PERFORMANCE GAP AMONG BRAZILIAN UNDERGRADUATE STUDENTS IN ONLINE AND FACE-TO-FACE COURSES.

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ABSTRACT

With SARS-CoV-2 pushing many higher education institutions to try different teaching formats, online education is becoming a relevant topic in the educational field. In the last twenty years, online education has been contributing for the expansion of higher education in Brazil, constantly increasing the number of enrollments and courses offered in this modality. In 2018, for example, the number of vacancies offered in the online modality exceed the numbers offered in traditional face-to-face (F2F) format. Based on this context, this study investigates the existence of a performance gap among Brazilian undergraduate students in online and F2F courses. In other words, the purpose of the study is to analyze the impact of taking an online course, instead a F2F one, on the student's performance. For the empirical analysis, the study considered 1,212,230 observations from the National Exam of Student Performance (ENADE), which is a national Brazilian exam that annually assess graduating students' performance. By using a linear regression with fixed effects model, the study verifies that there is the performance gap among students in online and F2F courses. Even by controlling with different explanatory variables, Brazilian graduating students in online courses tend to have a lower performance compared to other students in F2F ones. Additionally, the study also analyzes which student's characteristics contributes for their performance. This research sheds light on how graduating students in online courses have been developing in the Brazilian post-secondary education, contributing for the debate of whether online education is equally effective for the development of undergraduate students.

Keywords: online education, higher education, performance, ENADE.

INTRODUCTION

Online education has been growing in Brazilian higher education (HE) during the last twenty years. In 2018, the number of vacancies offered in the online education modality surpassed the number of courses offered in the traditional face-to-face (F2F) format and enrollments in online courses represented almost 25% of all 8.4 million enrollments in the HE system. Among many reasons, this growth is due to the benefits promoted by online education. Students from rural or countryside areas can participate in courses offered by the same institutions and faculty that once were only available to students in privileged areas (Moore et al., 2007) and individuals can adapt their studies with the rhythm of their life and work (Ferrugini et al. 2014).

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Although there are some studies that analyzed which course modality students better perform (Redpath, 2012; Xu and Jaggars, 2014; Caetano et al., 2016; Bettinger et al., 2017; Scudeler, Flores and Pires, 2020), there is still a gap in Brazilian academic studies that investigate online and F2F education in a holistic approach using the ENADE. As further explained, ENADE is a Brazilian national exam that assesses graduating student's performance in Brazil. After analyzing more than a thousand research papers from 2005 to 2016, Lima et al. (2019) found only 40 studies related to the ENADE. Considering only those related to student's academic performance, the number drops to 19. Given that not all of those were related to online education, it is reasonable to argue that the number of studies related to online education and student's performance using the ENADE might be even lower.

Based on this, the purpose of this study is to investigate the existence of a performance gap among Brazilian undergraduate students in online and F2F courses. By considering six databases from the ENADE, this study analyzes the impacts of taking an online course, instead of a F2F one, on student's performance. In addition, considering other variables assessed by the ENADE, this study also sheds light on which student's characteristics might affect their performance on the exam. By extracting valuable insights from granular data, this study contributes for the debate of whether online education courses are equally effective as F2F ones for the development of Brazilian undergraduate students.

ONLINE EDUCATION IN BRAZIL

Among many terminologies, the study uses the name online education as a direct translation for "Educação a Distância" which is the Brazilian terminology used for this modality in HE courses. According to the Brazilian decree nº 5.622, online education "is an educational modality in which the mediation didactic-pedagogy of teaching and learning process occur through the utilization of Information and Communication Technologies (ICT) with students and professors developing educational activities in distinct places or time" (Brasil, 2005).

Private institutions have been responsible for the growth of this modality in Brazil. From Figure 1, private institutions are predominant in the Brazilian HE landscape, concentrating 75% of total student's enrollments. Additionally, between 2009 and 2018, the number of enrollments in F2F courses increased 41% in public institutions and 19% in private ones and the total enrollments in online education courses increased 0.13% in public institutions and 183% in private ones.

Although this notable growth, online education also faces many negative aspects. First, Gatti and Barreto (2009) point out the precarious quality in the online education formation, especially for professors that will be teaching. There is lack of specialized faculty prepared to teach contents in the online format, lacking skills and knowledge (Ferrugini et al., 2014). In addition, there are obstacles and fragilities concerning the knowledge acquired by the students, preparing future professionals with limit capabilities for exercising their functions. Students in online education courses are more passive related to the creation and development of new knowledges and skills: they are absorbing much more information rather than properly developing contents and promoting new ones (Ferrugini et al., 2014).

Besides that, another negative aspect is related to some characteristics where online courses are offered. Some institutions do not have physical libraries located in presential centers where online education courses are offered and student's learning is solely based on the materials available by the professor's textbooks in the virtual platforms (Ferrugini et al., 2014).

Furthermore, there are regions and areas that do not have the minimal infrastructure required for online courses, like electricity or broadband internet (Martins and Mill, 2016). Overall, there is a gap between teaching, formation and learning which is due to the failure of didactic-pedagogical process, lack of prepared and specialized faculty, absent of control and constant course assessment, inefficient teaching materials among other factors (Ferrugini et al., 2014).

Figure 1 – Total number of enrollments segmented by course modality and administrative category.
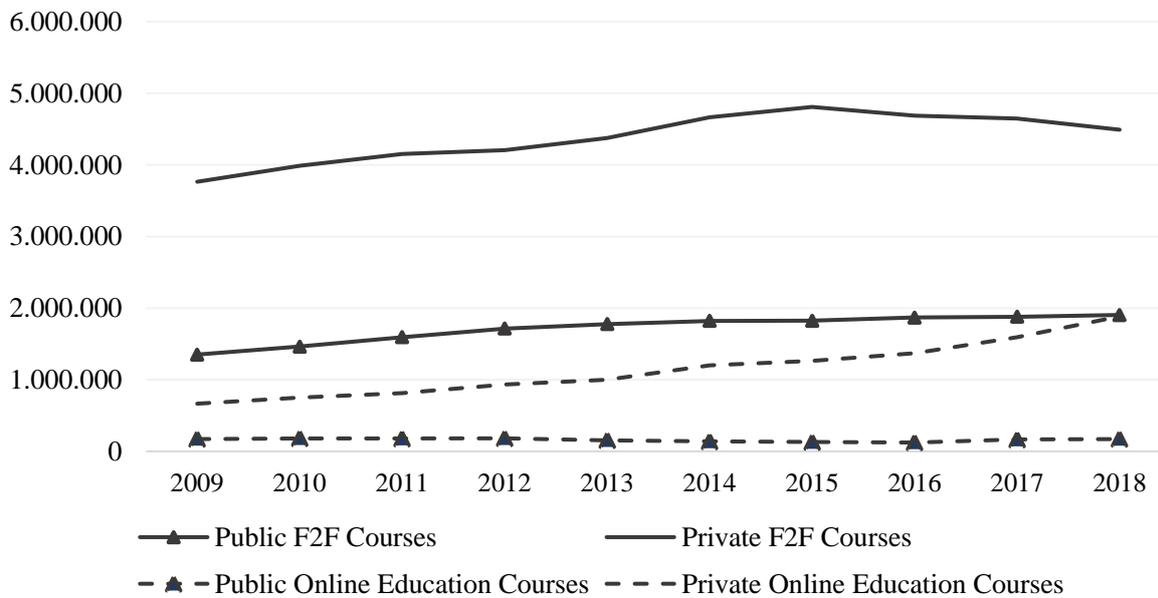
Source: INEP – Sinopses Estatísticas da Educação Superior

THE NATIONAL EXAM OF STUDENT PERFORMANCE (ENADE)

In Brazil, both F2F and online education courses are evaluated by an annual exam called The National Exam of Student Performance or ENADE (Exame Nacional de Desempenho de Estudante) that assess student's performance. The ENADE is controlled by The National Institute for Educational Studies and Research "Anísio Teixeira" or INEP (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira) which is a federal autarchy from the Ministry of Education that provides educational research and evaluation.

According to the law nº 10.861 of 2004, the ENADE will "measure students' performance according to the predefined syllabus guidelines of the respective undergraduate course degree's curriculum, students' abilities to adjust them based on the arising demand of knowledge development and students' competencies to comprehend external topics outside the specific scope of their professional occupation related to other areas of knowledge" (Brasil, 2004). In other words, the ENADE has the objective to assess basic skills, competences and knowledge regarding the student's undergraduate field as well as transdisciplinary issues involving a broader general knowledge (Brito and Limana, 2005).

There are many specificities regarding the ENADE assessment. First, this exam is a mandatory curricular component in Brazilian undergraduate courses, appearing in the student's bachelor transcript. Second, the ENADE is annually applied only to graduating students which already have completed more than 80% of total course workload, but not yet graduated. Moreover, the

exam evaluates different courses in each year, having a maximum periodicity of three years to reevaluate the same undergraduate subjects. For instance, subjects assessed in 2013 will be revaluated in 2016 and 2019. Finally, besides the exam that evaluates student's performance, the ENADE is also composed by the student's questionnaire which characterizes the students' profile to better comprehend their results in the exam (Brasil, 2019).

The ENADE is constituted by two parts: general education and subject area. The former is composed by questions that are common to all students and the latter is consisted of specific questions related to each subject assessed. According to Brito and Limana (2005), the common component of the general education part is related to the tacit knowledge that individual needs to be successful, but it is not taught by HE institutions. In the subject area component, questions assess the domain of a certain area related to the knowledge of a specific field and abilities expected for the professional profile.

Related to the structure of the exam, the ENADE has 40 questions: the general education part has 10 questions (8 multiple choice and 2 open-ended questions) and the subject area component has 30 questions (27 multiple choice and 3 open-ended questions) (Brasil, 2019). Both the general education and subject area components constitute the ENADE overall score which is a grade between a continuous scale from 0 to 100 points. The student's final score is consisted of 25% of the score in the general education component and 75% of the score in the subject area part. Students have a total duration of 4 hours to complete all 40 questions.

Besides the forty questions, students subjected to the ENADE must also complete the student questionnaire. This form allows the comprehension of the student's background to understand their results on the exam. The questionnaire is composed by questions like gender, age, family income, and other demographic, economic and academic attributes related to the student. The complete filling of this form is configured to be one of the elements that characterizes the effective participation of the student in the exam. All answers are analyzed by INEP and aggreged by each graduation course, maintaining the confidentiality of the student's identity (Brasil, 2019).

According to Brito and Limana (2005), the sample for the exam is composed of students selected by INEP from a list of senior students sent by HE institutions. It is worth noting that institutions only send the list of the students that meet the criteria for the exam and INEP applies the sample selection procedures. Hence, institutions do not have any interference to decide which students should take the exam.

PERFORMANCE GAP AMONG F2F AND ONLINE EDUCATION

One of the topics studied in the post-secondary educational field is the difference between online and F2F education, analyzing to what extend online education has the same effects on students' performance compared to F2F education. While some studies find that students taking F2F modality performs better than those in online courses, others find no difference at all. One reason for this is the variability of contextual elements considered in each research. Some studies use available datasets provided by governmental surveys, while others run their own experiments; some consider a group of courses, while others adopt a broader perspective.

One study by Caetano et al. (2016) found that Brazilian graduating students enrolled in online courses had a lower performance compared to students enrolled in the F2F modality of the same course. By analyzing more than 75,000 observations from Accounting courses in the

ENADE of 2009, the research found that universities, public institutions, male and senior students presented a higher performance. The authors argue that it is alarming the fact that the increase of online education courses happen at the expense of higher education's quality.

In a similar approach, Scudeler, Flores and Pires (2020) compare online education and F2F courses by using the ENADE course's score ("Conceito Enade"). This metric is assessed by INEP and it evaluates HE courses with a score ranging between a discrete scale of 1 to 5 (INEP, 2019), in which score 1 means a weak result and 5 an excellent one. The authors used the results of ENADE 2018, comparing Pedagogy online and F2F courses of private institutions. Based on their findings, fewer Pedagogy courses offered in the F2F modality received a lower course's score between 1 and 2 (30.82%) compared to courses offered in the online modality (40,63%). This result implies that private online education courses in Pedagogy are perceived as worse compared to the F2F ones.

When looking at studies outside Brazil, Xu and Jaggars (2014) analyze the performance gap between students in online and F2F courses. By considering more than 40,000 observations from students enrolled in Washington State's 34 community or technical colleges, the authors found that students performed more poorly in online courses compared to those in F2F ones. Besides that, the authors also stated that "males, young students, Black students, and students with lower prior GPAs had wider online performance gaps than their peers" (Xu and Jaggars, 2014). Moreover, another research that contributes to the argument that students in online courses underperform was conducted by Bettinger et al. (2017). The authors use data from a large for-profit American university, considering over 230,000 students enrolled of more than 730 different courses. Based on their findings, students taking online courses had on average a grade C (score 2.4) which is a lower performance whenever compared to those in F2F modality which had a grade B (score 2.8).

In a local study, Urtel (2008) analyzed the performance of students taking a F2F and online. By considering a sample of 116 students taking a F2F course and 269 students in online one, and taking into account the same course content, course instructor, performance evaluation and other constant variables, Urtel found that students who took a F2F course had a higher grade (3.16/4.00) compared to other students who took an online course (2.28/4.00).

In contrast, there are other studies that found that course modality does not have an impact on student's performance. In a Brazilian study, Nascimento and Junqueira (2012) compared two samples of students taking F2F and online education courses in an Accounting Introduction course from a federal university located in the Southeast region of Brazil. Both courses had many similarities, being taught by the same professor and having the same activities, materials and assessment methods. By analyzing both samples, the authors found no significant differences between students' score mean, which indicated that the online education course was efficient as the F2F course.

Another Brazilian study named "Classroom or Distance Learning: does the modality influence learning?", by Nascimento, Czykiel and Figueiró (2012), compared students taking F2F and online education courses for a Social-environmental subject. According to the study, both groups had similar results and, for most of the assessed items, student taking the online education modality had a better performance. The study concludes that depending on how the online course is delivered, as well as, its preparative conditions and dynamics used in the virtual classrooms, online education can motivate sceptics to believe that this modality can promote the same learning possibilities as traditional course modality.

Previous studies are related to Redpath's article (2012) which she talks about a bias towards online learning in Management Education. The assumption that presential interactions and physical instructor's presence are necessarily a superior method of educational delivery is a bias that needs to be overcome. Although the quality of the course and HE institution is a valid argument, "the method of delivery should not be confounded with the quality of an institution, its programs, or its teaching and learning effectiveness" (Redpath, 2012). Furthermore, Redpath suggests that administrators should learn more about the benefits of the online teaching and learning. The author recommends that institution's policies and incentives should be adapted in order to increase adoption of the online delivery, like rewarding faculties members for dedicating extra time for developing online courses or supporting them with IT services. Removing these barriers, Redpath considers that "management educations must be better informed and more open-minded toward online learning".

DATA COLLECTION

The data used in this study is from a set of ENADE databases. Since 2004, INEP has been annually releasing databases containing granular data of the ENADE exam. By assessing a range of variables, each ENADE database provides a variety of observations about student's performance on the exam, as well as, student's demographic, economic and academic characteristics and other attributes.

As mentioned previously, the ENADE evaluates a different set of subjects every year and it takes three years to reassess them again. Based on this, the present study narrowed its data collection by using only the ENADE datasets from the years 2013 to 2018, because not only the last available database is from 2018, but by selecting these years the study could consider at least two different datasets that evaluate the same set of subjects. The consolidation of the six databases rendered an aggregated database of 2,528,339 observations.

Furthermore, the study applied filters over the consolidated database. First, the study separated the observations based on their course modality (F2F or online) and considered only those subjects that had at least 300 observations in both modalities. This first filter removed many observations from the dataset since many courses were not offered in both modalities. In addition, the study did not consider Technologist courses degree, leaving the final dataset with only Bachelor and Licentiate course degrees. Finally, other filters were applied in order to remove inconsistent data. After these filters, the final database consisted of a total of 1,212,230 observations with 872,089 respondents enrolled in a F2F course and 340,141 enrolled in an online one, analyzing student's responses from 2.023 HE institutions and 28 subjects.

The study also adapted some of the ENADE's responses of the final database in order to better fit the study's interests. The main variables considered in this study are presented on Table 1.

Table 1 – Main variables considered in the study.

Variable	Description	Measurement
HE_Institution	*Brazilian HE institution's code ID*	HE Institution ID
Year_ENADE	*Year of the database*	Year from 2013 to 2018
Subject	*Course's subject*	Subject ID
Online	*Course modality*	1 = online; 0 = F2F
TimeSpent	*Time spent by the student to complete the exam.*	A = Less than an hour B = Between one and two hours C = Between two and three hours D = Between three and four hours E = Four hours and the student did not finish
Age	*Student's age*	Discrete variable
Gender	*Student's gender*	1 = Male; 0 = Female
Single	*Student's marital status*	1 = Single; 0 = Other marital status
White	*Student's ethnicity*	1 = White; 0 = Other ethnicities
AffirmativeAction	*Whether or not did the student entered HE through affirmative action policy.*	1 = Entered HE through affirmative action 0 = Did not enter HE through affirmative action
FamilyIncome	*Student's total family's income*	A = Up to 1.5 minimum wage B = Between 1.5 to 3 minimum wages C = Between 3 and 4.5 minimum wages D = Between 4.5 to 6 minimum wages E = Between 6 and 10 minimum wages F = Between 10 and 30 minimum wages G = Above 30 minimum wages
Work	*Student's working situation.*	1 = Student works; 0 = Student does not work or works eventually
SchoolLoan	*Whether or not the student received scholarship to support monthly expenses.*	1 = Student received school loan 0 = Student did not receive school loan or did not have to pay for it
FinancialAid	*Whether or not the student received financial aid.*	1 = Student received financial aid 0 = Student did not receive financial aid
Scholarship	*Whether or not the student received academic scholarship.*	1 = Student received scholarship 0 = Student did not receive scholarship
ExchangeProgram	*Whether or not the student participated in curricular programs and/or activities abroad.*	1 = Student did an exchange program 0 = Student did not an exchange program
HighSchool	*Type of high school in which the student studied.*	A = All in public school B = All in private school C = All abroad D = Majority in public school E = Majority in private school F = Part abroad and part in Brazil
Score_General	*Score of the ENADE general education component*	Continuous variable from 0 to 100
Score_SubjectArea	*Score of the ENADE subject area component*	Continuous variable from 0 to 100
Year_ENADE - YearFinishHS	*Proxy for student's maturity (year of the exam subtracted by the year that the student finished high school.)*	Discrete variable

Source: INEP – Sinopses Estatísticas da Educação Superior, created by the author.

MODEL SELECTION

In order to investigate the existence of a performance gap between Brazilian undergraduate students in online and F2F courses, a multiple linear regression with fixed effects model was chosen for the empirical analysis (equation 1). The main objective for selecting this model is to investigate the impact that the key variable *Online* has on the student's performance.

$$Score\_SubjectArea_{it} = \beta_1\, Online_{it} + \beta_2\, Score\_General_{it} + \beta_3\, TimeSpent_{it} + \gamma X_i + \delta_t + \delta_s + \delta_h + \varepsilon_i \qquad (1)$$

The key explanatory variable for the study is the modality of the course (*Online*) and it is 0 if the course was taught F2F or 1 if the course was taught online. The idea behind this variable is to measure whether studying through an online course in a Brazilian HE institution contributes or not for the graduating student's performance. This variable measure whether students that had online classes managed to achieve the course's learning objectives predefined by the course's syllabus of the HE institution.

Choosing the subject area component grade (*Score_SubjectArea*) as a dependent variable for performance is more appropriate given that it measures the direct impact that the course had on the student's learning. This dependent variable was standardized based on the course' subject and the year of the exam in order to consider possible variation in grading standards among courses and years in which the ENADE was taken. The study did not adopt the ENADE overall score as a dependent variable given that this grade also considers the general education grade which is common among all courses and not necessarily assess taught knowledge from the student's course.

Related to other independent variables, a proxy for student's intelligence was considered by using the grade from the ENADE general education component (*Score_General*). This variable was also standardized based on the year of the ENADE. In addition, time spent on the exam (*TimeSpent*) was also considered given the hypothesis that students who spend more time on the exam can answer more questions and, hence, increase their score. Moreover, the model also controlled the variable *Online* by student's demographic, economic and academic variables (*Xᵢ*). First, the demographic variables used in the model were: *Gender*, *Age*, *Single*, *White*, *AffirmativeAction* and a proxy for student's maturity (year of the exam subtracted by the year that the student finished high school). Additionally, student's economic attributes were considered by the student's family income (*FamilyIncome*), student's working conditions (*Work*) and whether the student received a school loan (*SchoolLoan*) and financial aid (*FinancialAid*). Finally, regarding student's academic variables, the model considered student's scholarship situation (*Scholarship*), whether the student did an exchange program (*ExchangeProgram*) and which type of high school the student studied (*HighSchool*).

Additionally, the model also adopted three fixed effects: the year in which the ENADE was taken (δ_t), the course's subject (δ_s) and the HE institution (δ_h); as well as, a double clustered-robust standard error at the individual (i) and year (t) levels. Based on equation 1, the study ran six different models by adding distinct combinations of explanatory variables in each model (Table 2).

Table 2 – Variables considered in each regression model.

	Models					
Variables	Online and Score (1)	Adding Subject FE (2)	Adding Time to Complete Exam (3)	Adding student's demographic attributes (4)	Adding student's economic attributes (5)	Adding student's academic attributes (6)
Online	Yes	Yes	Yes	Yes	Yes	Yes
Score_General	Yes	Yes	Yes	Yes	Yes	Yes
TimeSpent			Yes	Yes	Yes	Yes
Age				Yes	Yes	Yes
Gender				Yes	Yes	Yes
Single				Yes	Yes	Yes
White				Yes	Yes	Yes
AffirmativeAction				Yes	Yes	Yes
Year_ENADE - YearFinishHS				Yes	Yes	Yes
FamilyIncome					Yes	Yes
Work					Yes	Yes
SchoolLoan					Yes	Yes
FinancialAid					Yes	Yes
Scholarship						Yes
ExchangeProgram						Yes
HighSchool						Yes
HE_Institution FE	Yes	Yes	Yes	Yes	Yes	Yes
Year_ENADE FE	Yes	Yes	Yes	Yes	Yes	Yes
Subject FE		Yes	Yes	Yes	Yes	Yes

DESCRIPTIVE ANALYSIS

First, as presented on Table 3, a little more than one fourth (28%) of the students considered in the database chose to take an online course. This result reinforces the increasingly popularity that this modality has been gaining over the last twenty years. Second, the majority (74%) of students who took the ENADE often spent two to four hours to complete the exam and this pattern remains equal regardless of course modality.

By analyzing student's demographic characteristics, students in online education courses had on average 34.7 years, while those who took F2F courses had on average 28.3 years. This finding reinforces previous studies in which students taking online courses are older, presenting a higher frequency of age over 40 years old (Las Casas, de Almeida & Viana, 2012). In addition, three fourth of the students in online education courses were female. While this result is in accordance with other studies (Nacimento & Junqueira, 2012; Bettinger, Fox, Loeb, & Taylor, 2017; Las Casas, de Almeida & Viana, 2012; ABED, 2017), it is worth noting that most of the subjects selected in the study was related to either Pedagogy or Licentiate courses. This finding may be related to Las Casas, de Almeida and Viana (2012)'s result: most of the Brazilian courses offered in the online modality is related to Social and Human Sciences, which traditionally appeared to have more women than men enrolled.

Related to marital status, while 71% of students in F2F courses reported to be single, the percentage decreases to 37% for students in online education. This finding reinforces the idea that since online education promotes flexibility, online students can study while having other responsibilities, like working or giving attention to their family (Palloff and Pratt, 2004). Additionally, although the majority (72%) of Brazilian graduating students worked while studying, this percentage increased for students in online courses (83%). Since working might be a high opportunity cost for engaging in presential courses, individuals who work are more

likely to enroll in online courses (Ortagus, 2017), given that online courses might also attract adults to improve required knowledge for employment (Moore et al., 2007).

Moreover, 50% of students in both groups self-declared to be White, followed by Brown (38% in online and 35% in F2F) and Black (9% in online and 11% in F2F); Asian and Indigenous are the minority in the dataset. This result is similar with ABED's finding about the profile of online students in 2017. Whenever comparing socioeconomic attributes, more than 50% of the students that took the ENADE had a family income of less than three minimum wages. Even though the distribution of family income remained almost the same in both modalities, students in online courses had a slightly lower family income on average. This is coherent with ABED's study in 2018 which showed that online courses offered by HE institutions are cheaper than other F2F courses.

Related to student's overall performance in the ENADE, the average score of students in online education courses was lower compared to other students in F2F courses, scoring on average 39.4 and 43.1, respectively. On average, students in F2F courses had a higher score both in the general education and subject area component grades.

Table 3 – Summary of the descriptive analysis.

	Total Database	F2F	Online
Online (n = 1,212,230)	100%	72%	28%
Time Spend on the ENADE exam (n = 944,971)			
Less than an hour	1%	1%	1%
Between one and two hours	16%	15%	17%
Between two and three hours	31%	30%	35%
Between three and four hours	43%	43%	40%
Four hours and did not finish	9%	10%	7%
Age (n = 1,212,230)	30.1[1]	28.3[1]	34.7[1]
Gender (n = 1,212,230)			
Female	63%	59%	75%
Male	37%	41%	25%
Marital Status (n = 1,046,220)			
Single	62%	71%	37%
Married	29%	22%	49%
Separated	4%	3%	6%
Widowed	0.4%	0.3%	1%
Other Marital Status	4%	3%	6%
Ethnicity (n = 1,046,196)			
White	50%	50%	50%
African American	10%	11%	9%
Brown	36%	35%	38%
Asian	2%	2%	2%
Indigenous	1%	1%	1%
Not Answered	1%	1%	1%
Affirmative Action (AA) (n = 1,045,973)			
Student entered HE through AA	21%	24%	15%
Student did not enter HE through AA	79%	76%	85%
Family's Income (n = 1,046,168)			
< 1.5 minimum wage	22%	21%	24%
1.5 - 3 minimum wages	31%	30%	34%
3 - 4.5 minimum wages	21%	21%	20%
4.5 - 6 minimum wages	11%	11%	10%
6 - 10 minimum wages	10%	10%	8%
10 - 30 minimum wages	5%	6%	3%
> 30 minimum wages	1%	1%	0.3%
Working Status (n = 1,046,122)			
Not Working	28%	31%	17%
Working Eventually	7%	7%	6%
Working < 20h weekly	9%	9%	9%
Working 21-39h weekly	13%	12%	15%
Working > 40h weekly	44%	41%	52%

	Total Database	F2F	Online
School Loan (n = 1,046,017)			
Student received school loan	*23%*	*27%*	*11%*
Student did not receive school loan	*77%*	*73%*	*89%*
Financial Aid (n = 1,046,164)			
Student received financial aid	*7%*	*9%*	*2%*
Student did not receive financial aid	*93%*	*91%*	*98%*
Scholarship (n = 1,046,035)			
Student received scholarship	*17%*	*21%*	*5%*
Student did not receive scholarship	*83%*	*79%*	*95%*
Exchange Program (n = 1,046,040)			
Student did an exchange program	*3%*	*3%*	*1%*
Student did not an exchange program	*97%*	*97%*	*99%*
High School (n = 1,035,035)			
All in public school	*75%*	*72%*	*82%*
All in private school	*17%*	*20%*	*9%*
All abroad	*0.1%*	*0.1%*	*0.1%*
Majority in public school	*5%*	*5%*	*6%*
Majority in private school	*3%*	*3%*	*3%*
Part abroad and part in Brazil	*0.2%*	*0.2%*	*0.1%*
Total ENADE score (n = 1,003,543)	$42.1^1 (14.2)^2$	$43.1^1 (14.1)^2$	$39.4^1 (14.0)^2$
General education score (n = 1,003,543)	$49.3^1 (17.5)^2$	$50.2^1 (17.5)^2$	$46.8^1 (17.1)^2$
Subject area score (n = 1,003,543)	$39.7^1 (15.6)^2$	$40.7^1 (15.5)^2$	$36.9^1 (15.4)^2$

[1]Mean. [2]Standard deviation. Source: INEP – Sinopses Estatísticas da Educação Superior, created by the author.

EMPIRICAL RESULTS

The statistical model proposed in this study investigates the existence of a performance gap among Brazilian undergraduate students taking online and F2F courses. The purpose is to analyze the coefficient of the key variable course modality (*Online*) and it is 1 if the student did an online course or 0 if it was a F2F one. Overall, all models considered in this study were statistically significant (p-value < 0.01). By analyzing the last regression (model 6) in which all independent variables were taken into account, the model resulted a R^2 of 0.31. Regression outcomes are presented on Table 4.

The model proposed by this study verifies that there is a performance gap among Brazilian students in online and F2F courses. By running all different regressions, the beta for modality presented to be significantly negative in all of the six models considered in the study. This means that even controlling with more explanatory variables students in the online courses tend to have a lower performance compared to other students in F2F courses. This finding is in accordance with previous studies by Caetano et al. (2016), Scudeler, Flores and Pires (2020), Xu and Jaggars (2014) and Bettinger et al. (2017).

Regarding demographic attributes, men tend to have a higher performance than women. Even though the literature says that gender is an unconclusive variable to determinate student's performance, the model's result is aligned with other Brazilian studies that used the ENADE as the main source of data (Ferreira, 2015; Rodrigues et al., 2016; Caetano et a., 2016). Moreover, the model found a negative coefficient for age, meaning that the older the student the worse the student's performance. This finding is different from the literature review, reinforcing the argument that this variable remains unconclusive to predict student's performance. Related to marital status, single students tend to have a lower performance, but there is still lack of research on this variable (Ferreira, 2015; Rodrigues et al., 2016). Related to ethnicity, the model found that people that self-declared to be White had a better performance than other ethnicities. While this result is in accordance with Ferreira (2015) and Caetano et al. (2015), this result might be related to other factors. According to Ferreira (2015), historically Black and Indigenous people did not have the same opportunities for education access, income

distribution and education in Brazil and these other elements might explain the differences between students' performance, not just ethnicity in isolation.

By analyzing student's economics attributes, family income has a positive effect on student's performance, meaning that students with higher family income tends to perform better. This finding is accordance with many studies (Miranda et al., 2015; Souza, 2008; Rodrigues et al., 2016; Ferreira, 2015). Students with a higher family income are those that have the opportunity to study in better qualified schools and invest in courses outside the school environment (Ferreira, 2015). Regarding working conditions, students who work tend to have a worse performance. This finding reinforces the argument that students who do not work have more time to dedicate for their studies (Souza, 2008). Additionally, the variable School Loan had a significant positive coefficient, which reinforces the idea that students who receive school loan must meet certain conditions to keep the loan and a good performance might be one of them (Ferreira, 2015). Finally, concerning whether the student received any financial aid, like housing or food support, the model presented a negative coefficient. This variable might be related to student's income, implying that students with less income and the most need for financial aid have a worse performance.

Related to student's academic attributes, students who studied most of their high school in public institutions had worse performance compared to those who studied in a private high school or abroad. If one considers that Brazilian public high schools have lower quality compared to private ones, this finding is in accordance with Miranda et al. (2015) and Rizvi, Rienties and Khoja (2019) in which previous knowledge influences student's performance. This may also explain why the variable *ExchangeProgram* had a positive coefficient, meaning that students that did an exchange program abroad tend to have a better performance, even though only 3% of all students managed to study abroad during graduation.

Finally, according to the regression, student's performance on the general education component of the ENADE was the most important variable to predict student's subject area grade. Although still lack of research, one can argue that the comprehension of knowledge related to general formation of the student positively contributes for the student's learning in the course. In addition, the time spent by the students to complete the exam is directly related to their performance. Students who finish the exam in less than two hours tend to have a lower score compared to those who spent more time to complete it.

CONCLUSION

The study concludes that there is a performance gap among Brazilian graduating students in online courses compared to those in F2F courses. Even by considering student's demographic, economic and academic attributes, students who take online education courses perform worse than those in F2F ones. Interpretating this result from the perspective of the ENADE, graduating students taking online courses are less subjected to achieve the predefined course's curriculum objectives established by HE institutions. Based on this result, it is reasonable to assume that online courses in Brazilian HE system negatively contributes for student's learning, implying a performance gap compared to the F2F modality.

One reason for this performance gap can be related to the way in which online education has been expanding in Brazil. On the one hand, according to Ferrugini et al., 2014, students join this modality by assuming it is an easier way to learn, it requires fewer studying hours and it is an easier way to obtain a graduate diploma without too much effort. Nevertheless, online

education courses require dedication, discipline and formation of the student's own knowledge. Moreover, as previously mentioned students are more passive to their studies than properly developing contents and promoting new ones. According to Maia and Meirelles (2003), online education's strategy has the assumption of a greater emphasis on self-learning and students' interest regarding their own learning. Students have to establish when they will study, how much they want to learn and how to find information individually (Moore et al., 2007). This becomes a bigger challenge if one considers that students might decrease their performance since they are less oversighted by professors, following the principal-agent problem (Bettinger et al., 2017) and most of students work while studying, having less time to dedicate for their studies (Souza, 2008).

On the other hand, private institutions and government's actions should not expand the number of online courses without considering what is required in online education. As Rizvi, Rientes and Khoja (2019) found, student's region of origin and socio-economic indicators can predict learning outcomes. In Brazil, there are still some regions in Brazil that lack the minimum infrastructure required, like electricity, internet and other required supports for online education (Martins and Mills, 2016). In a recent study by Rodrigues et al. (2016), the conditions of centers (*polos*) in which online education courses are offered by HE institutions in Brazil had a negative coefficient to predict student's performance, creating the hypothesis that these centers lack in infrastructure quality for the development of student's learning. In addition, the lack of specialized faculty prepared to teach contents in the online format (Ferrugini et al., 2014) tends to continue if one considers that some HE institutions do not incentive or support faculty members to develop and deliver online courses (Redpath, 2012).

It is likely that online education will continue to grow in the educational field, especially with SARS-CoV-2 pushing many HE institutions to try new formats to deliver education. If this is true and based on this student's findings, as Caetano et al. (2016) argued, it is alarming that the increase of online education courses occurs to the detriment of higher education's quality. This expansion of online education could intensify, rather than decrease, educational inequality (Xu & Jaggars, 2014). By analyzing 28 different subjects and considering 1,212,230 respondents from the ENADE, this study contributes for the debate of how online education has been developing in Brazil.

Table 4 – Regression model's results.

	Online and Score (1)	Adding Subject FE (2)	Adding Time to Complete Exam (3)	Adding student's demographic attributes (4)	Adding student's economic attributes (5)	Adding student's academic attributes (6)
				Models		
Online	-0.196*** (0.037)	-0.262*** (0.031)	-0.258*** (0.035)	-0.237*** (0.035)	-0.208*** (0.034)	-0.179*** (0.029)
Score_General	0.415*** (0.012)	0.430*** (0.013)	0.409*** (0.014)	0.398*** (0.014)	0.385*** (0.013)	0.381*** (0.013)
TimeSpent (A = < 1 hour)			-0.301*** (0.046)	-0.349*** (0.048)	-0.368*** (0.045)	-0.380*** (0.045)
TimeSpent (B = 1-2 hours)			-0.036 (0.038)	-0.072 (0.040)	-0.083* (0.039)	-0.087* (0.040)
TimeSpent (C = 2-3 hours)			0.110** (0.031)	0.087** (0.034)	0.085* (0.033)	0.085* (0.034)
TimeSpent (D = 3-4 hours)			0.251*** (0.022)	0.239*** (0.023)	0.243*** (0.023)	0.244*** (0.024)
TimeSpent (E = 4h not finished)			0.223*** (0.014)	0.220*** (0.015)	0.224*** (0.015)	0.223*** (0.016)
Age				-0.013*** (0.001)	-0.013*** (0.001)	-0.012*** (0.001)
Gender (M)				0.105** (0.029)	0.089** (0.028)	0.091** (0.028)
Single				-0.040*** (0.006)	-0.031*** (0.005)	-0.035*** (0.005)
White				0.078*** (0.003)	0.059*** (0.003)	0.056*** (0.004)
AffirmativeAction				0.024** (0.009)	0.028** (0.007)	0.032** (0.009)
Year_ENADE – YearFinishHS				0.011*** (0.001)	0.010*** (0.001)	0.010*** (0.001)
FamilyIncome (B = 1.5 to 3 minimum wages)					0.101*** (0.008)	0.096*** (0.008)
FamilyIncome (C = 3 to 4.5 minimum wages)					0.178*** (0.015)	0.170*** (0.014)
FamilyIncome (D = 4.5 to 6 minimum wages)					0.227*** (0.017)	0.215*** (0.015)
FamilyIncome (E = 6 to10 minimum wages)					0.292*** (0.022)	0.275*** (0.018)
FamilyIncome (F = 10 to 30 minimum wages)					0.376*** (0.027)	0.345*** (0.023)
FamilyIncome (G = above 30 minimum wages)					0.372*** (0.048)	0.327*** (0.041)
Work					-0.028*** (0.005)	-0.017** (0.005)
SchoolLoan					0.113*** (0.015)	0.123*** (0.013)
FinancialAid					0.008 (0.012)	-0.039*** (0.008)
Scholarship						0.146*** (0.021)
ExchangeProgram						0.055** (0.015)
HighSchool (B = all private)						0.077*** (0.017)
HighSchool (C = all abroad)						0.141*** (0.034)
HighSchool (D = majority public)						-0.033** (0.008)
HighSchool (E = majority private)						0.005 (0.014)
HighSchool (F = abroad/Brazil)						0.126** (0.043)
Observations	1,003,523	1,003,523	1,003,523	991,111	990,751	975,143
R2	0.266	0.282	0.295	0.301	0.309	0.312
Adjusted R2	0.264	0.281	0.293	0.299	0.308	0.311

Note: *p<0.1; **p<0.05; ***p<0.01. Values in parenthesis correspond to the standard error of the estimate.

REFERENCES

Associação Brasileira de Educação a Distância (ABED). (2017). Censo EAD.BR: Relatório analítico da aprendizagem a distância no Brasil 2017. Retrieved from: http://www.abed.org.br/arquivos/CENSO_EAD_BR_2018_digital_portugues.pdf, on September, 13, 2020.

Associação Brasileira de Educação a Distância (ABED). (2018). Censo EAD.BR: Relatório analítico da aprendizagem a distância no Brasil 2018. Retrieved from: http://abed.org.br/arquivos/CENSO_DIGITAL_EAD_2018_PORTUGUES.pdf, on September, 13, 2020.

Bettinger, E. P., Fox, L., Loeb, S., & Taylor, E. S. (2017). Virtual classrooms: How online college courses affect student success. American Economic Review, 107(9), 2855-75.

Brasil (2004). Lei Nº 10.861, de 14 de abril de 2004. Institui o Sistema Nacional de Avalição da Educação Superior – SINAES e dá outras providências. Retrieved from http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2004/lei/l10.861.htm on August, 24, 2020.

Brasil (2005). Decreto Nº 5.622, de 19 de dezembro de 2005. Regulamenta o art.80 da Lei n 9.394, de 20 de dezembro de 1996, que estabelece as diretrizes e bases da educação nacional. Retrieved from http://portal.mec.gov.br/seed/arquivos/pdf/dec_5622.pdf, on August, 24, 2020.

Brasil (2019). Edital nº43, de 04 de julho de 2019. Exame Nacional de Desempenho dos Estudantes (ENADE) 2019. Retrieved from http://download.inep.gov.br/educacao_superior/enade/edital/2019/edital_n43_04062019-enade2019.pdf on August, 24, 2020.

Brito, M. R. F. D., & Limana, A. (2005). O modelo de avaliação dinâmica e o desenvolvimento de competências: algumas considerações a respeito do ENADE. Avaliação, Campinas, 9-32.

Caetano, C. C. R., de Oliveira Cardoso, T. A., Miranda, G. J., & de Freitas, S. C. (2016). Desempenho no ENADE em Ciências Contábeis: ensino a distância (EAD) versus presencial. Revista Universo Contábil, 11(4), 147-165.

de Oliveira Rodrigues, B. C., Resende, M. S., Miranda, G. J., & Pereira, J. M. (2016). Determinantes do desempenho acadêmico dos alunos dos cursos de ciências contábeis no ensino a distância. Enfoque: Reflexão Contábil, 35(2), 139-153.

Ferreira, M. A. (2015). Determinantes do desempenho discente no ENADE em cursos de Ciências Contábeis.

Ferrugini, L., Souza, D. L., Morais, R., & Pinto, C. L. (2014). Educação a distância no Brasil: potencialidades e fragilidades. Revista da Universidade Vale do Rio Verde, 12(1), 90-98.

Gatti, B., & de Sá Barretto, E. S. (2009). Professores do Brasil: impasses e desafios. Unesco Representação no Brasil.

INEP (2019). Indicadores de Qualidade da Educação Superior. Retrieved from http://portal.inep.gov.br/artigo/-/asset_publisher/B4AQV9zFY7Bv/content/instituicoes-ja-podem-conferir-dados-para-calculo-do-conceito-enade-e-idd/21206#:~:text=Indicadores%20de%20Qualidade%20da%20Educa%C3%A7%C3%A3o%20Superior%20%E2%80%93%20O%20Conceito%20Enade%20avalia,estudantes%20concluintes%20participaram%20do%20exame. on August, 24, 2020.

Las Casas, A. L., de Almeida, K. P. D. R., & de Cerqueira Viana, R. B. (2012). Identificando o Perfil do Público-Alvo dos Cursos de Graduação na Modalidade de Educação a Distância, no Brasil: Uma Análise Explora Tória. Revista Brasileira Multidisciplinar, 15(1), 23-34.

Lima, P. D. S. N., Ambrósio, A. P. L., Ferreira, D. J., & Brancher, J. D. (2019). Análise de dados do Enade e Enem: uma revisão sistemática da literatura. Avaliação: Revista da Avaliação da Educação Superior (Campinas), 24(1), 89-107.

Maia, M., & Meirelles, F. (2003). Information technology applied to distance education in business administration courses in Brazil. BUSINESS ASSOCIATION OF LATIN AMERICA.

Martins, S. L. B., & Mill, D. (2016). Estudos científicos sobre a educação a distância no Brasil: um breve panorama. Inclusão Social, 10(1).

Miranda, G. J., da Silva Lemos, K. C., de Oliveira, A. S., & Ferreira, M. A. (2015). Determinantes do desempenho acadêmico na área de negócios. Revista Meta: Avaliação, 7(20), 175-209.

Moore, M. G., Kearsley, G., Galman, R., & Mello, A. (2007). Educação a distância: uma visão integrada. Cengage Learning.

Nascimento, M., & Junqueira, E. (2012). Análise do perfil do aluno de ciências contábeis na modalidade a distância e do seu desempenho na disciplina de contabilidade introdutória. Anais do Encontro da Anpad (EnAnpad), Rio de Janeiro, RJ, Brasil, 29.

Nascimento, L. F., Czykiel, R., & Figueiró, P. S. (2013). Presencial ou a distância: a modalidade de ensino influencia na aprendizagem?. Administração: Ensino e Pesquisa, 14(2), 311-341.

Ortagus, J. C. (2017). From the periphery to prominence: An examination of the changing profile of online students in American higher education. The Internet and Higher Education, 32, 47-57.

Palloff, R. M., & Pratt, K. (2004). O aluno virtual-um guia para trabalhar com estudantes on-line. Penso Editora.

Redpath, L. (2012). Confronting the bias against on-line learning in management education. Academy of Management Learning & Education, 11(1), 125-140.

Rizvi, S., Rienties, B., & Khoja, S. A. (2019). The role of demographics in online learning; A decision tree-based approach. Computers & Education, 137, 32-47.

Scudeler, M. A., Calderon, A. I., & Pires, A. (2020). O Desafio da Educação a Distância no Ensino Superior Brasileiro: a Expansão dos Cursos de Pedagogia a Luz do ENADE como Índice de Qualidade. Jornal de Políticas Educacionais, 14.

Souza, E. S. D. (2008). ENADE 2006: determinantes do desempenho dos cursos de ciências contábeis.

Urtel, M. G. (2008). Assessing academic performance between traditional and distance education course formats. Journal of Educational Technology & Society, 11(1), 322-330.

Xu, D., & Jaggars, S. S. (2014). Performance gaps between online and face-to-face courses: Differences across types of students and academic subject areas. The Journal of Higher Education, 85(5), 633-659.