</b>			3.04	3.15
<b>Major</b>	<b>STEM (# of students)</b>	1850	1436	414
		(%)	77.6%	22.4%
	<b>STEM Female (Male) (# of students)</b>	520 (1330)	356 (1080)	164 (250)
		(%)	68.5% (81.2%)	31.5% (18.8%)
	<b>Non-STEM (# of students)</b>	1330	748	582
		(%)	56.2%	43.8%
	<b>Business (# of students)</b>	419	220	199
		(%)	52.5%	47.5%
	<b>Business Female (Male) (# of students)</b>	203 (216)	81 (139)	122 (77)
		(%)	40% (64.4%)	60% (35.6%)
	<b>Non-Business (# of students)</b>	2761	1964	797
	(%)	71.1%	28.9%	
<b>Semester Choice</b>	<b>Accelerated (# of students)</b>	667	365	302
		(%)	54.7%	45.3%
	<b>Traditional (# of students)</b>	2513	1819	694
		(%)	72.4%	27.6%

Table 1 provides summary information on the observed characteristics of the students who enrolled in this Introductory Economics course. According to the university’s General Education Core Curriculum, all students are required to take this Introductory Economics course regardless of their majors. This study is based on data collected over a two-year period and includes data from traditional and accelerated semesters in the 2018 and 2019 academic years. We selected the 42 sections of this Introductory Economics course taught by the authors of this paper. Overall, there were 163 sections offered during that time period. After removing 158 students from the data set due to non-standard class performances such as class withdrawals, incompletes, and dual enrollments, the final sample consisted of 3,180 students. Introductory Economics classes are typically large sections. The average class size in this study was about 79 students per section. Furthermore, during that time period, 19 sections were taught online and 23 were taught F2F. Out of our sample of 3,180 students, 1,865 students were male and 1,315 female. There were 1,850 STEM

majors (1,436 F2F and 414 online), 419 Business majors (220 in F2F and 199 online) and 911 non-STEM and non-Business majors. For our purposes, STEM majors include all Engineering, Sciences (excluding Social Sciences), Mathematics, and Information Technology fields. Business majors include Management, Marketing, Finance, Entrepreneurship, Sales, Economics, and Accounting fields.

Based on the aforementioned information, we devised the following research questions.

**Research Question 1:**

*Is there a statistically significant difference in the Final Course Completion Grade mean between F2F and online instructional modalities?*

H0:  $\bar{x}_1 - \bar{x}_2 = 0$ . No difference exists in the Final Course Completion Grade mean, between online and face-to-face instructional modalities

H1:  $\bar{x}_1 - \bar{x}_2 \neq 0$ . A difference exists in the Final Course Completion Grade mean, between online and face-to-face instructional modalities

**Table 2**  
***T-Test Comparing the Means for Face-to-Face Classes and Online Modalities***

Student Final Course Completion Grade		
Face-to-Face N=2184	Online N=996	Means Differences
Mean Grade ( $\bar{x}_1$ ) 3.17537 *	Mean Grade ( $\bar{x}_2$ ) 3.20683 **	=-0.03146 ***
Std. Error of Mean (SE <sub>x1</sub> ) 0.0199725	Std. Error of Mean (SE <sub>x2</sub> ) 0.0314688	
Std. Deviation (s) 0.933382	Std. Deviation (s) 0.993139	

*Note.* Significant differences in means for two-tailed two-mean t-test are indicated with \*\*\* =  $p < 0.01$ ; \*\* =  $p < 0.05$ ; \* =  $p < 0.10$ . Test statistic:  $t(3178) = (3.20683 - 3.17537)/0.0364183 = 0.863878$ ; Two-tailed p-value = 0.3877 (one-tailed = 0.1939) \* 95% confidence interval for mean in F2F Classes: 3.1362 to 3.21453 \*\*95% confidence interval for the mean in Online Classes: 3.14507 to 3.26858.

To investigate the first research question, we used a two-tailed two-mean t-test method to analyze the data. Table 2 reports the performance of F2F and online students in this Introductory Economics course as indicated by the final course completion grades. The t-test result shows that the p-value =  $0.3877 > 0.05$ , leading us to conclude that we cannot reject the null hypothesis. Therefore, based on the data and the results of this study, we can infer that there is no statistically significant difference in the FCCG means between F2F and online classes. This finding corroborates the conclusion that, if students' performance was measured based on the students' overall semester grade, then student performance in the online instructional modality is at least as good as students' performance in traditional F2F classes (Motii and Sanders, 2014).

**Research Question 2:**

*What are the determinants that affect final course completion grades in this Introductory Economics course?*

Using OLS regression analysis, the second research question was modeled to evaluate the effect of various determinants on final course completion grades (FCCG). Table 3 reports the results of two OLS regressions using FCCG as the dependent variable for both instructional modalities.

**Table 3**  
**Determinants of Student Performance in Face to Face (Model I) and Online (Model II)**  
**Dependent Variable (Final Course Completion Grades)**

Independent Variables	F2F	Online
	Model I	Model II
Constant	0.574163 SE= 0.108205 t=5.30263 P= <0.0001 ***	0.439769 SE=0.14442 t=3.0451 P= 0.0024 ***
STU_GENDER	-0.113269 SE= 0.0325671 t= -3.4780 P= 0.0005 ***	-0.122398 SE= 0.0507268 t=-2,4129 P= 0.0160 **
STU_AGE	-0.0108514 SE= 0.00384838 t= -2.8197 P= 0.0048 ***	-0.00952987 SE= 0.00314656 t=-3.0287 P= 0.0025***
STU_MAJORSTEM/NONSTEM	0.268674 SE= 0.0357294 t= 7.5197 P= <0.0001 ***	0.110486 SE= 0.0527294 t= 2.0953 P= 0.0364 **
STU_MAJORBUS/NONBUS	0.137134 SE= 0.0541737 t= 2.5314 P= 0.0114**	0.00340437 SE= 0.0615698 t=0.0553 P= 0.9559
STU_PRIOR GPA	0.856241 SE= 0.0210873 t=40.6046 P= <0.0001 ***	0.953473 SE= 0.0334159 t=28.5335 P= <0.0001 ***
STU_ACCELERATED/TRADITIONAL	0.395371 SE= 0.039984 t=9.8882 P= <0.0001 ***	0.0828481 SE= 0.0506553 t=1.6355 P= 0.1023
F-Statistic	310.0113	139.4738
R <sup>2</sup>	0.460747	0.458332
Adjusted R <sup>2</sup>	0.459261	0.455046
Observations	<b>2184</b>	<b>996</b>

*Note.* The table reports the results of two OLS regressions coefficient estimates using the Final Course Completion Grades (dependent variable). Variable “STU\_GENDER” is a dummy variable with 1 for female and 0 for male. Variable “STU\_AGE” represents the student age in years at the time of taking the Introductory Economics course. The variable “STU\_MAJORSTEM/NONSTEM” is a dummy variable with 1 for students in STEM related majors and 0 otherwise. The variable “STU\_MAJORBUS/NONBUS” is a dummy variable with 1 for students majoring in business majors and 0 otherwise. The variable “STU\_PRIOR GPA” represents the student Grade Point Average on 0-4 scale prior to taking the Introductory Economics course. The variable “STU\_ACCELERATED/TRADITIONAL” is a dummy variable with 1 for students who took the class in accelerated semesters and 0 otherwise. The 2-tailed significance test of the regression coefficients are as follows and presented below the estimates: \*\*\* = p < 0.01; \*\* = p < 0.05; \* = p < 0.10.

The regression results indicate that, regardless of the modality of instruction (F2F or online), male students did better in this Introductory Economics course than female students. However, it is important to point out that although the sign of the STU\_GENDER coefficient was negative in both regressions (Model I and Model II), it was significant at 95% in F2F classes but only 90% significant in online classes. The negative sign of the STU\_GENDER may be related to the fact that there were more male STEM students than female STEM students in the data set and that STEM students performed better than non-STEM students in this Introductory Economics course. It is also important to point out that female students made up the majority of students (58.1%) in online classes, while they only accounted for 33.7% of the students in F2F classes (Table 1). Although our results align with the general findings in the literature that female students perform less well than male students in introductory economics courses (Williams et al., 1992; Allgood & Walstad, 1999; Ballard & Johnson, 2005), we can also infer that male students may in fact perform better in this Introductory Economics course simply because a greater proportion of them are STEM students. In our data set, males accounted for a large number of STEM major students: out of 1,436 STEM students in F2F classes, 75.2% were male. Out of 414 STEM students in online classes, 60.4% of them were male.

This study showed that younger students in our sample population performed better than older students, which is contrary to the findings reported by Dille and Mezack (1991), Laanan (1999) and Popovic and Green (2012). This might be due to the fact that younger students typically take their classes uninterrupted. Older students may be experiencing more interruptions in their education due to family and work obligations. Overall, the signs of the STU\_AGE coefficient in Model I and Model II were both negative and significant at a 95% confidence level.

The regression results in both models also suggest that students who were STEM majors earned higher grades than students in non-STEM majors. It is important to note that the coefficients' signs were positive in both models. However, the sign of the coefficient in Model I was significant at a 95% confidence level, while the sign of the coefficient was only significant at 90% confidence level in Model II. Along the same lines, business majors earned higher FCCG than non-business majors in F2F and online modalities. The sign of both coefficients was positive. However, while the coefficient was significant at a 90% confidence level for F2F classes, the coefficient was positive but insignificant for online classes. More interestingly, we can report that STEM students did better than business students in this Introductory Economics course. While the average FCCG for STEM majors was 3.27 in F2F classes, the average FCCG was only 3.07 for Business majors. Similarly, while the average FCCG for STEM majors was 3.32 in online classes, the average FCCG was only 3.14 for Business majors. This highlights the fact that, although economics falls under the umbrella of Social Sciences, its analytical framework is strongly grounded in mathematics. Therefore, a strong STEM background is likely to improve a student's FCCG in introductory economics classes, as posited by Swope and Schmidt (2006). Our findings support the fact that quantitative skills are important in economics courses (Ballard & Johnson, 2004) and that deficient math skills hinder student success in introductory economics classes (Arnold & Straten, 2012).

According to the regression results in this study, regardless of major, age or gender, the students' GPA prior to taking this Introductory Economics course was the strongest predictor as observed by both the positive sign of the coefficient at a 95% confidence level and the magnitude of the coefficient in both regressions. This reinforces the hypothesis that students with higher prior GPAs may find economics to be a more relevant subject and are more self-confident in their abilities to comprehend economic matters (Jensen & Owen, 2003). We also surmise that students with higher prior GPAs are more likely to value their overall education and possess stronger study habits, which enables them to perform better than other students in this Introductory Economics course.

This study also suggests that students who chose to take F2F Introductory Economics classes during accelerated semesters outperformed students who took the class in traditional semesters. The sign of the coefficient was positive and significant at 95% confidence level in Model I. Our research validates the findings reported by Walsh et al. (2019) who determined that abbreviated courses are offered at times when students have fewer commitments such as organization activities and sports, thus allowing them to focus on their course work and perform at a higher level.

However, the semester choice for students who took this Introductory Economics course online was statistically insignificant in Model II. This finding may illustrate the fact that students who choose to enroll in online classes have the same constraints year-round. It may also be an indication that online students apply the same study habits to all of their classes regardless of the semester format.

### **III. Summary and Discussion of Results**

Based on the adjusted R-squared of the regression models, we were able to explain 45.93% (F2F) and 45.50% (online) of the variation in FCCG in F2F and online classes respectively. It is worth noting that, in terms of statistical significance and magnitude, the most compelling variable which affected the FCCG was the students' GPA prior to taking the course, whether the instructional modality was F2F or online. This confirms the fact that, regardless of their majors, students who are

motivated to learn and who value education highly as evidenced by a higher prior GPA, are likely to succeed and outperform other students in this Introductory Economics course. The STU\_MAJORSTEM/NONSTEM variable is another important determinant of success. Students who major in a STEM field appear to perform better than students majoring in non-STEM fields. Finally, STU\_ACCELERATED/TRADITIONAL is another strong determinant of success, but only for F2F students. We surmise that taking fewer classes in accelerated semesters enables F2F students to achieve a higher FCCG in this Introductory Economics course. Further investigation is needed to determine why F2F students perform better in accelerated semesters.

#### **IV. Limitations/Implications**

This study has several limitations. First, only students of one large university were included in this study, which limits the generalizability of the results. Second, the study does not include all 163 sections of this Introductory Economics course that were taught during the 2018-2019 school years. Only the 42 sections assigned to the authors were used in this study. Third, this study focused on the final course completion grade as the primary indicator of student performance. The final course completion grades obtained from the university system are letter grades which limit the extent of the analysis that can be performed. Nuances of performance within letter grade ranges were not captured and addressed in this study due to this limitation.

Only a limited number of independent variables were used as potential predictors of the final course completion grades. In fact, other factors such as the duration of class sessions, the number of instruction days per week, the specific instructional modality (synchronous versus asynchronous online instruction, hybrid, hyflex, etc.), could influence the academic performance of undergraduate students. Nevertheless, this study attempts to explore a few important factors that may have a bearing on the academic performance of undergraduate students in introductory economics courses and may have several important implications for students, educators, researchers, and university administrators.

#### **V. Future Potential Research**

At the core of this study is the fact that students enrolling in this Introductory Economics course had the choice to select the instructional modality. Our data included 3,180 students enrolled in 42 sections of this course taught either F2F or online. Students were enrolled in either F2F or online sections as the result of a deliberate choice. As we started gathering and analyzing our data in early 2020, the COVID-19 outbreak disrupted the world of education and forced institutions of higher education to change their instructional modality. Practically overnight, classes were moved to virtual digital platforms and entire student populations migrated to online learning. COVID-19 effectively took away the choice of attending F2F classes. It would be very interesting to compare the academic performance of online students in this Introductory Economics course before and after the pandemic started.

In addition, as a result of being forced to move to online formats, there has been a proliferation of online instructional modality. Students now have to choose which modality best matches their learning style: hybrid, hyflex, synchronous or asynchronous, delivered via Zoom, Microsoft Teams, Collaborate Ultra, 3P Learning, Google Classroom, and Webex among others. Future research could enable the comparison of the performance of online students across instructional modalities in this Introductory Economics course.

Further research could also investigate similar performance-based data for a wider array of subject matter courses. Distance learning administrators, instructional designers, and faculty can benefit from understanding which instructional modalities best meet the needs of their students and which factors determine students' academic success in online classes. This is especially true as the COVID-19 pandemic has thrust the online instructional modality to the forefront of education



worldwide and has created both technological challenges and opportunities for change. As faculty, students, and administrators become more comfortable with online courses, it is reasonable to expect that online courses would become more of the norm than F2F courses.

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