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Article

Digital Gap and Academic Performance in the Covid-19 Pandemic: The Case of a Public School in Bogota

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Highlights

- The impact of digital gap on students' academic performance from a public school is analyzed amid the Covid-19 pandemic.
- Sources of heterogeneity around the effects of digital gap on students' academic achievements are identified
- Between students with permanent access to the Internet, female students show better academic results than male students.
- Electronic devices help to improve academic scores if students know how to use them, and the devices have permanent access to the Internet.

Abstract: This study analyzes the academic performance of students from an official school in Bogotá (Colombia) who had asymmetric access to Information and Communication Technologies during the first year of the Covid-19 pandemic. The Classical Linear Regression Model is employed using data from a survey of a representative group of students in the year 2020. Results show technological gaps between students that are associated with asymmetric academic performance against students with limited or null access to the Internet and electronic devices. Results also show that, among students with permanent access to the Internet, women have better scores compared to men's scores, which implies that women can achieve better academic results than men in virtual education. It is also noted that the sole access to an electronic device does not guarantee good academic achievements if there is no full access to the Internet, and if ICT-use skills have not been developed.

Keywords: Digital gap; academic performance; Information and Communication Technology; digital literacy; virtual education; Covid-19

Introduction

The Covid-19 pandemic and the subsequent quarantines implemented by different governments to reduce people's health-associated problems, deepened social differences and economic gaps in the most diverse nations. Colombia was not an exception to this phenomenon, as the lockdowns imposed at the national level from March 2020 to halt the spread of the virus (acts 417 and 457 of March 2020) led to an increase in income gaps between women and men, and to a rise in employment gaps between women and men from rural and urban areas (DANE, 2020, 2021). According to the United Nations Economic Commission for Latin America and the Caribbean (ECLAC), the confinement measures caused an imminent increase in digital gaps between students; this is, an asym-

metric increase in the number of students who have access to Information and Communication Technologies (ICT), compared to the number of students who do not have access to these technologies (ECLAC, 2021)¹.

One of the effects from the lockdowns imposed by the Colombian government was the suspension of in-person classes in all the schools. Educational institutions found it necessary to suddenly migrate their services to the digital environment with synchronous and asynchronous remote classes. However, the lack of Internet access in many academic communities revealed how the human right to education was impacted from new dimensions, including the digital domain. Saavedra et al (2021) showed that the drop in the presentation of the Saber 11 test in Colombia occurred mainly in students without Internet access; the number of tests taken by students with Internet connection increased by 8.97% between the periods 2019-II and 2020-II, while it fell by 26.79% among students who did not have access to Internet². Digital gaps caused by the lack of access to ICT resulted in pedagogical vulnerabilities in online learning, including a weak access to a full schedule of daily classes, and a poor academic support provided by teachers and tutors.

Scholarly works have shown that the access to ICT was essential for students to maintain their academic performance during the Covid-19 pandemic (Montenegro et al., 2020), especially in rural areas (Alvarez and Garcia, 2021). However, Saavedra et al. (2021) found no statistically significant differences in academic results between students with and without Internet access. These contradictory results suggest that technological gaps between students have divergent effects on the academic performance of students.

In the literature, there is little empirical evidence on the asymmetric academic performance of students from public schools along the Covid-19 pandemic, and the potential relationship between these academic outcomes and technological gaps between students (in the access and efficient use of ICT). In 2020, Bogotá reported 364 district public schools operated directly by the Secretary of Education. The schools are in different areas of the city, including the locality of San Cristobal (Alcaldía Mayor de Bogotá, 2020). This locality, where the public school studied in this paper is located, contributed 9% to the total number of public schools in the city.

The aim of this paper is to analyze digital gaps between students enrolled in a public school in Bogotá (anonymous) in the locality of San Cristobal during the pandemic, and the impact of these gaps on students' academic performance. Specifically, the study analyzes two complementary research questions. First, if during the Covid-19 pandemic, students with access to ICT and skills for its use, showed better academic performance compared to those who did not have access (or limited access) to ICT, and those who did not have skills to use ICT tools. Second, if the expected differences in academic results between students caused by existing digital gap between them were greater in female students as compared to male students.

The rationale of this study arises from the need to assess potential asymmetric academic results between students in the analyzed public school due to technological gaps between them during the Covid-19 pandemic. The results are expected to provide initiatives associated with ICT in the educational processes of students. The study first addresses the literature on the relationship between academic performance and ICT. The study then presents the research methodology and the study results. Last, the study provides some conclusions and recommendations.

¹ "In Latin America and the Caribbean, it was possible to connect 2/3 of the population to the Internet, 32 million children between 5 and 12 years of age in the region could not access virtual or remote education; 40 million homes were unable to connected to the Internet, and the largest gaps were between quintiles and between urban and rural areas" CELAC (2021).

² "...Internet access was not universal before the pandemic period; 60% of the poorest population in the country did not use the Internet, while more than 80% of the richest population group used this service every day" (Saavedra, V. et al, 2021).

Literature Review

Several factors that influence on school students’ academic performance have been investigated in the literature, including families’ socioeconomic status (Farooq et al, 2011; Capraro, Capraro and Wiggins, 2000), parents’ educational level (Jeynes, 2002; Mitchell & Collom, 2001), the aptitude and type of institutions and environment in which the student's academic process unfolds (Wahlberg, (1981), among other economic, social, and environmental characteristics. Digital gap between students and its effects on academic performance is an issue that has gained significant attention in the last decades, especially after the Covid-19 pandemic, due to its importance for the design of transversal public policy on ICT-education aimed at improving the academic performance of students in a balanced way.

Digital Gap and Academic Performance

In a study by Montenegro et al (2020) in Spain, with a sample of 252 teachers from the Autonomous Community of La Rioja, it is found that the fulfillment of academic aims is directly related to technology access; this is, greater access to ICT by students and teachers leads to a better academic performance. Notwithstanding, access to ICT is highly associated with the purchasing power of students' families. For Montenegro et al. (2020), the need to consider the interrelationship between socioeconomic factors and the development of skills in the use of digital tools is evident, not only for students, but also for teachers and parents.

Contrary to the results of Montenegro et al. (2020), the study by Saavedra et al. (2021) does not find significant changes in the average score of the Saber 11 test of people with and without Internet access between the period 2019-II (before the pandemic) and 2020-II (during the pandemic). High changes in these scores were expected for both groups of people due to the sudden implementation of virtual teaching-learning strategies. The results by Saavedra et al. (2021) also show that the academic gap between students with and without Internet access changes very little from 2019-II to 2020-II (3.2 points and -1.4 points for people in social strata 1 and 6, respectively). Notwithstanding, the study shows the persistence of significant score differences between students with and without Internet access within each social strata: the gaps are 17.4 points in strata 1 and 72.5 points in strata 6.

Table 1. Average Score (Points) in the Saber 11 Test, Periods 2019-II and 2020-II.

| Social Strata | Access to the Internet | 2019-II | 2020-II | Change 2019-2020 |
|---------------|------------------------|---------|---------|------------------|
| 1 | Without Internet | 230.9 | 228.5 | -2.4 ↓ |
| | With Internet | 245.1 | 245.9 | 0.8 ↑ |
| | Gap | 14.2 | 17.4 | 3.2 ↑ |
| 6 | Without Internet | 196.4 | 199.5 | 3.1 ↑ |
| | With Internet | 270.3 | 272.0 | 1.7 ↑ |
| | Gap | 73.9 | 72.5 | -1.4 ↓ |

Source: own elaboration based on Saavedra et al.’s (2021) study.
Social strata refer to the classification of population groups according to their economic status and residential geographic location: the higher the strata, the greater the families’ economic capacity (DANE, 2022).

In a study by Álvarez and García (2021) in Spain, the problem of digital gaps in rural schools is analyzed, and the impact caused by confinements amid the Covid-19 pandemic is examined. Virtual classes are found to present various difficulties associated with poor network connection and technological shortages. The study also uses a survey applied to 157 rural schools during lockdowns, and the results show significant digital gaps for 30% of rural-base students compared to urban-base students. In different interactive activities analyzed in this study, it is found that 74.5% of teachers expressed uncertainty regarding the true efficiency of E-learning. Moreover, 90.8% of the participants said that methodologies used in virtual classes led to less learning compared to methodologies applied in on-campus classes. Finally, 62.7% of teachers indicated that virtuality is not the most appropriate medium for learning in rural areas.

Expósito and Marsollier (2020) evaluate the participants' perception of students' academic performance during the Covid-19 period in Mendoza, Argentina. The research considers the sudden change from in-person education to an immersed strategy in a totally virtual environment that this region faced in March 2020. The responses of 777 individuals are used to compare the academic performance of students during the pandemic (with mandatory use of ICT) with the performance of students in years prior to the pandemic (with little or moderate use ICT). Results from this study's descriptive analyses show an evident perceived deterioration in students' academic performance, since 60% of participants believe students had an academic achievement below normal; 36% said that students had a normal performance; and the remaining percentage (4%) believe the students showed a performance above normal.

The study by Kuric, Calderón-Gómez and Sanmartín (2021) develops a typology of educational problems (with technical and psychosocial skill types) presented during the Covid-19 pandemic at secondary and university levels. Kuric et al. (2021) show that 44.7% of students believe the pandemic negatively affected their studies and the fulfillment of academic goals. Among the young population of lower and lower-middle class, 49.3% say the pandemic negatively affected their academic performance, while 21.7% believe they could take normal classes with the use of ICT. In the population of upper and upper-middle class, 38% of students perceive the pandemic negatively impacted their academic outcomes, and 36.4% express they were able to continue classes normally with the use of ICT.

A second analysis by Kuric et al. (2021) shows that 31.4% of students indicated the academic staff was not prepared to completely adapt virtual education methodologies; and 20.4% of students expressed that teachers were not totally aware of the students' academic process. The study concludes that the performance of teachers amid the Covid-19 pandemic is an important element to bring to empirical analyses, as ultimately students' learning difficulties during the period of confinement was also associated with the teachers' lack of preparation to virtual education (in term of teaching and mentoring).

Heterogeneous Effects of Technological Gaps on Academic Performance

In the literature, significant differences have been found in the academic performance of students explained by sociodemographic factors, including gender. A study carried out in Chile shows potential heterogeneous results in the PISA test before and during the Covid-19 pandemic among male and female students (Department of Education, 2020). Before the pandemic, 37% and 27% of male and female students achieved scores below level 2, respectively; however, after 10 months of school closure during the pandemic, these numbers would rise to 52% and 38%, respectively, suggesting that male students' academic performance is more vulnerable to full implementations of virtual education.

The World Bank Group (2020) made a forecast of what could happen in the coming years regarding education due to the impact of the Covid-19 pandemic, and the consequent crisis caused by different issues such as digital gaps. Based on indicators associated with diverse crisis in the last decades in Asia, West Africa, and Latin America, the report suggests that, at the household level, a greater academic impact on girls is likely if the trends observed in socioeconomic crises of past decades are repeated. In Sierra Leone, for

instance, after the economic crisis of 2008, the growth of the average school dropout of 15-year-old female students is 5 percentage points above the growth of the average population, which was recorded at 8%. In Cameroon, during the economic crises of the 1980s and 1990s, girls were 83% more likely to drop out from school as compared to boys. In Brazil, after the 2008 crisis, the impact of unemployment on household breadwinners was significantly greater on the education of girls living in vulnerable areas as compared to the education of boys living in the same areas.

The evidence found in the literature sheds light on potential analyses to make about two complementary problems experienced in public schools during the pandemic. First, if greater technological inequality among students from public schools is associated with asymmetric academic results between them, in favor of the groups with greater access to ICT and skills to use these technologies. Second, if the hypothetical existence of asymmetric academic performance among students due to technological gaps between them is more evident in female students compare to male students. The methodology to address these problems are explained in the following section.

Methodology

To examine the research questions of this paper, we use the final academic performance of students enrolled in a public school of Bogota in 2020. We differentiate between students who had permanent access to ICT and students who had partial or no access to ICT, as well as between students who affirm they had skills to use ICT and students who claimed they did not have such skills. The paper includes other covariates that can be associated with the academic performance of students. The data and econometric model employed in this paper are explained in detail in the following subsections.

Data

This study employs a population of 113 individuals, which constitutes the total number of students enrolled in the analyzed public school in levels seven, eight, and nine. The number of students in the survey accounts for 27% of total students’ population during 2020, and 70% of students enrolled in the school’s middle vocational level. A calculation of students’ grade point average (GPA) in 9 academic subjects is made. Grade Point Average (GPA) ranges from 0.0 points (lowest score) to 5.0 points (highest score). Descriptive statistics in Table 2 show that the students’ population mean and mode of GPA in year 2020 was 3.61 and 4.02, respectively. The standard deviation was 0.86 points; and the minimum and maximum scores were 1.23 and 4.78 points, respectively.

Table 2. Descriptive Statistics on Academic Performance, Year 2020

| GPA | |
|--------------------|------|
| Mean | 3.61 |
| Standard Deviation | 0.86 |
| Minimum | 1.23 |
| Maximum | 4.78 |
| Median | 3.84 |
| Mode | 4.02 |
| Observations | 113 |

Statistics from the surveys are complemented with data collected from a 12-question survey applied to the same students in October and November 2020. In these months the national and local governments of Colombia kept compulsory lockdowns to avoid the spread of Covid-19. Aspects associated with ITC accessibility are assessed in the survey

as factors that may influence students’ academic achievement, including student’s ease and frequency of use of electronic devices (such as computers, cellphones, and tablets), and access to Internet at home or in nearby places (in relatives/friends’ houses or in Internet cafes). The survey leaves aside the possible teaching effects that may have occurred in the performance of students in each subject.

Table 3 shows a cross-tabulation analysis between students’ academic performance in different subjects and the variables of interest: Internet access and access to electronic devices. The statistics show that students’ GPA was higher in those who had full access to the Internet, compared to students who had partial access or no access to the Internet. Only in Arts and Sports, students who had full access to an electronic device (without considering the Internet connection) had a better academic achievement compared to those who had a partial or no access to electronic devices. The overall figures show asymmetries between students regarding the access to ICT; for each student with partial access or no access to the Internet, there are 2.6 students with permanent Internet access, and for each student with access to an electronic device, there are 1.4 students without access to any of these devices.

Table 3. Academic Performance by Subject and Access to Internet and Electronic Devices, Year 2020

| Academic score by Access to Internet and electronic devices | | | | |
|---|----------|-----------|--------------|------------------------|
| Subject | Internet | Internet | Device | Device |
| | | Permanent | Partial/null | Permanent Partial/null |
| Biology (Science) | 3.190 | 3.116 | 3.109 | 3.255 |
| Social Studies | 3.703 | | 3.380 | 3.562 |
| 3.689 | | | | |
| Arts | 3.942 | 3.654 | 3.886 | 3.831 |
| Ethics | 3.735 | 3.319 | 3.471 | 3.831 |
| Sports | 3.959 | 3.554 | 3.950 | 3.706 |
| Religion | 3.729 | 3.300 | 3.463 | 3.819 |
| Language | 3.513 | 3.183 | 3.293 | 3.604 |
| Mathematics | 3.663 | | 3.458 | 3.504 |
| 3.751 | | | | |
| Computer Science | 3.802 | | 3.587 | 3.659 |
| 3.861 | | | | |
| GPA | 3.693 | 3.394 | 3.544 | 3.705 |
| Observations | | 82 | 31 | 66 |
| 47 | | | | |

Finally, Table 4 identifies the academic achievement of students by subjects and sex. The average academic performance of women is greater than the average academic performance of men. By areas of knowledge, women show higher achievements in Social Studies, Ethics, Sports, Religion, Language, Math, and Computer Science. The academic scores of men are greater than those of women only in Biology and Arts.

Table 4. Academic Performance by Subject and Sex, Year 2020

| Academic Achievement | Women | Men |
|----------------------|--------------|--------------|
| Biology (Science) | 3.135 | 3.201 |
| Social Studies | 3.735 | 3.505 |
| Arts | 3.827 | 3.896 |
| Ethics | 3.818 | 3.440 |
| Sports | 3.850 | 3.847 |
| Religion | 3.807 | 3.432 |
| Language | 3.574 | 3.284 |
| Mathematics | 3.629 | 3.586 |
| Computer Science | 3.866 | 3.630 |
| GPA | 3.693 | 3.536 |
| Observations | 54 | 59 |

The student survey also inquired about other important aspect of students' education: i) the interaction of students with their course teachers, parents, caregivers, and extended family members during the pandemic; ii) the monitoring process of students' education activities; iii) students' level of perception regarding their difficulties in learning through extramural (virtual) education compared to on-campus education, iv) students' satisfaction with their academic performance in the school and the quality of education received during 2020.

Econometric model

The first research question is analyzed through a log-linear econometric model for cross-section data using the Ordinary Least Squares method. See Equation (1):

$$lgpa_i = \beta_0 + \beta_1 woman + \beta_2 course9 + \beta_5 occupaserv + \beta_6 unemployed + \sum_{j=1}^5 \gamma_j ICT_j + u_i \quad (1)$$

Where *lgpa* represents the natural logarithm of GPA of 9 academic subjects in year 2020; *woman* is a binary variable that takes on the value of 1 if the student is a woman; *course9* is a binary variable that takes on the value of 1 if the student is in 9th level (the control group is 7th and 8th levels); *occupaserv* and *unemployed* are dummy variables equal to 1 if the student's father/mother/guardian/caregiver reports to be employed in general and domestic services or to be unemployed, respectively (the control group includes other labor activities). Finally, the following categorical variables associated with *ICT* are included:

accessint: according to the question "In the last six months, have you had access to the Internet service, either at home or in a nearby place?", the response option that reflects permanent and effective access to the Internet service is taken as 1.

accessdevice: according to the question "During the last six months, has it been easy for you to access a device (computer, tablet or cell phone) to do and send assignments, either from your home or from a nearby place?", it is taken as 1 the answer option that shows permanent and effective access to an electronic device such as cell phone, tablet, computer (personal or desktop).

goodlearn: according to the question "Do you think it is easier to understand the contents of academic subjects through virtual teaching methodologies?", the response options

that show positive learning or improvement in all subjects from virtual learning are taken as 1 (compared to student's perception of learning from face-to-face methodologies).

oncampus: according to the question "Do you think that, in order to have a good education process, you need to share on campus with your classmates and teachers?", the yes response option is taken as 1, and 0 otherwise.

assistance: according to the question "On average, how many hours a day have your parents, caregivers or relatives devoted to assist you with your school homework?", the response options in which the student perceives incomplete, little or no hours of schooling assistance from these groups are taken as 1.

Equation (2) is estimated to analyze whether the potential digital gap has more pronounced effects on women's academic performance compared to the academic performance of men (the second research question in this paper). This equation includes the interaction between *woman* and the variables of interest related to ICT (*accessint*, *accessdevice*, *goodlearn*, *oncampus*, *assistance*). The model is as follows:

$$\begin{aligned} lgpa_i = & \beta_0 + \beta_1 woman + \beta_2 course9 + \beta_5 occupaserv \\ & + \beta_6 unemployed + \sum_{j=1}^5 \gamma_j ICT_j \\ & + \sum_{k=1}^5 \theta_k woman \cdot ICT_k + u_i \end{aligned} \quad (2)$$

The Breusch-Pagan/Cook-Weisberg test detects the presence of heteroscedasticity in students' academic outcomes. Therefore, the econometric estimates include standard errors correction due to the presence of clusters (9 courses in total) to get efficient estimates. Standard errors are also corrected through bootstrapping with 50 replications. The log-linear estimates are corrected by logarithmic scale following Wooldridge (2009). The test of tetrachoric correlations, which are designed for dichotomous and polytomous categorical variables (Freiber, Stover, De la Iglesia and Fernández, 2013), shows low correlations between explanatory categorical factors. The Variance Inflation Vector (VIF) test shows no presence of perfect or quasi-perfect multicollinearity.

Results

Table 3, part A, shows the estimated coefficients of Equation 2 and their standard errors. Particular interest is placed on the coefficients of *ICT* composed by *accessint* and *accessdevice*, with which the first research question can be analyzed; that is, if during the pandemic, students who reported having permanent access to ICT and skills to use them showed better academic results than students who had limited/no access to ICT, and low ICT skills. Table 3, part B, shows the estimated results of Equation 2 to analyze the second research question: if the hypothetical gap in the academic performance of students linked to the asymmetric access to ICT was more accentuated in women as compared to men.

Evidence of digital gaps

The estimated coefficient for *woman* in Table 3, part A, shows that the average score for women is 3.2% greater than the average score for men, keeping everything else constant. The result is statistically significant at the 10% significance level. This result is linked to the study by MINEDUC (2020) in Chile, regarding the impacts of the pandemic on academic achievement by sex, in which women who study in private schools were found to get better academic results compared to men studying in the same type of school. The results of our paper, notwithstanding, focus on the academic performance of students in a public school.

Results for the variable *course9* show that the academic performance of students at the 9th level is 7.3% greater than the academic performance of students at the 8th and 7th levels (the control group). These results are statistically significant at the 5% critical value, and suggest that, during moments of physical isolation and compulsory use of ICT, students in more advanced courses tend to obtain better scores than students in lower courses. Greater academic maturity and autonomy in the learning process of students in higher courses may be a reason to explain this result. Our findings contrast with those evidenced by Expósito and Marsollier (2020), who noted that higher school levels showed lower or insufficient academic results during the Covid-19 pandemic period: at the pre-school level, 33% of the students had low performance; while in elementary and high school levels the percentage of students with low performance was 37% and 60%, respectively.

For the variable *ocupaserv*, estimated results show that students whose caregiver (student's assistant) reported to work in the general or domestic services industries had a 13.1% greater performance compared to students whose assistants said to work in other sectors of the economy (the control group). In the survey, 7% of assistants said to work in the general or domestic services industries. As the pandemic reduced the number of working hours in the economy, including the service sector (ILO, 2020), it is likely that the students' caregivers who work for companies in these industries dedicated more time to assist the students with their homework amid the Covid-19.

Table 3. Factors Associated with Academic Performance in the Covid-19 Pandemic.

| Dependent variable: Academic results (scores) | | |
|---|--------------------------------------|--------------------------------------|
| | Part A Coeff. (standard error) | Part B Coeff. (standard error) |
| <i>woman</i> | .0320* (.016) | .0755 (.1415) |
| <i>course9</i> | .073** (.030) | .2155** (.080) |
| <i>ocupaserv</i> | .1312*** (.040) | .1685*** (.061) |
| <i>unemployed</i> | .1581** (.065) | .2052** (.083) |
| <i>accessint</i> | .2425*** (.062) | .0626 (.089) |
| <i>accessdevice</i> | -.1350** (.075) | .0459 (.098) |
| <i>goodlearn</i> | .0961*** (.038) | .0744 (.0677) |
| <i>oncampus</i> | .0630* (.034) | .0722* (.038) |
| <i>assistance</i> | -.0806*** (.034) | -.0647* (.0362) |
| <i>womanaccessint</i> | | .2572* (.1388) |
| <i>womanaccessdevice</i> | | -.2787** (.1432) |
| <i>womangoodlearn</i> | | .0022 (.1440) |
| Observations | 113 | 113 |
| Prob>chi2 | .000 | .000 |
| R Square | .1538 | .2747 |

***, **, * are the 1%, 5%, and 10% significance levels, respectively. The values are corrected by logarithmic scale following Wooldridge (2009).

The result of the *unemployed* variable suggests that the academic performance of students whose assistant reported being unemployed in the survey was 15.8% greater than

the performance of students whose assistants were employed (the control group). This last result shows that adult parents/caregivers, by not having to carry out activities outside home (due to their unemployment status), may have a greater availability to accompany and guide their student children in their academic development and fulfillment of assigned tasks.

The key estimated coefficients of categorical variables associated with *ICT* identify important results. The coefficient of *accessint* shows that the academic performance of students with complete access to the Internet service is 24.2% greater than the academic performance of students who had incomplete or no access to this service. This evidence implies that students with effective access to the Internet reach higher scores in times of pandemics like the Covid-19. Moreover, the coefficient for *accessdevice* shows that the score of students with complete access to an electronic device is 13.5% lower than the score of students with incomplete or no access to electronic devices. This result suggests that having an electronic device does not guarantee a better academic performance perse. In line, the estimated coefficient of *goodlearn* shows that students with a perception of positive learning or improvement in all subjects or in several of them during the pandemic, had a 9.6% greater performance compared to those whose perception of learning from virtual classes was negative. This result could show a direct link between students' positive perceptions of learning from virtual education and their efforts to achieve good academic scores via adaptability, discipline, and commitment.

The concept of "digital literacy" developed by Berrio (2012) supports the ICT-associated results presented above, as the problem of digital gap not only addresses the measurements of ICT coverage, but also the skills and technological absorption capacities of individuals (known as the second-level digital gap). Digital illiteracy due to the lack of access to technological infrastructure (for generational reasons or low academic-cultural levels (Castanedo, 2017)) leads to a greater second-level digital gap; an issue that can become more complex to address (Berrio, 2012).

The *oncampus* coefficient in Table 3, part A, indicates that the average score of students who expressed the need to carry out fully in-person academic schedules is 6.3% greater than the average score of students who stated that in-person classes are not necessary (fully or partially). This result implies that students who carry out academic tasks virtually and attend synchronous remote classes are more aware of the difficulties that virtual education entail, having to work harder to get better results.

Lastly, the coefficient of *assistance* shows that the average score of students who stated that they had medium, low or no academic support from their relatives/parents/caregivers is 8% less compared to the average score of students who stated that they did have complete support in completing homework and attending virtual classes. This outcome suggests that, in a virtual education environment, students who have support from their assistants (via academic tutoring and guidance) tend to show better academic outcomes than those who do not. Expósito and Marsollier (2020) found that only in 3.7% of the cases of high school students there was null support during the Covid-19 pandemic; in 39.3% of the cases, family support was lower than expected; in 38.5% of the cases there was normal support (based on the support received in the years prior to the pandemic); and in 18.40% of the cases, there was support beyond the expected.

Heterogeneous Effects of Technology Gaps by Sex

Table 3, part B, shows the estimated coefficients of Equation (2) using interactions between *woman* and the variables of interest linked to ICT. Results show that the coefficient for *womangoodlearn* is not statistically significant at any conventional level. The estimated coefficient of *womanaccessint* indicates that the average score of women who had access to the Internet in the Covid-19 pandemic is 25.7% greater than the average score of students in the control group (men who had Internet access in the pandemic). On the other hand, the coefficient of *womanaccessdevice* indicates that the average score of women who had access to electronic devices in the Covid-19 crisis is 27.8% lower than the average score

of students in the control group (men who had access to electronic devices in the pandemic). These results confirm that, during the covid-19 pandemic, female students with Internet connection had better academic results than their counterparts (male students), *ceteris paribus* their skills in the use of electronic devices.

Concluding Remarks

This study empirically examines the relationship between digital gaps and the academic performance of students enrolled in an official public school of Bogotá (Colombia) during the Covid-19 pandemic, year 2020. A log-linear model is estimated through the ordinary least squares method with clustered standard error correction. The model is used to examine two hypotheses about the association between students' digital gaps during the pandemic and their academic results. The findings show that the students who had permanent access to ICT (Internet and electronic devices) reached better academic scores than those who did not have permanent access to ICT. However, the results show that having full access to the Internet and an electronic device is not a guarantee of a better academic achievement if other factors do not intervene in the student's educational process, including the quickness to assimilate ICT, the ease to understand teaching-learning methodologies in virtual education systems, and the willingness to use E-learning technologies.

Women with full Internet connection showed better academic achievement than men with similar Internet access; a result that implied that the attendance to virtual synchronous meetings are better assimilated by women. Parents' assistance turns out to be fundamental for students to get better academic results during virtual education activities, as students may tend to find in their parents/caregivers the support they used to have from their teachers and classmates before the pandemic. Full access to ICT leads to little positive impacts if students, on the one hand, have not developed notions of responsibility, self-discipline and good study habits, and on the other hand, have no constant support from their parents/caregivers in the learning process. Families must adopt a broad vision of the benefits and threats of ICT that comprise basic values of their formative role with children.

The so-called "digital gap" was evidenced at the beginning of the Covid-19 pandemic, when the majority of students did not have effective access to ICT. The public schools of Bogotá were not the exception, as they did not have the infrastructure to alleviate the needs of educational entities (as it was for the public school studied). Over the months, digital gaps between students tended to breach in a forced way. Figures indicate that many students were gradually accessing to the Internet service as well as to the purchase of different electronic devices to fulfill educational activities in the schools.

Finally, it is essential to bear in mind that the reduction of the so-called "digital gap" will come not only from the access to the Internet and electronic devices, but also from the development of skills to use these technological devices; ultimately, students may own a cell phone, a computer or a tablet (devices highly used during the pandemic), but if they do not have a permanent Internet connection for their virtual meetings, and/or they don't have enough skills to use the devices, their educational process may be hindered.

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