The Long-Term Impacts of COVID-19 on Education: A Focus on Students' Enrollment and Attainment

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Abstract

The global COVID-19 pandemic caused wide disruptions in most sectors: health, aviation, retail, leisure, education, etc. This study will focus on the impact of the pandemic on the education system in Europe, in the long run. It will analyze, by comparison, the students' academic results before and after the lockdowns. The study examined how schools responded to an emergency and its aftermath by analyzing data from the Program for International Student Assessment (PISA) and Eurostat. The schooling system worldwide was transformed immediately from physical to digital learning. Students, teachers, and parents had to adapt to remote education using different tools and platforms to stop the spread of the virus. Moreover, the shift had happened in a time record, while some teachers were still trained in new pedagogical and digital skills. All stakeholders compromised with the hybrid learning format for more than two years. Now, after the official end of the pandemic, it is time to analyze the effectiveness of the method applied, the academic results of the students, and the impact in the long run. Unfortunately, studies proved that students have a deficit in mathematical skills, and not only. Significant relationships were also found in the analysis between the education attainment rates and other variables, such as early school leavers and enrolment rates at various educational levels The primary and elementary students appear to have suffered the most, compared to high school and college level students. Moreover, school closures significantly impacted enrolment rates, especially at the upper secondary and postsecondary levels. These results imply that additional effort should be made to help students catch up with the gaps to avoid negative long-term consequences for them and the future leaders of society.

Keywords: *COVID-19, education, impact, enrollment, attainment*

1. Introduction

Millions of students have had their education disrupted by the COVID-19 pandemic, and frequently difficult shifts to online learning modes have been required. The adaptation to the new pedagogies skill set was a must. Moreover, the closure of colleges, universities, and schools came to stop the virus's spread. The pandemic's immediate and long-term impacts on educational systems, student results, and the future of learning have all come into question because of this extraordinary disruption.

This study evaluates the long-term effects of COVID-19 on the education sector. The study's specific goal is to examine how the pandemic has impacted important educational metrics like enrolment rates, closings of schools, learning outcomes, and levels of educational attainment. Throughout the analysis of these variables, the research aims to shed light on the obstacles that global education system confronts and suggest possible approaches to lessen the pandemic's detrimental effects on learning.

The findings offer insightful information to school managers and educators. Policymakers can address learning loss, create more resilient education systems, and help students and teachers by having a better knowledge of the long-term effects of COVID-19 on education. Researchers can delve deeper into the

intricate relationship between pandemics and educational outcomes, and educators can use the data to enhance their methods and adjust to the evolving requirements of students.

2. Literature Review

The COVID-19 pandemic represents a historical turning point that may result in great opportunities or revolutionary transformation. The response will determine whether we stay on the dysfunctional and unfair path or work toward building a more equitable, inclusive, and sustainable society. To create a better future, education must align with these principles [1]. The pandemic significantly impacted education worldwide, with over 1.7 billion students affected, particularly in underprivileged communities The pandemic's unintended consequences, like food instability and financial hardship, had a significant influence on education even though the infection rate was low worldwide [2].

Various studies have been conducted to study the impact of COVID-19 on education. One study models the effects of COVID-19-related school closures and projects a decline in global learning and enrolment [3]. The estimated losses range from 0.3 to 1.1 years of education, lower earnings of $366 to $1,776 per student year, and potential dropout risks for 11 million pupils. A five-month closure might result in $10 trillion in lost learning. An impact study was conducted in response to the global disruption of education caused by the COVID-19 epidemic. The analysis predicted that students will have retained 63-68% of reading gains and 37-50% of math gains upon returning to school in fall 2020, based on estimates of absenteeism and summer learning habits of 5 million students. However, the top third students might have improved their reading during the closures [4].

In the United States of America, grades K–12 schools switched to remote learning during the COVID-19 pandemic. To better understand how teachers were utilizing technology throughout this transition, the study [5] polled teachers. To maintain academic consistency, teachers mainly used well-known websites and apps. The obstacles included getting parents and students involved with unclear rules and having problems with students' technology access. It is suggested that emergency preparations be made more explicit and that online elements be incorporated into present education and professional development [5]. The research investigated the experiences of parents during the COVID-19 school closures. Parents reported difficulties juggling obligations, learner motivation, accessibility, and learning results, even though they were not against the closures, to stop the spread of the virus [6].

In autumn 2020, a study polled more than 2,000 students in Alberta, Canada, between the ages of 12 and 18, and the results showed that 84.9% of them returned to traditional classroom settings. 25% of students reported stress levels over critical thresholds, with female students and older students more affected even if the majority coped well. Stress was linked to behavioral issues such as conduct issues and poor effect, which emphasizes the necessity for schools to offer specialized support to students who are under a lot of stress [7], especially during the pandemic. Extended school closures brought on by COVID-19 have interfered with instruction and vital non-academic services for students. This emphasizes how important it is for schools to offer food aid, mental health services, health care, and support for homeless people [8]. Kenya's use of education technologies (EdTech) for remote learning during the COVID-19 pandemic benefited some people at the expense of marginalized ones [9]. Increasing inclusion in the use of EdTech is one of the recommendations to guarantee fair access to education.

From all the above, there is a gap in the study as most of the literature doesn’t compare the education attainment rate, which is the core of this study. Mendelian randomization was employed in a study [10] to examine the correlation between the risk of COVID-19 and educational attainment (EA). The results – from more than a million European participants – showed that a greater EA was substantially linked to a lower probability of developing severe COVID-19. These findings indicate that EA may have an impact on COVID-19 outcomes. The pandemic had an influence on student learning worldwide due to school closures. According to a German study, most students reduced their daily learning time in half, but low-achieving students cut theirs by 4.1 hours while high-achieving students cut theirs by 3.7 hours [11]. Additionally, low achievers used entertainment media like TV and video games to replace schooling. The low-achieving students had greater needs, but they received less help from parents and schools, which could lead to a worsening of their educational level.

The COVID-19 pandemic significantly impacted education, leading to the shutdown of schools in 2020. In response, international organizations pushed for systemic policy changes. Three main issues came to light: improving teacher development, tackling educational inequality, and digitizing education [12].

The transition to remote learning has presented difficulties for educators, especially in maintaining fair access to technology. This is supported by studies conducted in Germany and the United States. Moreover, studies conducted in Alberta, Canada, revealed that although most students managed the difficulties effectively, a notable percentage expressed stress and behavioral issues. Also, the research highlights how crucial schools are for supplying non-academic support interrupted by school closures, like food aid and health care. Finally, these results highlight the necessity of anticipatory planning and assistance to help educators and students deal with the difficulties brought on by the pandemic.

3. Methodology

The study uses two sets of different datasets to analyze the impact of COVID-19 on education in the European Union. The study utilizes regression analysis and descriptive statistics to compare the data of different metrics across time to understand how education was impacted before and after the pandemic.

3.1 Data Collection

For this investigation, two datasets were considered. The dataset from the Program for International Student Assessment (PISA) is the initial dataset in this study [13]. PISA is an international survey that analyses educational systems across the Globe to assess the performance of 15-year-old students in reading literacy, mathematics, and science.
The second dataset was gathered from the European Union's statistical website, Eurostat [14]. Numerous statistical data regarding several facets of life in Europe, including education, are collected, and disseminated by Eurostat. Education-related data from the Eurostat database was chosen for this analysis to supplement the PISA data and offer a more thorough picture of the impact of COVID-19 on education in Europe.

3.2 Description of Datasets

In February 2021, the total school enrolment for boys ranged from 0 to 2679, and for girls between 0 and 2259. The schools in the dataset are mainly of one kind, such as public or private. There are 0 to 375 full-time certified teachers and 0 to 240 part-time qualified teachers. COVID-19 caused school closures for an average of 112.99 days, with additional closures occurring for strikes or other uncontrollable events. A mean score of 4.58 indicates a high level of digital proficiency in remote training, mostly done utilizing digital devices. With a mean score of 1.23, classes were canceled but not entirely replaced with remote instruction.

Table 1. Descriptive Statistics and PISA Dataset

PISA	N	Minimum	Maximum	Mean	Std. Deviation
School Type	3538	1	2	1.14	.349
Total_Enrollment_Boys_Feb2021	3538	0	2679	332.15	281.375
Total_Enrollment_Girls_Feb2021	3538	0	2259	318.07	264.884
Certified_Teachers_FullTime	3538	0	375	46.89	41.761
Certified_Teachers_PartTime	3538	0	240	10.36	16.171
School_Days_Closed_Covid	3538	0	1000	112.99	80.634
School_Days_Closed_OtherReasons	3538	0	365	2.54	11.605
Remote_Instruction_Digital	3538	1	5	4.58	.801
Cancelled_Classes_No_Remote	3538	1	5	1.23	.743

There are 228 observations in the Eurostat dataset from 2017 to 2022. The average number of students enrolled in Early Childhood to Tertiary education is 3,236,505, whereas Early Childhood education has

485,373 students and Pre-Primary to Tertiary education has 3,462,510 students. These numbers show significant variation among educational levels. On average, 7.32% of students are not in school, 8.32% of early dropouts are in school, and 26.49% of the population has completed their education. 49,478.51 students are enrolled overseas on average. These findings demonstrate how the education measures in the dataset vary significantly.

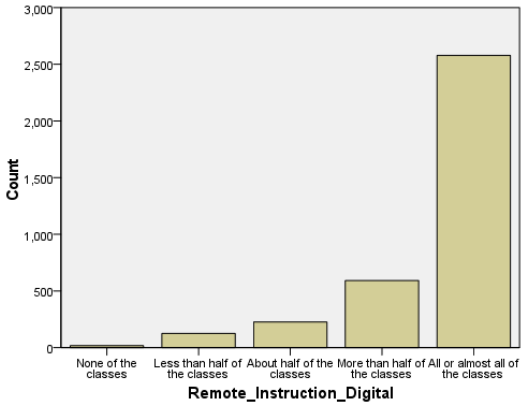
Table 2. Descriptive Statistics and Eurostat Dataset

EUROSTAT	N	Minimum	Maximum	Mean	Std. Deviation
Time	228	2017	2022	2019.50	1.712
Enrollment_EarlyChildhood_Tertiary	228	0	27452530	3236505.14	5599239.003
Enrollment_EarlyChildhood	228	0	3516328	485373.86	752967.190
Enrollment_PrePrimary_Tertiary	228	0	27427331	3462510.35	5655230.359
Enrollment_Primary	228	0	5433901	870607.63	1306968.550
Enrollment_LowerSecondary	228	0	5701564	694872.96	1237193.514
Enrollment_UpperSecondary	228	.0	6543599.0	702306.390	1189932.098
Enrollment_Bachelors	228	0	4506054	437164.62	780923.995
Enrollment_Masters	228	0	1133094	165322.46	262453.602
Enrollment_Doctoral	228	0	201800	23277.52	39352.248
Out-of-school_rate	228	0	98.710	7.322	10.155
EarlyLeavers_Rate	228	0	32.500	8.316	5.4354
Population_EducationAttainment_Rate	216	0	46.100	26.489	9.071
Students_Abroad	228	0	489019	49478.51	83359.441

3.3 COVID-19 Analysis on Education

COVID-19 changed the landscape of teaching. Public schools had a significantly higher number of school days closed because of COVID-19 than private schools. This discrepancy can indicate several things, including variations in governmental regulations, educational resources, and the capacity to do distance learning. Managing the effects of COVID-19 and maintaining educational continuity may have presented more difficulty for public schools, which frequently serve a bigger and more varied student body. The pandemic's disproportionate effects on areas with fewer resources and less access to technology for distance learning may also be reflected in the greater number of school days lost in public schools.

Fig. 1. Remote Instructions During COVID-19



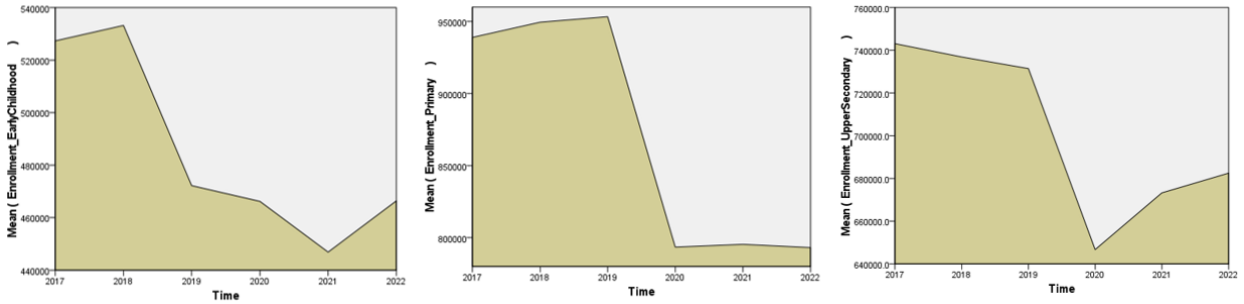
According to Figure 1, during the COVID-19 shutdown, a sizable portion (72.9%) of respondents reported receiving a high degree of instruction remotely using digital devices, and a small portion

(0.5%) reported having received none of the classes remotely. Additionally, a small percentage encounter class cancellation without replacement, which may indicate difficulties adjusting to distance learning or disruptions in the educational system during the pandemic.

3.4 Trend Analysis

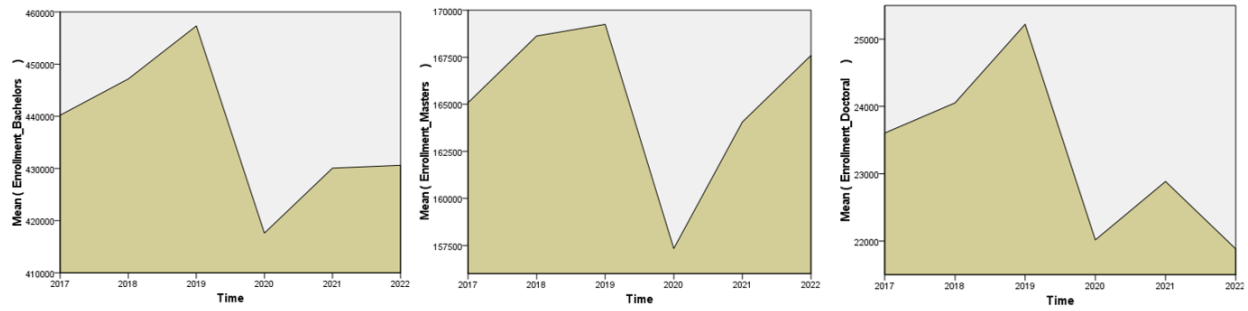
Eurostat dataset was used to analyze how different educational metrics varied across time. The total enrollments for Early Childhood to Secondary education from 2017 to 2022 are shown in Figure 2. Enrolments during the COVID-19 era have decreased significantly, especially between 2019 and 2021.

Fig. 2. Enrollment for Early Childhood to Secondary by Time



The total enrollment for bachelor's, master's, and doctorate level education is shown in Figure 3. There is a discernible pattern at all levels, with enrollment numbers significantly declining in 2020—the year the COVID-19 pandemic peaked. A substantial increase in enrollments follows this decline, suggesting a speedy rebound. This increase in enrollment is a result of nations opening their borders to admit international students for academic purposes. For higher education level, this trend is more noticeable, indicating an increase in overseas students looking for higher education possibilities.

Fig. 3. Enrollment for Bachelor to Doctorate by Time



Moreover, according to the study, the early leaver rate decreased overall during the pandemic and did not increase following it. This pattern would suggest that the pandemic and the difficulties it brought about had a long-lasting effect on schooling, possibly resulting in fewer students dropping out of school early. It might also be an indication of initiatives to enhance learning environments and other support systems so that students continue to be motivated to learn despite the pandemic's disruptions.

3.5 Correlations and Regression Analysis

Correlation analysis was conducted to find significant correlations with the attainment variable. Table 3 shows the statistically significant variables with attainment.
A higher population education attainment rate is linked to increased enrollment rates in elementary, lower secondary, upper secondary, bachelor's, and master's degrees, as seen by the positive connections with enrollment levels. In contrast, a lower percentage of students quitting school early appears to be linked to a higher population rate of education attainment, according to the negative association with the early leavers rate. A higher percentage of mobile students is linked to a higher population rate of education attainment, as seen by the positive correlation with mobile students from overseas.

Table 3. Statistically Significant Correlated Variables with Education Attainment

Variable	Pearson Correlation
Enrollment_EarlyChildhood_Tertiary	0.101
Enrollment_Primary	0.042
Enrollment_LowerSecondary	-0.035
Enrollment_UpperSecondary	-0.032
Enrollment_Bachelors	-0.036
Enrollment_Masters	-0.020
Enrollment_Doctoral	0.001
EarlyLeavers_Rate	0.086
MobileStudents_Abroad	0.093

Important factors influencing the Population Education Attainment Rate are indicated by the statistically significant variables in the regression analysis. For instance, there appears to be a positive tendency over time, as the Population Education Attainment Rate increases by 0.848 units for every unit rise in Time. Comparably, variables such as EarlyLeavers_Rate, MobileStudents_Abroad, Enrollment_Primary, Enrollment_UpperSecondary, Enrollment_Bachelors, and MobileStudents_Abroad generate significant positive relationships with the Education Attainment Rate. This suggests that the greater enrollment in these educational levels, the fewer early school leavers, and the greater number of mobile students abroad are linked to higher levels of education attainment in the population. In contrast, variables with negative coefficients, such as Enrollment_Doctoral, indicate that a rise in doctorate enrollment is associated with a decline in the population's educational attainment rate.

Table 4. Regression Analysis Results

Coefficients[a] Model	Unstandardized Coeff.		Standardized Coeff.	t	Sig.
	B	Std. Error	Beta		
(Constant)	-1692.075	689.569		-2.454	.015
Time	.848	.341	.160	2.485	.014
Enrollment_EarlyChildhood_Tertiary	6.638E-7	.000	.417	.991	.323
Enrollment_EarlyChildhood	2.607E-6	.000	.220	.796	.427
Enrollment_PrePrimary_Tertiary	-9.491E-7	.000	-.602	-.458	.647
Enrollment_Primary	8.220E-6	.000	1.203	2.632	.009
Enrollment_LowerSecondary	-4.734E-6	.000	-.658	-1.211	.227
Enrollment_UpperSecondary	-1.422E-5	.000	-1.900	-3.174	.002
Enrollment_Bachelors	1.369E-5	.000	1.201	2.515	.013
Enrollment_Masters	-4.538E-6	.000	-.134	-.517	.606
Enrollment_Doctoral	.000	.000	-.617	-2.345	.020
Out-of-school_rate	-.087	.060	-.098	-1.452	.148
EarlyLeavers_Rate	.667	.159	.383	4.186	.000
MobileStudents_Abroad	8.354E-5	.000	.781	3.470	.001

a. Dependent Variable: Population_EducationAttainment_Rate

4. Conclusion

The long-term impacts of COVID-19 on education are profound and multifaceted, affecting various aspects such as learning outcomes, mental health, socio-economic disparities, and educational infrastructure. The impact of pandemic-related school closures was significant, particularly for public schools, which experienced a notably higher number of closure days than private schools. With most classes being taught digitally, remote instruction became the standard. Interestingly, while most schools with remote capabilities could not keep their class schedules, those without such choices frequently had to cancel. Additionally, the decline in the early leaver rates, during the COVID-19 period, which did not rebound afterward, suggests that the pandemic may have had a lasting impact on schooling. This points to a possible long-term change in educational trends.

Furthermore, several factors that substantially impact educational outcomes are revealed by examining variables correlating with education attainment rates, including rates of early school leavers and enrolment at different academic levels. To address the problems caused by the pandemic, the education system must continue to monitor and adapt, as these data illustrate the complex and multidimensional influence of COVID-19 on education.

Recognizing the added stress and anxiety brought on by the pandemic, the education system should emphasize providing mental health and well-being support for both educators and students to overcome these issues. Access to mental health resources and counseling services can assist in lessening the crisis's detrimental effects on the classroom. In addition, it's critical to promote an innovative and adaptable culture in education. This entails investigating novel pedagogical approaches, utilizing technology to augment educational encounters, and encouraging cooperation among instructors to exchange optimal approaches. The education system may become more robust and resilient to upcoming problems by welcoming change and adjusting to new situations.

Another crucial factor is the need for inclusive and comprehensive policies to address the socioeconomic inequities exacerbated by the pandemic. This involves providing targeted support to people in need, like students from low-income families, people with impairments, and members of disadvantaged communities. Ensuring all students have access to gadgets and internet connection should be the main goal of efforts to close the digital divide. A conducive learning environment can also be established post-pandemic, through programs that promote family involvement and community cooperation. The education system may strive toward creating a more resilient and fair future for all Covid-affected students by addressing these inequities.

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