



THE IMPACT OF THE COVID-19 PANDEMIC ON LEARNING IN GREECE: INVESTIGATION OF THE UNIVERSITY ENTRANCE EXAMS

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Abstract:

It has been evidenced by a number of studies and international organizations that the unprecedented Covid-19 pandemic has caused disruptions to schooling around the world; drastic measures were undertaken for the health of people, among which were school closures. The expected impact on student learning was big and, in most cases, led to learning loss; a cost that may seriously affect human capital accumulation, productivity, and the quality of life for individuals and societies. The aim of this study was to explore the case of school closures in Greece, during the pandemic. It used the results of the Panhellenic University Entrance Exams (PUEE) by comparing the achievements of the 2019-2020 and 2020-2021 student cohorts with those of the previous school year (2018-2019). A considerable loss seems to be present in both years, as opposed to the year before the pandemic. Several interesting issues arose regarding the learning effectiveness of the type of education provided (distance, tele-education, blended or other); these are presented with reference to the current educational debate in Greece. It is shown that the most vulnerable are those that experienced the pandemic measures for two subsequent years. Also, some suggestions for remedial measures are provided for increased future effectiveness.

Keywords: education, Covid-19, pandemic, school closures, learning loss, learning curve, policy measures

1. Introduction

As it was suggested by United Nations Social and Cultural Organization - UNESCO (2020) the Covid-19 pandemic brought serious problems and disruptions to schooling in most countries around the world; most governments had to take drastic measures for

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health safety, one of which was school closure. The expected impact on student academic achievement was drawn from evidence of previous crisis situations i.e., physical disasters, such as floods and earthquakes, teacher strikes and previous pandemics. However, the disruption caused by the Covid-19 pandemic was of a different style, bigger size, and scale, and, therefore, not easily and directly compared with other cases (Alfavita, 2021; Esos, 2021).

Worldwide, it is not still certain that the economic decline experienced in 2020 and 2021 would be overturned. Although the developments in digital technology might offer economic advances, more corrective measures seem to be needed to stabilize the economy in the future. More specifically, global economic output is expected to stay more than 5 percent below the trend it had before the pandemic (Brunello & Bertoni, 2021). At the same time, there is a risk of delays or setbacks that may bring obstacles to sustainable recovery; the pandemic has been a factor in elevating the risks of poverty and global debt accumulation, as well as development slowdown (Lambropoulos et al., 2022).

Last decade, Greece, like most countries in the world, has experienced a serious and difficult economic crisis apart from the referred to as health crisis caused by Covid-19. In addition to the global recession, Greece had been in a debt crisis since 2009 (Thomsen, 2019), which was an additional negative factor to its economic prospects. Policymakers ought to ensure that the foundations for economic development and sustainable growth were set. Within this framework, individuals, households, and entrepreneurial firms had to react effectively to a very changing economic environment. Policies had to be undertaken, on one hand, to protect the vulnerable and on the other to promote productivity and innovation in a way that all kinds of capital (human, cultural, economic etc.) would move successfully towards new goals for a qualitative economic environment in the contemporary era of post Covid-19 (Lambropoulos et al., 2022. Karalis, 2020).

The main work of the policymakers in Greece is to make sure that better growth outcomes would appear, and worse ones would be limited by using government support measures to increase cooperation among stakeholders. These would be against the challenges that would arise. Extrapolation from other countries should be made carefully, as there exist contextual differences that may influence findings, which must be considered (Psacharopoulos et al., 2020).

As already stated, the Covid-19 pandemic has caused an unwanted impact on student learning and, consequently, on their individual earnings later in life, their productivity and, consequently, the Gross Domestic Product- GDP, which leads to economic development and quality of life; an issue of special concern to researchers (Donnelly & Patrinos, 2021). Related studies undertaken (Psacharopoulos et al., 2020), showed that school closures were an action adopted by 192 countries, which closed all schools and universities, affecting more than 1.5 billion children and young people (that is more than 90%). The consideration underlying the impact of the pandemic, firstly relies on human capital theory, within which school attainment leads to increased individual and social productivity and, therefore, individual earnings and social productivity; so,

the closures are expected to reduce learning and, lead to future losses in earnings and productivity (Karatzia-Stavlioti & Lambropoulos, 2009). It is evidenced, by the European Commission-European Expert Network on Economics of Education (EENEE) (Brunello & Bertoni, 2021) survey in 27 countries that labor productivity increases in economic expansions and declines in economic “downturns”, such as a pandemic.

This paper is an investigation of whether a learning loss has been experienced in Greece due to school closures. The term learning loss is used in the literature to describe declines in student knowledge, competencies, and skills (Donnelly & Patrinos, 2021. Pier et al., 2021). Time cohort-longitudinal aggregate data provides researchers with information on the initial state of learning (baseline) as well as on where student learning should be year over year; it is often measured through regular testing, such as the national tests in various countries and the university entrance exams in Greece. These exams are undertaken by a larger percentage of secondary school graduates (around 100,000 each year) and are commonly used in the contemporary debate as an indicator or a proxy for education quality (Lambropoulos, et al., 2022). Learning loss occurs when educational progress does not appear at the same rate it historically has compared to previous years (Pier et al. 2021).

The study used available data on school closures that were included in relevant governmental/ministerial decisions· they referred to the duration of closures and the type of education provided (distance/tele-education - synchronous and/or asynchronous, supplementary/blended or autonomous etc.). Also, information was gathered on the way the university entrance exams took place, as well as on their content, before and during the pandemic. These exams are considered a valid tool for the measurement of student knowledge and learning, by the Greek educational community and society in general. Our aim was to examine whether evidence of student learning loss can be documented and, if so, how much of it can be measured. The paper starts with a historical review of relevant literature and reports on the main findings regarding learning loss and its impact on individual earnings and on how economic growth might be affected.

Due to the novelty of the theme, the literature on Covid-19 impact is not ample, it has a specific geographical focus, and it includes limited numbers of students. It is, therefore, presented and, also, used in the discussion of the findings. The present research developed a method and a model, based on previous work, which is adapted to the case of Greece. It applied the model to the data obtained on the university entrance exams in Greece and analyzed the data with appropriate statistics. Finally, it estimated the degree of the effect of school closures on student learning (learning loss). It concluded by commenting on the results and projecting them on the issues that dominated the relevant discussion in Greece. Lastly, it commented on the types of remedial measures that might be undertaken by educators and politicians.

2. Historical Evidence on the Impact (Costs) of Previous Crises and Pandemics

It is evidenced by research that there are negative effects on earnings from previous pandemics that lasted for long, even if each pandemic is different. The “Black Death” (Routt, 2020) was the largest demographic disaster in European history (1347-1353) that killed around twenty-eight million people. The hard, difficult and deadliness symptoms ended up with a cultural, social, and economic impact that became a field of instigation for generations of scholars until now (Karalis, 2020). It has brought disaster to many urban areas and lessened the available labor by lowering agricultural wages. Researchers have estimated an impact of ten percent a year, based on lost productivity and other outcomes during the pandemic, such as mortality, more illness and absenteeism from work (Routt, 2020).

In 1918 the pandemic of influenza brought impacts that lasted until the 1980's. The so-called, “Spanish Flu” (1918-1920), led to the deaths of up to 100 million people and negatively influenced economic activity (Almond, 2006) for more than 60 years. The economic impact of the severe acute respiratory syndrome (SARS) in the UK, France, Belgium, and The Netherlands was estimated at 0.5%-2% of GDP. Past crises led to earnings declines that persisted for several years (Almond, 2006; Keogh-Brown & Smith, 2008). The studies showed lower educational attainment, increased rates of physical disabilities, lower socioeconomic status, and higher transfer payments in relation to other birth cohorts. Results (Psacharopoulos et al., 2020) indicate that pandemics reduce future income by 5-9 percent. This outcome is like the reduction in earnings from economic-fiscal crises, where the losses to earnings were found to last for a decade or more (mostly for highly educated ones in rigid labor markets). Altonji, Kahn & Speer (2016) measured the early impacts on labor market outcomes for US college graduates from 1974–2011. Further economic analysis showed a recession that reduced earnings by 10% with small impacts on wages. The graduates of high paying degrees experienced smaller impacts on most labor market outcomes and thus, widening earnings inequality across degrees.

During the Great Recession period, early earnings losses were much larger than predicted given past patterns and the size of the recession. This was found to be related to the cyclical sensitivity of demand for college graduates, which had more than doubled. Recession effects also became more evenly distributed across degrees (Brunelo & Bertoni, 2021). It is worth mentioning that in China, secondary school closures in rural areas immediately after the Cultural Revolution led to a sharp 35% decline in high school completion rates among the affected students and negative labor market outcomes a decade later (Hai et al., 2021). More educated workers suffered less because educated (or skilled) workers were more and better able to react effectively to any disequilibria resulting from the economic crisis, as they could adapt to the radical changes brought by new technologies and demanded by employers (Schultz, 1975). They might also look for information on job opportunities from people close to them, advertisements, other employees, media, and the labor office. The calculated rates of return to education might rise in some cases due to the higher unemployment rates among the less educated. The

numbers of unemployed less-educated workers might lower the wages of less-educated workers.

Such was the situation in Argentina, during 1992-2002 (Geethanjali & Pravakar, 2003), the earnings of the educated workers were less affected by crises than those of the less educated. Similar patterns have been found in other countries during crises, including Greece (Cholezas et al., 2013), Latvia, Mexico, and the República Bolivariana de Venezuela (Psacharopoulos et al., 2020). Additional work was undertaken on the Greek economy which is characterized by high levels of graduate unemployment and low levels of wage flexibility by Livanos & Pouliakas (2019). Their findings may be considered in examining the returns of education during a crisis.

It must, however, be noted that most previous research on returns to education had left unexplored the question of whether and to what extent the returns to additional years of schooling vary with education quality. Towards that direction, DeCicca and Krashinsky (2020) examined the returns to schooling with three common measures of school quality: pupil-teacher ratio, relative teacher salaries, and length of the school year. They found evidence that the returns to schooling do vary among United States losses of school closures (as part of facing a pandemic strategy). In the UK, Sadique, Adams, & Edmunds (2008) found that closing all schools for four weeks would cost the productivity of the nation. In the USA, Lempel, Epstein, & Hammond (2009) estimate that the costs of closing schools for four weeks are borne by current workers and due to absenteeism and productivity losses that represent a reduction in productivity.

3. Research on the Cost of Covid-19 Pandemic

3.1 The Impact of the Pandemic on Student Learning

There is a lot of microeconomic evidence on the, theoretically supported by the economics of education, strong relationship between education and earnings (Mincerian approach-human capital theory). Years of schooling are used as key determinants of wages-number of growth-accounting ages; also, several growth accounting studies adjust the workforce for improvements in educational attainment, which is considered an operationalization of the human capital factor (Goczek et al., 2021).

It is a fact that the world was already in a learning crisis when the pandemic started; this was also reported in the text of the United Nations Agenda for sustainable development (2015). As a result of its emergency, the pandemic is expected to bring more difficulties to those that could not easily achieve learning gains. Learning loss prediction models were initially used by some researchers such as Azevedo et al. (2020). They used the results of simulations that considered three, five-, and seven-months closure and related them to different levels of lessening effectiveness resulting in optimistic, intermediate, and pessimistic global scenarios.

A different type of research emerged on the impact of the pandemic on students learning and attainment; this tried to uncover and understand the ways by which school closures were influencing student progress; the findings of this kind of research were

expected to inform educators, policy makers and researchers on how to move ahead. These late efforts aimed to isolate the pandemic effects through the impact that school closures had on the “learning curve” (Igbal et al., 2020; Donnelly & Patrinos, 2021). In this kind of investigation, a special focus might be given to the poorest and the not well-off students, to design more appropriate actions in their best interest.

Learning curves are usually used by those that design and apply national assessments worldwide (such as National Assessment of Educational Progress - NAEP) or international ones (such as Program for International Student Assessment- PISA, Trends in International Mathematics and Science Study - TIMSS, or Progress in International Reading Literacy Study - PIRLS). They can be adjusted by normal curves and the averages that are represented by the top of these curves are important because they are used to rank countries. Also, the width of the curve, expressed i.e., by the standard deviation, shows the spread of a bell curve and identifies issues of inequality within school systems, an issue that is currently very much investigated by trying to make the curves more comparable. An important fact is that the learning curves may be used to rank students based on attainment and proficiency levels (Donnelly & Patrinos, 2021).

It is true that the literature on learning loss is concentrated on students’ test performance, mostly in literacy and numeracy; it is supported that there should be given very vital importance on non-cognitive social-emotional skills, creativity, and the ability to cooperate with others and have the capacity for collective action in the radically changing world of today. This focus on learning may be considered rather narrow and non-transformative in nature, as well as that it does not reflect non-school learning that is not targeted in the way achievement is approached in tests. All the above are fundamental and linked to present and prospects for employment, health, and democratic participation (these are qualities of human capital accumulation) (Alahiotis & Karatzia-Stavlioti, 2006; Karatzia-Stavlioti & Lambropoulos, 2009).

There is research evidence from the USA, England, Belgium, and the Netherlands that indicate the serious impacts that the school closures and/or disruption have had on students. Although the type and length of education disruptions varied and the educational systems differ across countries, the provided data give an insight into what may be relevant to the case of Greece. Mackey et al. (2019) summarized the scope and findings of fourteen large-scale international studies published in 2020-21. Also, a systematic review of eight studies on recorded learning loss between March 2020 and March 2021, was carried out by Donnelly & Patrinos (2021); they aimed to consolidate the data evidenced on learning loss; they included studies that conducted student analyses and reported effects/impacts on learning progress because of Covid-19 school disruptions.

The reviewed studies used consistent measures of achievement, such as results from standardized tests and aggregated results from diagnostic assessments used for classroom purposes. Mackey et al. (2019) documented considerably lower achievement levels in 2020 than in the years before. Relevant studies had several differences in the

ways that the measure the impact of Covid-19 disruptions on learning; these included standard deviations, months behind, scale points behind, percentages of students not at grade level and, still, most point to average achievement that was well behind that of previous cohorts, measured at the same point of time. Significant losses appeared even in cases with populations having low levels of income inequality, school closures of less than two months and perfect internet access. Their findings may be summarized as follows:

- An earning loss in months, with that being (at least) two months behind where students would have been at the same time in the previous years.
- Increases in the number of students below grade level.
- Greater losses in younger students.
- Achievement in Math lacks far behind than achievement in Reading.
- In-person schooling has a return associated with recovery of learning loss.
- Students learning through distance tele-education were behind their in-person learning classmates (0.278 standard deviations loss in students' learning through distance, 0.233 for blended learning and 0.182 loss for in-person instruction).
- Learning losses are unequally distributed, with the students of lower-income backgrounds, whose parents had lower education, are Black or Hispanic, English language learners, with special educational needs have fallen further behind their class peers.
- International assessments, such as PISA and TIMMS, although they show differences in both measurement and context, they indicate important learning loss during initial school closures and predict ongoing learning loss, through constant disruptions in the school year, which will be unequally distributed.
- Investments of resources and teachers' skills and energy for adapting to remote learning seem to mitigate learning loss.
- There is no data on how sustained, full-time distance learning is affecting students' academic skills.

The review of Donnelly & Patrinos (2021), which is even more comprehensive, reported that almost all studies found a learning loss amongst at least some of the students investigated. The results were reported in average standard deviation learning loss, with them being summarized as follows:

- Grade 6 students in Belgium showed losses of 0.19 SD in Math and 0.29 SD in Duch.
- Grade 4-7 students in the Netherlands have experienced an average of 0.08 SD learning loss in Math, spelling and reading.
- Primary school students in Switzerland showed learning progress during in-person learning to be more than twice as high compared to the progress made during the eight-week school closure.
- Year 3 students studying math in low socio-economic advantaged schools to be two months behind the progress students made in 2019 in Australia.

- Grade 5 students in Germany showed learning losses of 0.07 SD in reading comprehension, 0.09 in operations, and 0.03 in numbers.

The observed learning losses were seen in a range of subjects, grade levels and geographical areas; this showed that although research was limited, the learning loss itself may not be. It is true that not all students examined were found to be experiencing learning loss, as well as that some students show more learning loss than others. Given the limited quantity of studies available, more research is needed to drive concluding results for all student groups (and larger ones) and geographical regions. Only then, a stronger understanding of how Covid-19 school disruptions have impacted student learning (and observed inequalities) may be achieved.

4. Background of the Study

Education and schooling in Greece have been disrupted by the pandemic for two subsequent years. To face the pandemic schools were closed at first and then, students attended in shifts so that their numbers were lowered. Later, tele-education was used for a number of weeks for all levels of the educational provision. More details are provided in the findings section below.

4.1 A Model for Measuring Learning Loss

An example of the measurement of learning loss is using the learning curve and is given by the World Bank text on “learning poor” (Understanding Poverty, 2020); this is focused on the students below the minimum proficiency level who cannot read and understand a basic text by age 10. This group is important because children who do not learn to read early enough often find difficulties in their educational and (even) later in their work life (Alahiotis & Karatzia-Stavlioti, 2008, 2013). The text refers to three possible scenarios/cases of how the learning curve may evolve.

The first case refers to the effect caused by the expected reduction in average learning levels across the distribution; this scenario may take place, even if the educational systems try to offer distance/tele-education. The paper claims that variation in instructional time is associated with learning loss, especially for disadvantaged and minority students. A general conclusion might be that students who are not in schools learn less, even if distance learning is well offered.

The second case shows the flattening (or skewing) of the learning curve that represents the highly unequal effects of the pandemic. In this scenario, students at the top (of better-off families) perform better while students at the bottom (of poor families) perform lesser and fall further behind. It is evidenced that the richer are much better placed to face this problem. Better off families live in comfortable homes, have good internet connections, and can hire a private tutor. Poorer families, especially the extreme poor, generally, live in not so good homes, may not have even a radio (let alone internet connection or digital tools); they have the resource means to hire a tutor, and parents will

struggle to keep up with their children's homework and assist them. In such a scenario, the performance difference between the wealthy and the poor is expected to rise.

In the third case, the curve may change due to dropouts; school enrolment may fall due to both supply and demand effects. Especially, families with income problems may have their children (especially girls) work instead of returning to school. Also, during school closures, governments may face fiscal constraints and they may minimize the cost of teaching by minimizing the numbers of teachers by merging schools; this policy initiative has been taken in Greece in the year 2020-2021 (Katsikas, 2021). In conclusion, the modeling of how a learning curve will evolve, if no appropriate action is taken, is of great importance; especially nowadays when useful databases such as the Harmonized Learning Outcomes and the Learning Poverty (World Bank, 2020), may assist in extending our investigation. It will take time to know how large and what type the effects of the Covid-19 crisis will be. However, action must be taken immediately and simulations of the impact on learning should be made.

5. Research Questions and Methodology

The main research question of this study is whether the Covid-19 pandemic in Greece and the relevant school closure, have a related learning loss for students, as this has been recorded in the literature and appears in the contemporary debate. Supplementary research questions may be summarized as follows:

- 1) What type of educational provision was used (school closure only, remote/distance learning- tele-education mode or blended mode)?
- 2) Which is the duration of school closure (in months) in the school years 2019-20 and 2020-2021?
- 3) Which is the distribution of the results in the Panhellenic University Entrance Exams-PUEE for the three last years and how can they be compared (the year 2018-2019 used as a "base line")? Which are the differences in averages? Is there any learning loss documented in the last two years, in terms of SD differences?
- 4) Which is the percentage of students that lies below grade 10,000 out of 20,000 in scale points/"moria", which might be considered a passing mark (nowadays, each university department sets its own passing mark/baseline, which is, generally, close to grade 10 out of 20).
- 5) Which is the data provided (and by whom) on the percentage of students that experienced absenteeism and/or low childcare? For example, during tele-education they did not (always or sometimes) have access to a PC, internet, or they could not use this technology on their own- when their parents could not be present and/or assist them. Even more, the fact that they did not meet their friends and classmates, might influence their socialization. Is there a position expressed by teacher and parent unions on the above?

5.1 Method of Data Collection

We, firstly, collected information from the Greek Ministry of Education on the duration of the school closures since the pandemic started in Greece. It seemed important to understand the framework of the contemporary debate in which school closures and the varying learning types took place. We started through the examination of the relevant legal documents (Ministerial Directives mostly on the Pandemic that were sent to schools); additionally, we searched for the teacher and parents' Unions positions on school closure. The information on the time that schools were closed was organized in Table 1 (below) where the type of educational provision provided each time was also shown.

Then we used the data on the results (grades) of the students that participated in the exams in the three subsequent years Summer 2019, Summer 2020 and Summer 2021). The aggregate data was published by the PUEE Bureau at the Ministry of Education. The information was organized (usually) in 40 categories of 500 scale points ("moria") from zero to 20,000; numbers of students within each category were also provided. The exams refer to four scientific directions (Human and Social Sciences, Positive Sciences, Health Sciences, Technological Sciences), each of which includes the exams in 4-5 subjects; these and their teaching matter are often revised. Due to these revisions and especially those that could influence the comparability of the results, we had to use the results of the first direction of the General Lyceum students (Human Sciences and Social Sciences), as their framework has been stable in the referred three years.

The results of the statistical analysis are discussed in the frame of the relevant educational debate in Greece; towards this, we studied official documents by the Ministry and/or the teacher and parent Unions, educational news sites and relevant research, as these are presented below.

5.2 Data Analysis

Using the Social Sciences Statistical Package (SPSS 26), we firstly homogenized the data (measurements) and calculated the missing values (when the category referred to 1000 points, we adjusted it to two of 500 points each). Then, the curve line of their distribution was calculated and presented in a graph. Also, the main statistics, such as the Mean and the Standard Deviation were also calculated. Standard Deviation was used to investigate the precision of our measurements, and more specifically, to find out whether they agreed with our theoretical model of "normal distribution". That is, about 68% of the data values are within one SD of the mean, about 95% are within two SD and about 99,7% are found within three SD. We checked whether the Mean of each distribution was not as close as the model of the normal one predicts and measured the distance in Standard Deviations.

6. Findings

This section reports on the findings according to the supplementary research questions set above.

6.1 Supplementary Questions 1&2

The Government declared a state of emergency and all schools were closed from March 11 till March 24, 2020. After these dates, schools operated in two shifts and on a cycling mode, due to the necessary social distancing need that the pandemic brought. That worked as follows: every class was divided into two teams that attended lessons on different days- one group on Monday, Tuesday, and Wednesday and the other on Thursday and Friday; a situation that altered every week. The latter educational delivery had led to fewer teaching hours for all students, in general; and, as a result, to an expected learning loss.

In the school year 2020-2021 schools were closed for a (summative) period of 12 weeks (3 months), during which a tele-education mode was applied at all levels of schooling. The teaching hour was shortened by an average of 10 minutes, which means that every school day, students were provided with at least 1 teaching hour less education. The Government took some remedial measures, which included the extension of the school year by an average of 10 days, the lessening of the teaching matter in secondary schools (Palaiologos, 2021) and especially the one that was to be examined in the PUEE, a situation we examine in this paper. The above information is summarized in Table 1 below:

Table 1: School closures in Greece during the Covid-19 pandemic.
 Type of education provided and duration

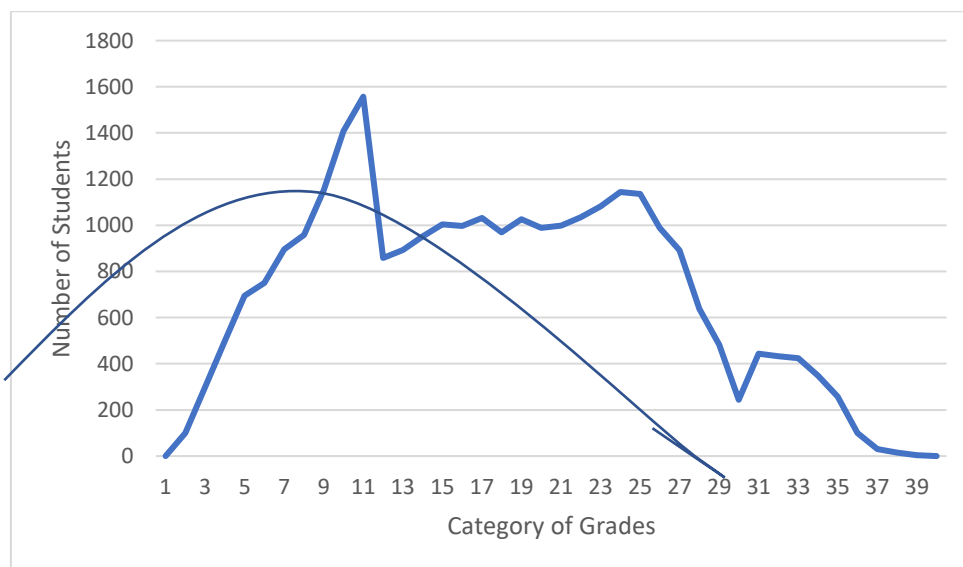
School year	Type of educational provision	Duration
2019-2020	- Closure of all schools, with voluntary non-synchronous distance education (ie. uploading digital educational material).	- March 11 - March 24, 2020
	- Schools open and operate in shifts, on a cycling mode	- March 24 - June 10, 2020
		<i>Sum of Lost Months of Full Time in Person (face-to-face) Learning: 2.2</i>
2020-2021	- Distance (tele) education	- November 16, 2020 - January 11, 2021
		- March 3 - May 10, 2021
		- School year extended for ten (10) days
		<i>Sum of Months with tele-education: 3.9</i>

6.2 Supplementary Question 3

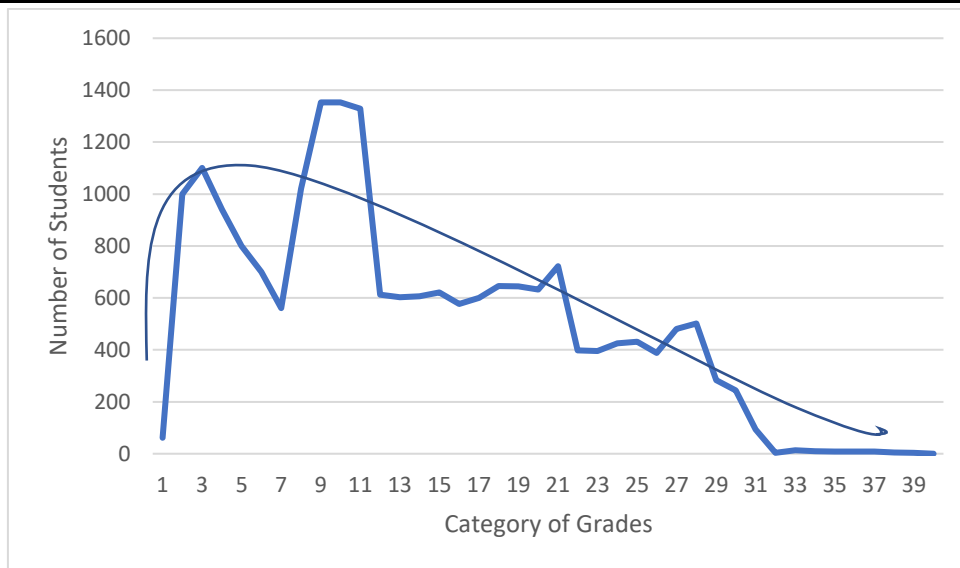
We investigated the distribution of the results in the PUEE- in the “direction of Human and Social Studies” for the last three years; this decision was made because in this direction there have been no changes in the subjects examined- something that did not happen in the other directions. The subjects are Modern Greek, Biology, Ancient Greek, Latin, History.

We compared the results using the year 2018-2019 data as a “base line”. The aggregate results provided by the Ministry of Education, are organized in categories of grades (homogenized by the writers for every 500 grades- that is, in 40 categories from 0-20,000). We chose to show the graphic of Curve Lines, on which the normal distribution is adjusted, as in this way the differences are made clearer.

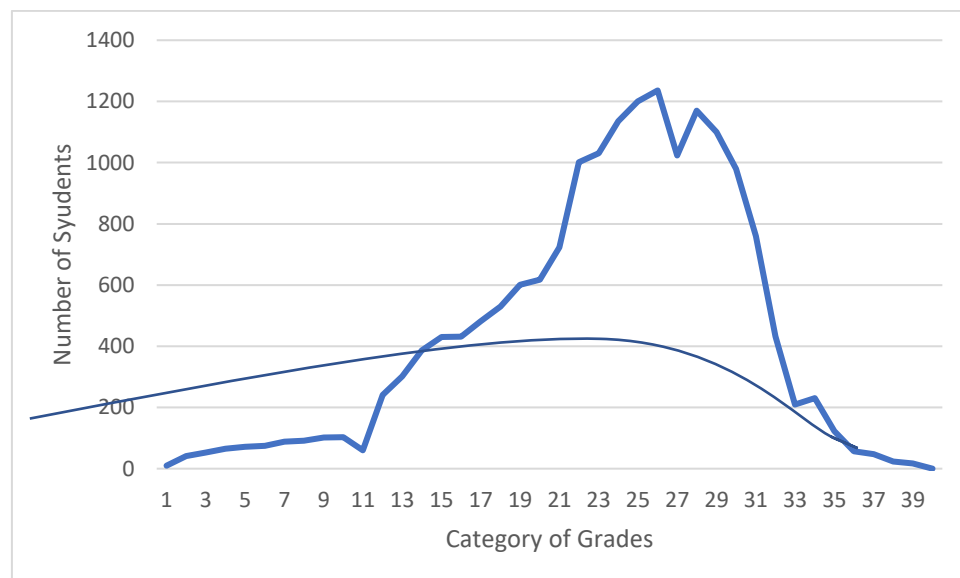
As evidenced below, the distribution of the grades in the first year of the pandemic (Summer 2020) is asymmetric, skewed, with the tail of the lower scale points being longer. The base of 10,000 points (category number of 20) splits the area of the line into uneven areas, with the one of lower grades to be larger. This shows that there is a learning loss that is initially indicated by the difference of 0.22 SD from the 2019 results. The distribution of the grades in the second year of the pandemic (Summer 2021) is quite flattened, with a difference of 0.305 SD from the 2019 results. The above findings indicate a learning loss for the students, especially those that experienced the pandemic measures of school closures for two subsequent years. The difference in SD from the curve learning line before the pandemic (2019) is in consistency with the learning loss indicated by the loss of learning time shown in Table 1.



Graph 1: Grade Distribution of the PUEE Results in 2019 (Number of Students = 27,728)



Graph 2: Grade Distribution of the PUEE Results in 2020 (Number of Students = 20,180)



Graph 3: Grade Distribution of the PUEE Results in 2020 (Number of Students = 17,280)

6.3 Supplementary Question 4

The percentage of students with a score grade below the basis of 10 out of 20 is as follows:

- 1) In the exams of the Summer 2019 (before the pandemic), 15.4% of the students scored below the basis.
- 2) In the exams of the Summer 2020, the first year of the pandemic, 16.5% scored below the basis.
- 3) In the exams of the Summer 2021, the second year of the pandemic (when special measures were undertaken to assist students in the exams), the curve is flattened (showing a general trend to less learning) and 17.3% scored below the basis. The 82.7% scored over 10, with the higher grades to be scored by most of the good students (as this appears in the original, not normalized curve of Graph 3).

The above results indicate the learning loss in both years of the pandemic, with the cohort of 2021 exams to have suffered the learning loss of both years, an issue that worsens their general loss. Even more, it has been an issue in the contemporary educational debate that the teaching matter of the subjects examined in the PUEE was lessened by the Ministry (Alfavita, January 5, 2021; Palaiologos, 2021); this means that it should be easier for the students to achieve higher grades in 2021.

6.4 Supplementary Question 5

Data on absenteeism, in terms of percentages, is not provided by the Ministry of Education. However, in the contemporary debate (Alfavita, March 13, 2021; Esos, December 2020) there appear news and research findings that relate to the effectiveness of distance (tele)learning, as this was used in Greek secondary schools. These include:

6.5 Relevant Parliament Questions

The Minister of Education had to answer questions that included the worries of the parents. These included worries problems due to their lack of PC and Internet; an issue that relates to high absenteeism on behalf of the children; additionally, it was claimed that some parents could not be present and/or assist their children, either because they are not at home, or they do not have the needed digital competences. More specifically, parents from the island of Ikaria sent a letter to the Minister, in which they point out the problems that arise from tele-education (Katsikas, 2020); they mention that not all students have access to this type of education provision and claim that the students are exposed to the radiation of the computer screen for many hours, an issue that has a bad impact on their health. They end the letter by stating that this kind of learning is anti-educational and ineffective.

6.6 Teacher Unions Actions against the Tele-education Mode of Learning

On the 15th of October 2021 the Secondary School Teacher Union decided to go on strike opposing the Ministerial Directive 111525/GD4/09.09.221 (State Gazette b' 4188/221), which set the framework for tele-education. Following the strike, on the 16th of October 2021 the General Assembly of the local Presidents of the Secondary Education Teacher Unions decided that tele-education should be provided only from the schools with equipment, provided by the Ministry. In this decision, the members of the Union claimed that the Ministry had not provided any equipment to teachers or students; this resulting, on the one hand, in "force" them to buy what they needed on their own and be charged with expensive internet connections; on the other hand, thousands of students were excluded from tele-education due to their inability to spend any money.

6.7 Relevant Research

Such was that of Kessopoulou & Tsibidaki (2021), who provided us with findings on the electronic (tele)communication of schools with families during the pandemic, through the investigation of the Headteachers' views. The researchers claimed that the main

themes of communication were different to the ones before the pandemic and focused on the distance education provided; the head teachers thought that the parents' attitudes were rather positive towards this communication.

6.8 Information from the Parent Organization

This consists of the local parent associations. The Parents Organization set up an internet forum on the practice of tele-education in Greece. Many individual parents and other interested educational actors, such as teachers and students, could post and express their views on the process of distance learning in tele-education. A brief analysis of more than such 50 posts showed that the majority (more than 60%) expressed their worries about the effective application of the tele mode of learning and wondered whether teachers and students were competent in doing so; some parents claimed that they had to work and, therefore, could not help their children; at the same time, they complained about the extra cost that the internet connections would bring to the family budget. A percentage of more than 20% expressed a negative view towards tele-education, as opposed to the face to face one. Researchers published studies on the Parents' organization website on the views of the parents. In his, most read article, Margaritis, (January 19, 2021) investigated the views of the parents on tele-education; he claims that only 24% of the students could participate in tele-education program, provided by their school, and managed to "cover" all teaching matters. According to parents, this happened because only a very small percentage of schools could continue a normal program of learning through electronic classes. Even, in the schools that offered this mode of learning, only 54% of students attended them without being behind in the teaching matter. In this case, priority was given to the subjects of high validity, while lessons like foreign languages, arts, or ICT were not included in tele-education. Important is also the survey carried out by an online platform (devolo Greece), according to which only 7% of the parents thought that the online lessons were the same as the face-to-face ones. 54% believed that even when they were effective, they could not (in any case) replace the traditional classroom lesson. It is of vital importance that 39% of the participating parents believed that the tele-lessons could not offer the necessary knowledge to children. Additional work by Giavrimis & Nikolaou (2020) investigated the losses in the students' social capital, due to "isolation" they were in when tele-learning took place in Greece.

6.9 Related Press Articles

These are published by teachers and/or educational researchers. Such is the one by Katsikas (2020) who presented data on official records given by local Teacher Unions. For example, the one in the area of Keratsini-Perama claimed that 30% of their nursery student population did not have the necessary equipment or the necessary internet connection. Part of this percentage was connected via mobile; a situation that cannot be considered qualitative or effective.

7. Discussion

Researchers point out that, globally, the learning time was lessened (Gallagher-Mackay et al., 2021; Schleicher, 2020), especially after the second year of the pandemic measures on schooling; such are the findings for Greece as well (Katsikas, 2020; Psacharopoulos et al. 2020). As a result, there appears a learning loss for students; an issue demonstrated by our analysis, as well. The loss in learning is evident in the comparisons of the learning curves that show a difference in SD; more specifically the findings on the curve of the university entrance exams results in the Summer 2020 show a difference of 0.22 SD; those of Summer 2021 shows a difference of 0.405 SD. These results seem to affect the most vulnerable parts of the population, such as the poor and the immigrants; more inequalities appear due to the tele-education mode of learning, since (as found in other research) a percentage of around 25% of the students cannot attend tele-learning due to the lack of equipment and/or the inability of their parents to assist. The well-off parents could pay for individual tutors to help their children overcome the problems in tele-education and contribute to more learning as well.

The latter is very important, though there is no concrete evidence on the effectiveness of tele-education; the general information, as stated earlier, points to the fact that this mode of learning is not as effective as the face-to-face mode; with this affecting more the students in need, who face more obstacles (educational and/or financial) in accessing the tele-mode. Also, there are instructional competences needed for the effective delivery of tele-education, on which teachers should get in-service training.

Another relevant issue is that school children in Greece spent less time daily on tele-learning lessons, with this being almost three quarters of the instructional time before Covid-19 (Katsikas, 2020). It is documented by other studies that lower-performing students and those without university-educated parents, learned significantly less effectively at home (Gallagher-Mackay, K., 2021). Also, the impact on girls and, therefore (later) women, should be noted, as their share of them in the future labor force is likely to increase (Böheim & Gust, 2021). The expected digital transformation of society and education, appeared to have significant gaps during the pandemic in Greece as well as in other countries (Hanushek & Woessmann, 2015; 2020); a situation from which lessons might be drawn in the long run.

As a separate note of particular importance, Economists of education could use special macro-economic tools to further calculate the expected (by the learning loss) lower individual productivity (thus affecting future earnings) and the relative lower social productivity and the effect on the related Gross Domestic Product-GDP; this leading to affecting the country's development.

To face the "problems" in learning and all the others that might follow, special organizational issues must, firstly, be designed for schools and all public administration to speed up a secure and effective digitalization. The above-estimated effects should be used to inform mitigation, recovery, and equalitative strategies and policies. This includes effective distance (tele) learning strategies to provide learning continuity, while

schools are closed; this type of education can be achieved by using multiple education technology solutions (radio, television, mobile phones, digital/online tools, and print) with relevant support to students, teachers, and parents. Governments should also design and implement appropriate actions to ensure the safe reopening of schools, consistent with each country's overall Covid-19 health response; they should also speed up learning by building more equitable and resilient post-Covid-19 education systems, that enable children to learn continuously both in schools and at home.

Policies towards introducing fiscal reductions in education at crises' time include merging schools and having more students in classes; these have been applied in Greece, producing more problems in the operation of schools (Volitakis, 2021). It is generally stated that the scarce resources invested in education should be boosted and evenly and effectively distributed; also, consensus should be achieved among all the educational actors.

8. Conclusion

The present study has some limitations due to the type of data used that were aggregate; while the use of the data of one scientific direction was decided for reasons of validity, as already explained. However, it may be claimed that the results indicate the situation regarding learning during the pandemic in Greece, quite closely. It is vital to point out that the future of the students, as well as of society depends on the enforcement of drastic measures for limiting the impact of Covid-19 pandemic on education as well as on the psychological health of children.

Greek Government should undertake immediate and decisive remedial action so that, on the one hand, the found learning student loss for the past two years might be minimized and, on the other, students (and especially the most vulnerable ones) should be "protected" against any other future threat. More specifically:

- Multifaced actions must be put forward by many Ministries in Greece toward the expected today effective Digital Transformation of the society (education and economy).
- School closures ought to be limited, as much as possible and a tele-education mode should be designed, ready to be put forward, if there is a need (not only a pandemic, but any other kind of "disaster" or "problematic situation").
- Special in-service training for teachers should take place to increase their competences in the provision of tele-education.
- Appropriate teaching practices towards the socialization of the students must be designed and applied by teachers not only in "traditional" classes, but in virtual as well.
- Special digital educational material ought to be available for all subjects taught in schools.
- Computer rooms with internet connections must become available at all schools, so that teachers and students could use them (if, and when they wish).

- Financial assistance must be offered to the financially vulnerable families to get the needed for tele-education equipment and internet connections.
- Parent Organizations and individual parents must become aware (be informed) of the need by their skills and attitudes to effectively assist their children with tele-education.

If no proper measures are undertaken, the lower productivity, the lower income, and a reduction in the quality of life are soon expected to appear; following the above, other aspects of development may be influenced, such as the tax revenue, the deterioration of health services, the rise of social inequalities and the general social uncertainty. Policies towards the opening of schools should be promoted and established; not only for economic reasons but for individual, psychological and social (very important) reasons as well; without, of course, putting in danger the individual or social health of the students.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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