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**Remote Teaching during the pandemic and its
influence on the students performance at the
Economics Faculty “G.Fuà”.**

**Remote Teaching durante la pandemia e la sua
influenza sulla performance degli studenti della
Facoltà di Economia “G.Fuà”**

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INTRODUCTION

At the beginning of the year 2020 the outbreak of the Corona virus disease (Covid-19) brought hard times and many difficult challenges to be faced all over the world. Starting from China the number of cases increased in an exponential way affected all the countries, first and foremost Italy. The rapidity of the spread and the simultaneous unknown remedy against the virus brought to the overburden of the Italian healthcare system. The emergency status forced the government to adopt general restrictions in order to slow down the rate of infection. The most important one was the general lockdown, it consisted in limiting the citizens in their houses except for going out to buy basic necessities as food or medicines. The consequences of this measure were mainly the stop of many activities for the market labor as for the Educational system. In this latter one the forced closure for every degree of education was critical for the possibility of losing the complete academic year. The solution to allow students to continue their academic year, in school or at the University, was the Distance Learning. It consists in delivery lectures and, in the case of Universities, exams through online platforms in form of live stream meetings or recorded videos. Given this context the aim of the present thesis is to analyze the efficacy of the Remote Teaching on the university students of the Economics Faculty Giorgio Fuà in Ancona. The study focused on the students enrolled at the first year of the bachelor degree on the academic years 2018/2019, 2019/2020 and 2020/2021. The difference between the students from those academic years is basically the pandemic context, indeed 2018/2019 is characterized by university students who carried out the university activities in the faculty while for the other two academic years, affected by the government restriction, students followed the same

activities from home thanks to the Remote Teaching. To analyze the changes in performance has been considered those students that take the second semester exams, of the first year, in presence. For the analysis has been carried out an OLS Regression and a Probit model to see if the performance of students has been influenced by the year of enrollment and so by the method of attending lectures.

The structure of the thesis is characterized by three main chapter. The first one illustrates an overview on the University education in Italy and its importance in terms of human capital. It also shows the context of the covid-19 pandemic related to the challenges faced by the Educational institutions and the solutions adopted. The second chapter, after general information on the UNIVPM and the Giorgio Fuà Faculty, introduces the study defining its purpose, the population considered and it indicates the descriptive analysis of the variables taken in consideration. Last but not list the third chapter analyzed the results of the OLS regression and the Probit model to see if the independent variables and in particular the year of enrollment has been one of the main factor that influenced the performance of the students. At the end of the thesis there are the conclusions where are illustrated the comments to the relative results and suggestions.

CHAPTER 1

COVID-19 AND EDUCATION: THE LITERATURE

This first chapter collects the literature for the arguments of Covid-19 disease and the relation of it with education. Firstly it presents the Italian University system which has been transformed by the ministerial decree in 1999 in order to reach some goals as increasing the student mobility in the OECD territory and increasing the enrollments. In order to understand the importance of the higher education and the contribution of it in the economic system has been defined the human capital and how education and training can affect its accumulation bringing economic growth in society. Following it has been talked about how education has been developed thanks to the new technologies and what advantages and disadvantages they brought till the advent of Covid-19. It includes the explanation of how the pandemic has been influencing the method of teaching bringing the lectures online and which are the tools that institutions can use to allow students to continue their studies. Also the chapter shows the researches and articles that analyze the main effects of learning from home and how it has changed the behavior of students in this context. Then it analyzes the proper use of the term Distance Education and the differences with Emergency Remote Teaching, showing the general response of the Italian students and teachers to the ERT approach. At the end is illustrated the recent situation of education system and the plan organized by the OECD to overcome the challenges faced during the pandemic and to make education system more effective and equitable.

1.1 The Italian University System

The higher education institutions in Italy are given by Universities, High level arts and music education and Higher technical institutes.

Today, the Italian University system is characterized by 96 university institutes divided in 67 state universities and 29 non-state universities.(Eurydice,2020)

Before reaching those numbers the University education has gone through different reforms in order to improve its efficacy and efficiency. One of the biggest reform in this field was the ministerial decree number 509 in 1999 also called “Bologna Process”.

This reform had place to overcome the problems that were present during the previous framework, in particular:

- The high number of drop outs after the first year of university: in 1999 the drop-out rate was the highest respect the other OECD countries and it was 20.3% while the rate of “survival” ,representing those who continued the studies, in the year 2000 was 42%;

- The time spent by student to graduate: in most of the cases it was greater than the actual duration degree, indeed student could decide to not participate to lectures and to refuse marks that are too low and try again the next session.

Those problems were given by a system where students can decide to enroll for a Laurea which last for 4 to 6 years or a Diploma Universitario which last 3 years. And only after the Laurea there was the possibility to continue with a Ph.D or a Specialization. (Bratti, Broccolini and Staffolani,2006)

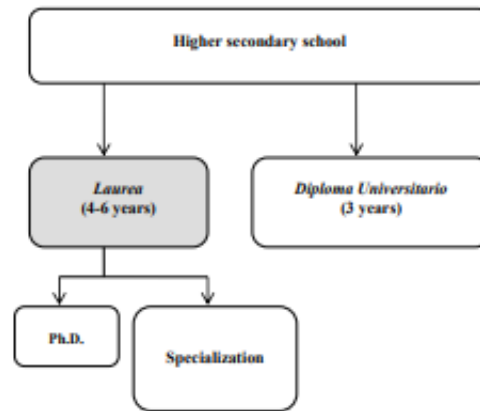


Figure 1 - 1: Old University framework

Source: Bratti M., Broccolini C. & Staffolani S., 2006, *Is '3+2' equal to 4? University Reform and Student Academic Performance in Italy, Quaderni di ricerca n.251, pp. 5*

In 1999 with the “Bologna process” there was a big reform that brought an important change to the university framework. It was introduced the so called “3+2” scheme instead of what before was defined as Laurea. In particular it created three levels of degrees where: the first one has a duration of 3 years giving the general scientific knowledge and professional skills then a second level of degree that last 2 years forming the student with highly professional skills in specific sectors.

Also, as it’s possible to see from the Figure 1-2, it introduced the possibility to:

- attend masters, divided in first and second level corresponding the level of the student graduation;
- to continue the studies with a Ph.D. after the second level degree, where the student postgraduates get trained for specialized research.

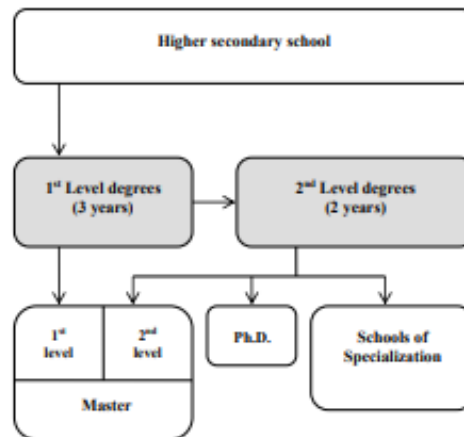


Figure 1 - 2: The Italian University frame work after the reform

Source: Bratti M., Broccolini C. & Staffolani S., 2006, *Is '3+2' equal to 4? University Reform and Student Academic Performance in Italy, Quaderni di ricerca n.251, pp. 7*

This reform with the introduction of the CFU system aims not only to overcome the problem of drop-outs and to reduce the gap between duration degree and effective time used by student to graduate, but it also wanted to encourage international student mobility thanks to the credits system that is adopted almost by all the OECD countries.

Another important result of the ministerial decree n 509 was the autonomy acquired by the universities in deciding its own the courses and the degrees. (Gasperoni, 2011)

1.2 Human Capital and Education

Analyzing the University system and higher education it is important to understand the reason why those are relevant factors in our economic system and this is possible by looking at the Human capital and its relation with education.

The first time that was possible to see the term human capital was at the time of Adam Smith that in his notes wrote “The acquisition of ... talents during ... education, study, or apprenticeship, costs a real expense, which is capital in [a] person. Those talents [are] part of his fortune [and] likewise that of society”.(Smith A.,1776)

But, recently, it is possible to find the definition in many sources such as the Oxford Dictionary that defines it as “the skills the labor force possesses and is regarded as a resource or asset.” or the Penguin Dictionary of Economics that defines it as “the skills, capacities and abilities possessed by an individual which permit him to earn income”.

The importance of the Human Capital is related to the work of Robert Solow and the discovery of the “residual”. This latter one represents the economic growth that isn’t possible to explain in physical factors such as number of workers or hours of work so it regards the creation of knowledge and skills through two main ways: education and training. (Goldin, 2016)

From the definition of human capital is possible to understand the relation with education. Indeed this latter one concurs in the accumulation of human capital because it increases the skills and competences of students until they will entry the labor market, here those skills will be transformed in productivity.

After compulsory school the decision to continue studying is related to the return and the cost of spending an additional year in education. The return of an additional year of studying is given by the skills and competencies that the individual acquires due to learning. Instead the cost is given by the opportunity cost plus the direct cost for education, where, for

opportunity cost is meant the wage that the individual would have earned if he left education and started working. As it is possible to see in the Figure 1-3, given on the x axis the number of additional years, the return line decreases the higher the number of additional year in education while the costs increases. This is reasonable since the wage that the individual would receive if starts working would increase during the years. Given that individuals have benefit from studying until the return from an additional year of education is greater than the cost of it. (Staffolani, 2020)

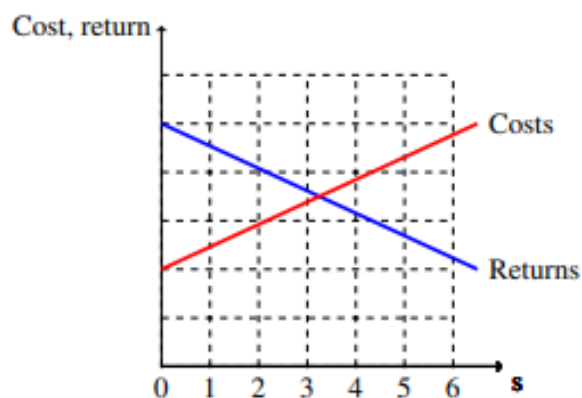


Figura 1 - 3: Cost and Return o fan additional year of education

Source: Staffolani S., 2020, *Dynamic Notes on Personnel Economics*, Department of Economics and Social Sciences UNIVPM, Ancona, pp. 188

The human capital accumulation brings development, economic growth and that is possible mainly through two ways: education and training. However the situation created with the Covid-19 crisis could be a threat for human capital creating human capital losses especially speaking about education due to schools closures.

This latter phenomena would leave more or less 1.5 billion of children at home leading to a lost learning in the short run and major capital losses in the long run. Those losses are not uniformly distributed across the population because of social inequalities that would become more relevant and along with that schools closure means also the stop of all the services created to help the poorer students such as meals program.

The human capital accumulation is the result of a dynamic process and it can be influenced by different channels depending on the individual's age. Setbacks at a certain age, especially the early childhood, can bring damage to human capital. An example could be that due to the pandemic families would spend their income for immediate consumption needs, ignoring the investments in health and education.

The Figure below represents for each age stage which are the hypothetical effects of the pandemic that would affect the human capital accumulation.

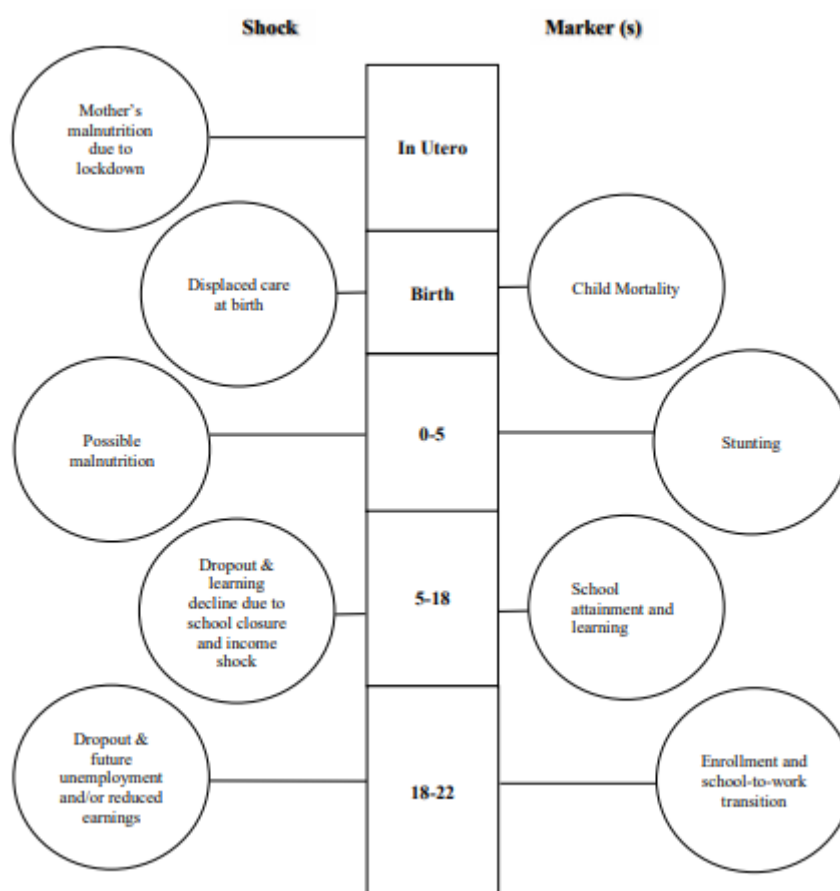


Figura 1-4: Human capital accumulation across the life cycle: Key stages and metrics

Source: Corral P. & Gatti R., 2021, *Accumulation interrupted: COVID 19 and human capital among the young*, World Bank.

The more important effects are given by the last two age stages where individuals at the stage 5 to 18 years old represents those who still attend school and the 18 to 22 years old that may choose to enroll at college or university. Those two stages contribute a lot to human

capital accumulation and the interruption or the damaging effects produced by Covid-19 could cause relevant negative shocks. For the stage of school years the closure of institutions could lead to a decline achievement scores and worsen learning outcomes and also to drop outs due to loss of income. While for many students enrolled in tertiary education it could be impossible to resume their studies due to the lack of the necessary materials for remote learning. Thus, the enrollment rates of tertiary education may be influenced by: the high unemployment rates that could reduce the opportunity cost of attending university or college and the recession due to the pandemic will affect families economically bringing the impossibility to enroll their children.(Corral and Gatti, 2020)

1.3 Education nowadays

During the 19th century education has been revolutionized and mostly thanks to the technological development and globalization that is affecting our society.

Technology, as the application of scientific knowledge for practical purposes, has been helping in teaching and learning. In particular higher education had a huge push with the advent of Internet, World Wide Web and the process of digitalization that brought basic innovations, as the use of the computer and the possibility of projecting slides, and more complex ones as the new telecommunications and meetings' platforms. However technology in education brings advantages as disadvantages.

The advantages are related to the facilitation of communication between staff and students including the possibility for the professors to share with them the material on which they can study and also making lectures more interactive and collaborative. Another important advantage is given by the absence of the need of a physical place, as classrooms, to teach and reach students. On the other side technologies bring some negative aspects in education,

in particular: the equipments are often very expensive and this creates limits to institutions that do not have enough funds, the facilitation that they bring into institutions may affect the behavior of students that might underestimate the importance of attending lectures and the higher probability of cheating during exams from students. (Mercel and Mkojera, 2021)

Nowadays the relation between technologies and education is even more highlighted due to the situation of Covid-19 pandemic.

At the beginning of the year 2020 the Coronavirus disease started to spread exponentially all over the world. This brought to an increasing number of mortality especially in Italy. The emergency situation led to a number of restrictive measures in order to slow down the transmission and to unburden the hospitals which had all the intensive care departments occupied and already beyond their capacity.

The most rigid measure was the lockdown where everyone had to stay isolated at home and had permission to go out just for necessary things like buy food or medicines or receive strictly necessary services. This measure envisaged the closure of education institutions of all levels causing an huge impact on the education system in both primary and higher education.

School temporary closure is a phenomenon that sometimes happen because of strikes of school workers or students or might be due to a calamity such as whether conditions or earthquake etc..

Researches made by Baker in 2013 on closures due to strikes found out that school closure for 10 days or more may reduce achievement with huge impact in math. His study standardized for 20 days shows that students might lose half of a standard deviation in the distribution of achievement meaning that is like moving a middle-ranking child down to the bottom by 30%. Given that example we should expect an important impact from the restrictive measures during Covid-19 pandemic and school closures that implied less time

spent at school and a reorganization of the educational programs.(Eyles, Gibbons and Montebruno, 2020)

1.3.1 *Distance Education, Emergency Remote Teaching and Online Educational Tools*

In order to not lose completely the academic year and react to this situation, the institutions started a new method of teaching providing the material and the lectures through online educational tools allowing student to learn from home.

Before talking about the online educational tools adopted, to face the lockdown measure, it is important to define two types of online teaching: the Distance Education and the Emergency Remote Teaching. After the school closures the only way to continue the education activity in Italy, as all over the world, was through Distance Education.

One of the definition of Distance Education is given by Keegan in 1995 saying that DE is the result of the separation between learner and teacher and it “ frees the students from the need of travelling to a fixed place, at a fixed time, to meet a fixed person, in order to be trained”. Thus, suggesting that the student can study and learn whenever he has the possibility to do it, so he can choose the time and the place that is most comfortable.

The term Distance Education has been used mostly after the spread of Covid-19 to represent all the tools and implementations that have been developed to substitute the on-site lectures during the lockdown measure. However the term, previously defined, is wrongly utilized since Distance Education appear to be effective only if it well planned and organized. The shift at the start of the pandemic was too fast in order to be well organized so instead of talking of Distance Education it should be called Emergency Remote Teaching (ERT).

“Using the right definition is important because (...) when things are settled and go back to normal, what people will remember will be bad examples from a time of crisis, and the years

of efforts it has taken to prove the effectiveness of distance education can vanish all of a sudden” (Bozkurt & Sharma, 2020)

In general the new approach of ERT adopted by the OECD partners were initialized by the government but there were also cases in which the more autonomous institutions organized by themselves alternatives to education.

The online tools could be divided in two main category:

- The educational content which can be explored by students at their own pace;
- The real-time lessons through virtual meeting platforms.

The first one is related to all the materials, such as video, audio, power point presentations that the professor can upload on a platform and students can access to those file and study the program following the order given by the teacher. A positive aspect of this category is that students can organize their time and their work individually while in the second category the students have to respect the timetable of the lectures since they are in real time with the professor and thanks of that they can always ask questions to the professor in case of doubts or misunderstanding of an argument.

These two categories have been adopted according to professors’ organization which didn’t have too much time to prepare their online lecture due to the imminent closure of the schools and the need to continue education lectures to not damage children and student.

For example in Portugal and Greece TV programs were an alternative method of delivering educational content and those were mostly utilized for primary school children. This method of teaching helped a lot to solve the problem of children digital skills but, on the other side, presented a disadvantage given by the low duration of the lectures because of the time availability on TV channels.

Two important factor that influences the new methods of teaching and learning from home are the role of the professor and the economical situation of the student.

Modern technology can provide a lot of opportunities for education but teachers must develop a certain digital skills level in order to be able to squeeze all the advantages of it and also update those skills regularly, moreover in the context that we are facing since the spread of Covid-19 and the phenomena of school closures. (OECD, 2020)

While for what concerns the economical situation of students' family it acquires a relevant importance because parents need to support their children in education providing them the technological resources such as smart phones, personal computers and internet connection to able them follow the lectures. This task is also a responsibility of schools and institutions that must ensure the same possibility of following online lectures to all the enrolled students giving incentives to those families who cannot support financially their sons and daughters. Another aspect that will influence the effectiveness of online education is the capability of the teachers/professors to motivate and urge their students and that's the same for their parents, it is necessary because learning from home in a isolated context may decrease the focus of students and affect their emotions as it will be explained in the next paragraphs.

1.4 The expected effects of learning from home during the lockdown measure

During the Covid-19 pandemic the effects around the world in the field of education weren't equal but similar to each other. Clearly school closures of all degree, especially in higher education, brought more problems in countries less developed.

This is possible to confirm looking at the table below where each continent lost a lot of time available for education in terms of suspended teaching or canceled teaching but it is remarkable how Africa had the highest percentage in cancelled teaching (24%) and suspended ones (43%).(Marcel and Mkojera,2020)

Continents	Not affected	Classroom teaching replaced by distance teaching and learning	Teaching suspended but the institutions developed solutions	Teaching canceled
Africa	3%	29%	43%	24%
Americas	3%	72%	22%	3%
Asia & Pacific	1%	60%	36%	3%
Europe	Almost zero	85%	12%	3%

Figura 1 - 5: Impact of Covid19 on teaching and learning

Source: <https://www.intechopen.com/chapters/73505>

As mentioned before distance teaching and learning brought to different forms of lectures. The most used one was the online lectures in real-time conferences with a percentage of 59.4% following that there was the 15,2% of presentations sent to students, 11.6% recorded video uploaded on online platforms and the 9.1% used written communications through forum and chats. The last 4.70% corresponds to the rarest method which is the audio recording.

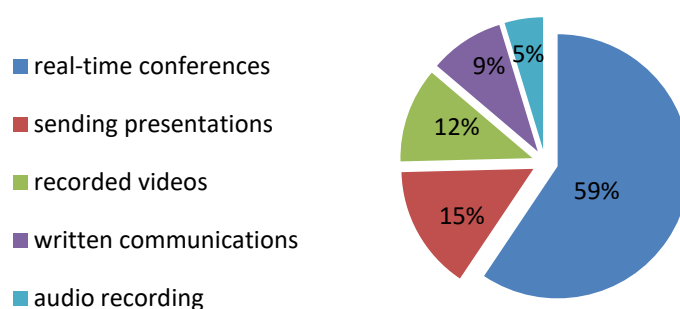


Figura 1 - 6: Percentage of teaching methods applied during the pandemic

Source: <https://www.intechopen.com/chapters/73505>

The research done at the University of Ljubljana about the impact of Covid-19 on higher education students from a global perspective highlighted through questionnaires some factors that may have changed students behaviors. The first one regards the amount of workload, since for most of the universities the change in online lectures was almost instantaneous there wasn't enough time to prepare with efficacy the lectures, plus the activity of learning from home bring in factors as motivation and dedication. Students from Europe, North America and Oceania reported an higher workload while the other countries registered a decrease due to the underdeveloped internet network. Other important aspect to consider is the emotional life, indeed students learning from home have more difficulties to focus and they miss all the interactions with their colleagues and professors. Given that the research also analyzed the emotional life of students which reported that the most frequently emotions expressed at home were: Boredom, Anxiety, Hope and Frustration with the highest level of anxiety in South America (65.7%) and Oceania (64.4%) while in Europe had a percentage of 48.7 %. The higher level of negative emotions respect to the positive ones shows the impact that the governments' measures have been having on students during the pandemic and that impact can have different duration in each individual. (Aristovnik et al.,2020)

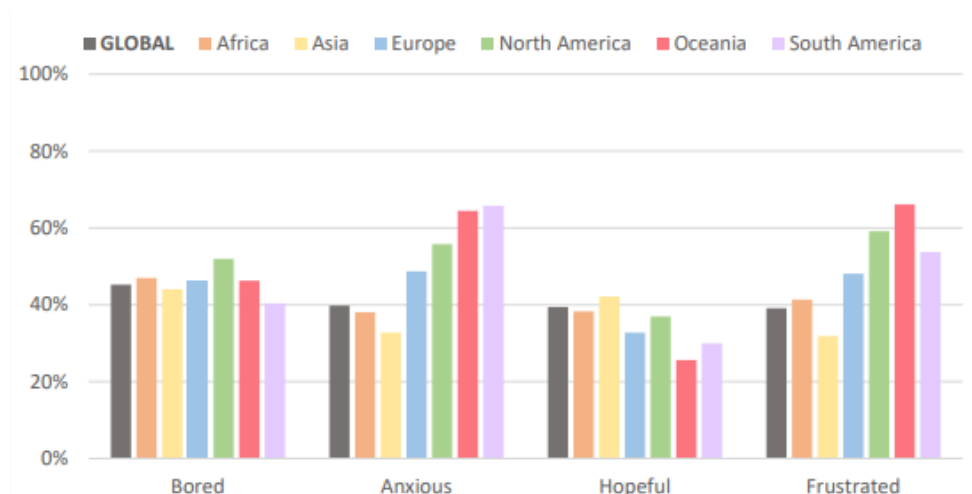


Figura 1 - 7: The most expressed emotions by students

Source: <file:///C:/Users/Utente/Downloads/sustainability-12-08438-v4.pdf>

Also the JRC(Join Research Centre) that is the science and knowledge service of the European Commission published a Technical Report of the Covid-19 effects on education. It highlighted how online learning has lot of potential only if it is well prepared. In the case of the Covid emergency the fast transition to online lectures could bring to a setback on student learning. The learning loss of students due to this immediate switch are characterized by the accumulated stress, the less time spent in learning, the lack of motivation and the different way students interact. The research estimated that the learning loss is greater in younger students than in older ones, in particular the online teaching might lead to a larger learning loss especially in mathematics and the schools closure could have negative effects on the soft skills of younger students such as communication and the ability of working in group.(JRC, 2020)

Different results on children education are given by the parental relationship and the parents socio-economic background. Indeed Moroni et al. (2020) claims that the isolation of students from teachers and their classmates affects their socio-emotional skills. Given that parents with a better background can support better their children in this context while children that

live in a lower status family may face a more stressful situation which can, in turn, arise learning loss.

1.5 Italy education during the pandemic

1.5.1 OECD Indicators

During the lockdown Italy, as the rest of the OECD partners, organized its resources in order to allow students to access the education service trying to accomplish the same quality as the lectures on-site. This caused the increase of total public expenditure which, in 2018, was 3% of gross domestic product already under the OECD partners average 3.2% of GDP.

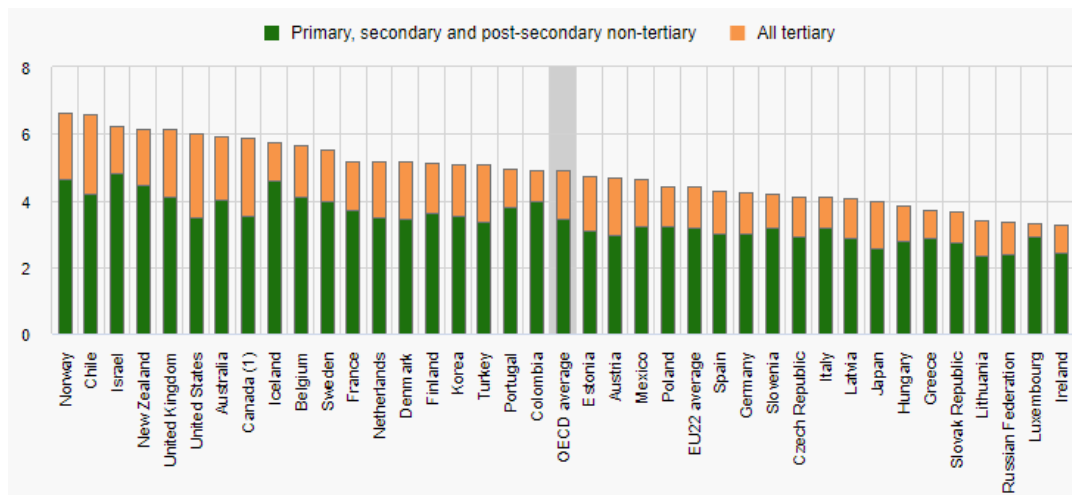


Figure 1 -8: Total expenditure on educational institutions as a percentage of GDP (2018)

Source: <https://www.oecd-ilibrary.org/sites/a2329af2-en/index.html?itemId=/content/component/a2329af2-en>

Also Italy, with other 16 partners allocated additional funds for those students socio-economically disadvantaged to ensure them the resources that they needed to continue studying during the pandemic. An important data in education was the decrease of 27% of adults in participating on average at formal or informal education and training in the OECD between the second quarter of 2019 and the second quarter of 2020 where this last one period was the peak of first covid-19 wave. In particular Italian adults participation in

formal or non formal education decreased by 19% respect to 2019. The crisis didn't increased a lot the share of NEETs, which stands for young people neither in employment or education or training. In Italy the share of 18-24 year-old NEETs rose from 24.2% in 2019 to 25.5% in 2020.

For what concerns how countries invest in education the OECD indicators, from the document "Education at Glance 2021: OECD indicators", show that Italy in 2018 was one of the ten OECD countries which spent the lowest proportion of GDP on primary to tertiary education. In particular in tertiary school the expenditure per student are USD 12305 that represents 4760 USD less than the OECD average.

Italy results under the OECD average also for the share of capital cost on total expenditure on educational institution. Indeed at primary, secondary and post secondary(non tertiary) level the capital cost amount for 1% of the total expenditure on educational institution while the OECD average is around the 8% (7 points more). For what concerns tertiary level the capital cost in Italy is 9% that is still lower than OECD average, 11%, but only for 2 percentage points.

1.5.2 *The ERT in Italy*

The situation in Italy about the Emergency Remote Teaching during the pandemic has been analyzed in year 2020 by Carlesso through a questionnaire reaching 148 teachers and 753 students from lower, upper secondary schools and universities among the national territory. The questionnaire presented all the feedbacks about ERT and the response of both teachers and students to this approach. The answers received were mainly from the North of Italy where the lockdown measure was firstly adopted. The questions asked to both professors/teachers and students were mainly concerned on their own digital skills and the program or online platform used to synchronous lectures and deliver the materials. To

conclude it was asked to highlight the negative and positive aspect and a comment on ERT approach.

The results shows that the main platform utilized during the lockdown were Google Meet to the synchronous lectures while Google Classroom for delivering the necessary materials such as presentations or other files. In the following Figure is possible to see the adaptation of students and teachers in comparison where the 48.8% of students and the 47.6% of teachers didn't have any issue with the new teaching method, respectively the 18.1% and the 42.1% had difficulties sometimes.

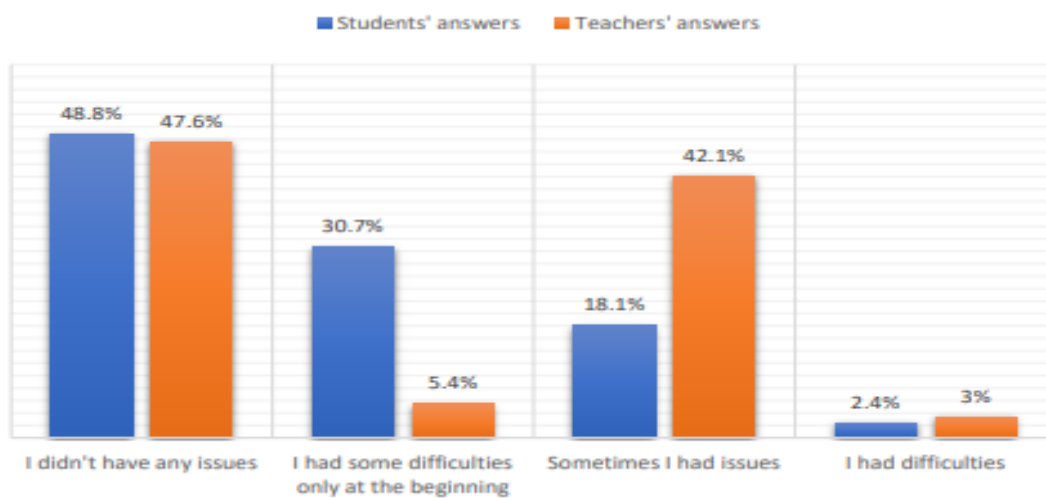


Figura 1-9: Difficulties with the new teaching approach by students and teachers

Source: Carlesso A., 2020, *Distance Education and Emergency Remote Teaching: An analysis of the Italian School System Affected by the Covid-19 Pandemic*, Università degli studi di Padova p.73

Before looking at the negative and positive aspects given by teachers and students it could be important to see the impression of the students about the level of difficulty and marks of the exams in the context of Emergency Remote Teaching.

Indeed as represented by the below figure the majority of students confirmed that tests difficulty and marks have remained the same as before covid with a percentage of 38.3%(test are the same) and 54.5%(Marks are the same).

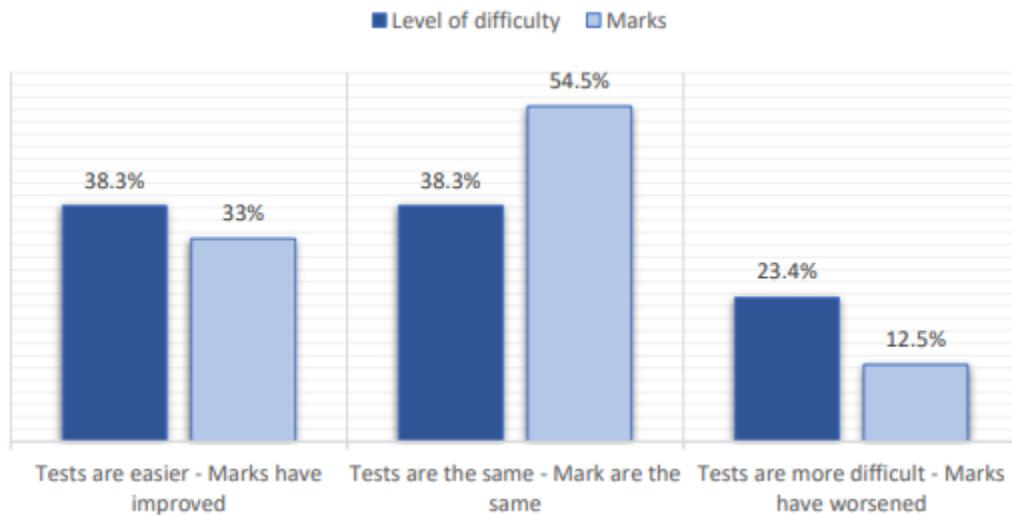


Figura 1- 9: Impressions on the level of difficulty of tests and exams compared to the actual grades
 Source: Carlesso A., 2020, *Distance Education and Emergency Remote Teaching: An analysis of the Italian School System Affected by the Covid-19 Pandemic*, Università degli studi di Padova p.75

To conclude teachers and students described the ERT method. Only the 4.6% of students and the 2% of teachers found it “motivating”, the majority of the students (51.6%) found it “convenient” unlike the teachers that found it “wearying” at 68.7. That shows a huge gap between the perception of students and teachers of ERT, indeed students define it convenient since they can follow the lectures wherever they want but this would mean a lot of dedication and hard work for professors to organize the lectures.

For the future of online teaching and if it will replace face-to-face lectures answers showed a 61.8% that choose “Partly” while the 28.9% of people choose “No” that indicates a possibility for online teaching to integrate or be complementary to lectures on site in the future.

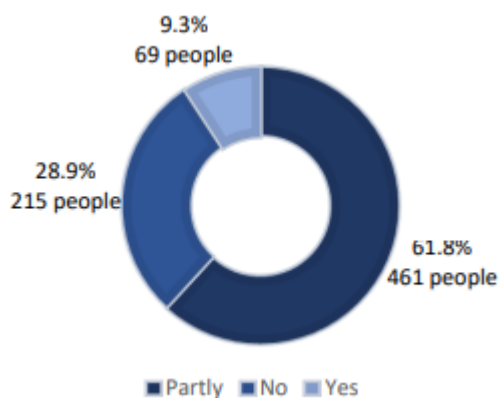


Figura 1-10: Opinions on the replacement of on site lectures with online lectures

Source: Carlesso A., 2020, Distance Education and Emergency Remote Teaching: An analysis of the Italian School System Affected by the Covid-19 Pandemic, Università degli studi di Padova p.87

1.5.3 Re-opening and Recovery Principles for Education

Nowadays the re-opening of schools and higher education institutions allows students to come back to lectures in presence but the possibility to follow from home those lectures is always guaranteed to enable those who may have to do a quarantine to stay at the same path of their colleagues.

This turning point is also possible thanks to the vaccine against the Covid-19 and related to that the Green Certification. That is a certification that confirms the vaccination from the individual allowing the government to track the number of vaccinated and non-vaccinated in the national territory.

The Green Pass is today one of the main political debate in Italy due to the ministerial decree that makes it mandatory to workers, meaning that those individuals that work in the public or private sector have to vaccinate otherwise take rapid tests every two days to enter in their office. That decree does not regard only workers but it works also for Education. In particular as declared from the MIUR at school the Green Pass is mandatory for the students

over 12 years old while for those under this age it isn't but it is mandatory to wear the mask in class, the only exception is for children below the 6 years old. Moreover the OECD and Education International have been established 10 principle with the scope of continuity and enhancement of students' development within countries and also to reduce learning gaps as a consequence of this crisis.

The 10 Principles for Effective and Equitable Recovery from Covid are:

1. Keep schools open as much and as safely as possible.
2. Ensure equity and align resources with needs.
3. Provide a remote learning infrastructure which is designed to reach all students.
4. Support teachers in their professional lives.
5. Enable teachers and parents to support learners.
6. Provide targeted support to meet students' learning and social and emotional needs.
7. Co-design a robust digital learning infrastructure with teachers and stakeholders.
8. Empower teachers to exercise their professionalism and benefit from professional learning opportunities.
9. Encourage a collaborative culture of innovation.
10. Learn from national and international evidence.

Those principles can be divided in two main groups, the first five are those for schooling during the pandemic while the last five principles concern the recovery towards effective and equitable education. The core of the principles is the learner and they aim to meet students' cognitive, social and emotional educational needs during and after the pandemic. The effectiveness of this recovery plan it depends mostly from the support and collaboration within all the stakeholders creating the "Recovery Ecosystem" represented by the Figure 1-8.

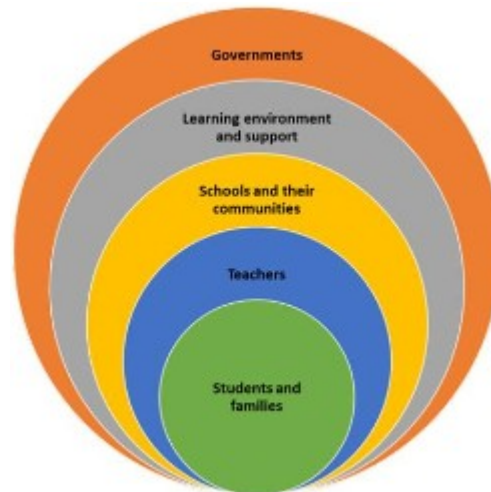


Figura 1-11: The recovery eco system

Source: <https://www.oecd.org/education/ten-principles-effective-equitable-covid-recovery.htm>

The Figure represents how achieving the goals of students' development and growth is possible only if all the partners that working in the education field collaborate with each other. Indeed at the center of the figure there are the students and their families and they need the direct support of teachers in order to continue to study and grow, in turn teachers need support from schools and their communities to accomplish in the best way their job and the systems goes on till the very first supportive partner of education which is the Government.

CHAPTER 2

OVERVIEW OF THE STUDY AND DESCRIPTIVE ANALYSIS

In this chapter the main arguments treated are those that allow to understand better the circumstances linked to the study. In particular, it starts with general information on the University of Ancona and the foundation of the Faculty of Economics followed by the analysis of the educational offer that it provides and the teaching method applied during the academic years considered. Then, it explains the organization of the first year of the Bachelor degree “Economia e Commercio” on which are based the data for the analysis.

In the second part of the chapter is highlighted the Purpose, the Population and the Dataset. The study has been conducted through a data analysis software called R-Studio, that allows the manipulation of the data through coding. At the end of the chapter is presented a descriptive analysis of the data collect such as number students analyzed, percentage of male and female, nationality of the students and information of the year of enrollment respect to the year of getting the diploma from high school. This descriptive analysis continues with the description of the student’s performance during the second semester of two academic years 2018/2019 and 2020/2021 in view of the third chapter focused on the models elaborated to explain the influence of remote teaching and the other variables on the performance changes of the students.

2.1 Historical Highlights of UNIVPM and the Faculty of Economics

The beginning of the process that brought a University in Ancona started in the Middle Ages with the authorization from Pope Pius V to found a “Studium Generale cuiuscumque Facultatis et Scientiae” in 1562 which offered courses on Theology, Civil and Canon Law. The “Studium” after a great period started a progressive decline in the second half of the XVII century due to the choices of students from wealthier families to attend the more famous studies in Rome and Bologna causing the closure of the “Studium” in 1739. After that the chair of Civil and Canon Law was reopened just for a short period because of the political issues between 1797 and 1799.

Many others proposals and aspirations were risen but none of those arrived beyond the planning stage interrupted by the World Wars.

The work for founding the University of Ancona was resumed during the postwar period. In 1969 it was established the Free University of Ancona with the first two faculties: Medicine and Engineering. At those two faculties were added later the Faculty of Economics and Commerce and the Faculty of Agriculture. The initial academics enrolled were 290 and that numbers increased in a relevant way arriving at 17000 in the academic year 2009-2010. Today the University of Ancona is called “Università Politecnica delle Marche” and it is characterized by six faculties:

- The Faculty of Agriculture;
- The Faculty of Economics;
- The Faculty of Engineering;
- The Faculty of Medicine and Surgery;
- The Faculty of Sciences.

The faculty that has been taken in consideration for the analysis is the one of Economics. This latter one is located in Ancona, at Villarei which was a military barrack until the end of

WW2. At that time hosted firstly a Infantry Regiment then open its doors to people and families which had been displaced by the bombing events. Postwar period had seen Villarei totally abandoned until it became the Economics' Faculty of the University of Ancona thanks to Giorgio Fuà, founder and the reason of the name of the Faculty itself. He was an economist and professor which realized his dream of building in his hometown a Faculty of Economy with the contribution of Carlo Bo, at those times rector of the University of Urbino.

Today the Giorgio Fuà Faculty is very well known for its high quality educational programs both on bachelor and master degrees. In details the available bachelor programs are:

- “Economia e Commercio” located in Ancona at Villarei;
- “Economia Aziendale” located in San Benedetto del Tronto;

For what concerns Master degrees the choice is wider since the Faculty offers six different educational programs and all of them are based in Ancona:

- “Economia e Management”;
- “International Economics and Commerce”;
- “Management pubblico e dei Sistemi socio-sanitari”;
- “Scienze economiche e finanziarie”;
- “Data Science per l’Economie e le Imprese”;
- “Management della Sostenibilità ed Economia Circolare”.

Among the Italian educational programs, the University offers the possibility to study in English through the course “International Economics and Commerce”.

2.1.1 The Bachelor's degree in Economics and Commerce

Having given an overview to the wide educational offer in the field of Economics by the UNIVPM it is important to highlight which of those represents the object of interest of this thesis.

The analysis has been focused on the bachelor degree course located in Ancona named *Economia e Commercio* (Economics and Business). It has been introduced for the first time in the year 2009 and it aims to build bases and competences in the Economics field in order to allow students either enter in the labor market or continue their studies. The peculiarity of this course it's represented by its organization.

The three years are not common for all the students, they share the same exams for the first two years, then, during the last one, have the possibility to choose the larger part of the courses to complete their credits. Thanks to this system students can get closer to topics in their interest and understand, in the case of continuing their studies, which Master degree could be more suitable for their academic pursuits.

The course, as we can see from the Figure 2-1, is composed by compulsory and optional exams. Each exam can be organized in different classes depending on the number of enrolled students due to structure limitations in number of seats of the classrooms and to give the possibility of better attending the lessons. The classes divide the students following the alphabetical order, if the subject is divided in two classes in one of them there would be the students which surnames starting from A to L and the second one with those surnames starting with letter from M to Z; in the case of three classes it follows the same logic beside that the groups would be A-E, F-O and P-Z.

Disciplina	Attività Formativa	Settore	CFU	Sem.
I ANNO – A.A. 2020-2021				
Matematica generale (A-L, M-Z)	A	SECS-S/06	9	
Economia politica I (A-E, F-O, P-Z)	B	SECS-P/01	12	
Economia aziendale (A-L, M-Z)	A	SECS-P/07	12	
Istituzioni di diritto privato (A-E, F-O, P-Z)	A	IUS/01	9	
Storia economica (A-E, F-O, P-Z)	A	SECS-P/12	9	
9 crediti a scelta fra:				
Storia del pensiero economico	C	SPS/01	9	
Sociologia economica (A-L, M-Z)	C	SPS/09	9	
Totale crediti			60	

Figure 2-1: Schedule of the first year of the Bachelor degree

Socource: https://www.econ.univpm.it/sites/www.econ.univpm.it/files/economia/EC-AN_IIIanno2.pdf

2.2 The Study's Purpose, Context and Population

2.2.1 The Purpose

The study has been conducted on the Faculty of Economics Giorgio Fuà in Ancona in order to understand if government restrictions, imposed due to Covid19 spread, has influenced the academic life of university students and how they have been reacting to these. In particular the purpose has been focused on the Faculty students' performance during the Covid-19 emergency. This latter one has been faced through a general lockdown including the closure of educational structure of all grades forcing the application of an alternative method, the online teaching, to ensure the delivery of lessons and the continuing of the academic year. The remote learning, as a solution for the distance between professors and students during that period, has been taken as one of the main factor that may have influenced the students performance.

2.2.2 The context analyzed and how the Faculty has faced the Covid-19 emergency

In order to better understand the way the analysis has been conducted and its results it is important to give information about the organization of the Faculty in terms of delivery lessons and teaching method. As highlighted in the paragraph above, to reach the purpose is not enough taking in consideration students performance during the Covid-19 emergency but it is necessary to have a base of comparison with an academic year that hasn't been affected from it. That explains the choice of including different academic years: 2018/2019, 2019/2020 and 2020/2021.

2018/2019:

This academic year preceded the Covid-19 pandemic, its period was not affected by any emergency and its teaching method remained the same as always for the last decade. It consisted in lessons in presence at the University characterized mainly, but not only, by "Passive Learning" which means that the lesson has one active part, the professor, and the

students receive information passively, this teaching method is especially adopted for the bachelor degree. By the way the term used is “mainly” because, due to the development of online platforms and group projects, students have becoming more and more involved during the courses.

2019/2020:

The Academic year, started in September 2019, has seen many changes over the time. Indeed it started with lessons in presence for the first semester ,as the previous academic year, but then the appearance and the spread of Covid-19 bring to a reorganization of all the university systems. At the beginning of the second semester the government restrictions brought the closures of the Italian universities for two weeks. In order to not lose the entire year and to allow students to continue their studies the Faculty, as the rest of the Italian Universities, decided to deliver the lessons through Remote Teaching. This one, as defined in the first chapter, consisted in using different online platforms to teach. The platforms have different uses, in particular the Faculty of Economics started by using Zoom to deliver live streaming lessons and the e-learning platform to upload the material such as assignments, slides, recorded lessons and notices. The organization of live streaming lessons was based by passive learning, as the ones in presence, however due to the distance, the continued use of the computer and the context students were more stressed and had more difficulties to remain focused during the entire duration of the lesson.

2020/2021:

The analysis included also the academic year 2020/2021 because it had been influenced by the second wave of Covid-19 forcing Universities, and so the Giorgio Fuà Faculty, to come back to the Remote Teaching for some parts of the year. However this period allowed students to take the exams of the second semester in presence after attending the lessons

online. Also in this case the lessons' organization and delivery were as the ones of the two past academic years that means students learnt mainly in a passive way.

2.2.3 The Population

The analysis takes in consideration only a certain part of the registered students of the Faculty. Indeed the population is composed by all the new enrolled students attending the first year of the Bachelor degree "Economia e Commercio" for three academic years: 2018/2019, 2019/2020, 2020/2021 that respectively represent two different situations, the one before Covid-19 and the one during the two waves of Covid-19. The reason of this decision is given by the fact that in the first year of this course students share the same exams and almost all of them are compulsory, another reason of the chosen population is that most of the students enrolling at the university are experiencing for the first time this kind of education system so they may come across the same difficulties.

2.3 The Dataset

The Dataset taken in consideration is characterized by 9462 observations and 35 variables. From the 35 variables has been considered just those that were significant for the study. Each observation represents an exam sustained by a certain student enrolled at the first year of the bachelor degree in "Economia e Commercio" at the Giorgio Fuà Faculty in Ancona for the academic years written above.

Going to the analysis of the variables utilized may be helpful starting with those linking the observation to the student generalities which are:

- *cittl_des*: the nationality of the student;
- *Sesso*: the gender of the student;
- *aa_off_id*: the year of enrollment of the student;
- *anno_maturita*: the year of graduation from High School;

- *prov_dom*: province where the students lived during their first year at the Faculty.

aa off id	sezzo	citt1 des	anno maturita
2018	M	ITALIA	2018
2018	F	ITALIA	2018
2018	F	ITALIA	2018
2018	F	ITALIA	2018

Showing 295 to 300 of 9,462 entries, 17 total columns

Figure 2-2: Sample of the dataset for the students' generalities

The remaining variables instead are those variables that for each observation describe the characteristic of the exam sustained, in particular:

- *des*, representing the name of the exam, only those from the first year of bachelor degree "Economia e Commercio" of the Giorgio Fuà Faculty;
- *insegnamento*, showing the sub-class at which the observation belongs to, given that each exam could be divided in subclasses;
- *tot_by_ins*, a numeric variable that indicates the total number of participants on each subclass of the exam;
- *semestre2018*, *semestre2019*, *semestre2020* giving for each observation the semester at which the exam belongs to. If it is 1 it means that the exam belongs to the first semester while if it is 2 it belongs to the second one;
- *peso_ad* shows the credits corresponding to the exam, for the first year of the bachelor degree an exam could be worth 9 or 12 credits;
- *tipo_ins_cod* considers the category of the exam if it is compulsory(OBB) or optional(OPZ);
- *data_sup* is the date of the exam on which it has been passed by the student;

- *aa_sup_id* represents the year of passing the exam and it is important because a student could have passed the exam on same session of the first available one but on the following year;
- *session* indicating the session on which the student passed the exam. The variable can assume three values 1, 2 and 3. Each of them represents a session of the academic year. In particular the number 1 represents the winter session, number 2 the summer session and finally number 3 represents the autumn session;
- *supesa* gives information about students passing or not the exam, it is a binary variable in the case it is 0 the students did not pass the exam otherwise it would be written the number 1;
- *sup_1*, it can assume two values, 1 if the student has taken and passed the exam at the first available session while 0 if the student did not pass the exam or he passed the exam after the first available session;
- *voto* represents the vote that the students has taken passing the exam, it goes from a minimum of 18 to a maximum of 31;
- *lode_flg* assumes two values that are 0 or 1 that respectively means the professor didn't give the lode or gave the lode to the student.

des	peso ad	tipo ins cod	data sup	aa sup id	voto	lode flg
MATEMATICA GENERALE	9	OBB	2019-02-05	2018	18	0
STORIA ECONOMICA	9	OBB	2019-06-26	2018	26	0
MATEMATICA GENERALE	9	OBB	2019-06-13	2018	18	0
SOCIOLOGIA ECONOMICA	9	OPZ	2019-07-10	2018	18	0

Showing 1 to 5 of 9,462 entries, 20 total columns

annoesa	session	supesa	insegnamento	tot by ins	sup_1
2019	1	1	MATEMATICA GENERALE MZ	259	1
2019	2	1	STORIA ECONOMICA AL	298	0
2019	2	1	MATEMATICA GENERALE AL	298	0
2019	2	1	SOCIOLOGIA ECONOMICA AL	278	1

Figure 2-3: The Dataset

2.4 The Descriptive Analysis

2.4.1 The students characteristics

Before talking in depth about the way of working during the study and discuss the results it might be interesting describe and see the preliminary information that the dataset include in order to have a general point of view of the observation's characteristics. Following the order utilized to show all the variables the first analysis to be presented is going to be the one about the generic characteristics linked with the students followed by the characteristics of the exams. The total number of observations are 9462 each of them represents an exam of a student enrolled on the first year of the "Economia e Commercio" degree in 2018, 2019 and 2020. However, each exam does not necessarily corresponding to a different student. For the first year of the course each student should have six exams to sustain, so six observations should belong to the same student either he/she passed or not those exams. To count the number of students enrolled in each academic year the observations has been grouped by the year of educational offer (*aa_off_id*) and then in each subset has been quantified the number of students. The results revealed that the new enrolled students were 547 in the academic

year 2018/2019, 517 in the one of 2019/2020 and 513 in the 2020/2021 one, as we can see in the figure below. The trend appears to be negative, each year less and less individuals enrolled in the Bachelor degree. The difference between the academic year 2019/2020 and the following one is very small respect to the difference between the 2018/2019 with the 2019/2020. Once discovered the number of students it has been analyzed the composition of them respect to students gender. In general the results present a greater percentage of male respect to female, 60% to 40%. In depth it is possible to see that 2018/2019 was characterized by 56% of male students and 42% of female among the new enrolled students in the Bachelor degree, for the following year the percentages were respectively 56% and 44% and in 2020/2021 they were 60% and 40%.

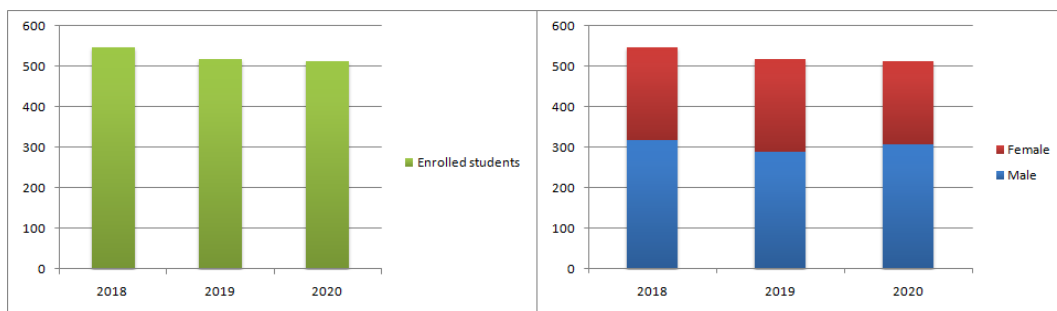


Figure 2-4: Total number of students and their gender composition

Another interesting information regards the year of getting the diploma respect to the year of enrollment at the Bachelor degree. Considering the three academic years, as happened for the gender composition, the percentages analyzed remained almost constant for the three years. In details, it has been considered the year of graduation in High school and it has been compared to the year of enrollment at the course. The results show that the enrolled students at the academic year 2018 were composed by a 81% of students that graduated from High school the same year while the 19% of them graduated before the year of enrollment, the same percentages has been confirmed for the two following academic years as we can see

from the figure 2.3. The graph demonstrates that in most of the cases individuals carry on their studies at the University immediately after High school.

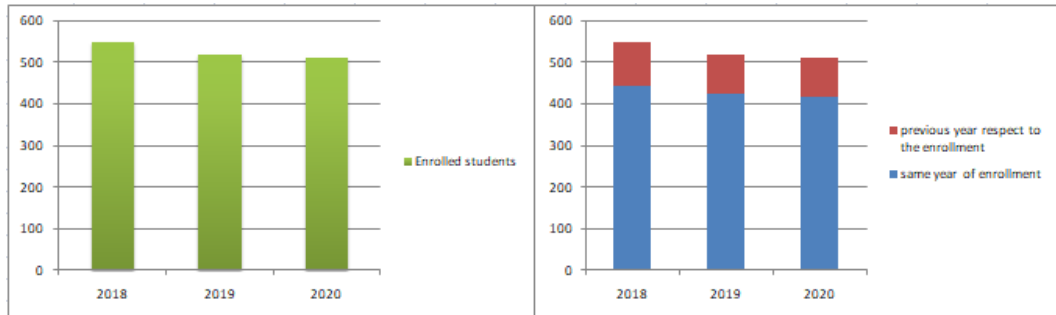


Figure 2-5: Total number of students and their composition respect the year of getting the High school Diploma and the year of enrollment at the University

The next variable analyzed has been the nationality of the students enrolled at the three different academic years showing the relative percentages of Italian and foreign students. As expected for the three years Italian students have exceeded the 90% specifically it amounted to 95% in 2018 and 94% in the two following years meaning that in the last two academic years there have been an increase of 1% of foreign students enrolled.

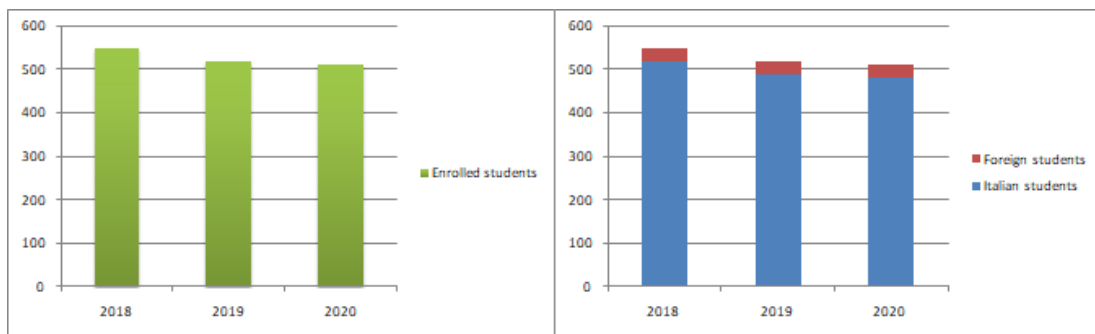


Figure 2-6: Composition of students in terms of nationality(Italian or not)

For the students has been done also a classification of the province of residence, the interest for this data are based on how the distance learning has impacted those that were used to attending in presence the lessons. To do that it has been considered two main provinces Ancona and Macerata because students that live there are more likely to attend the lessons in class due to the closeness to the Faculty. For the three different academic years the number of students living in Ancona are: 284 during the 2018/2019, 311 during the 2019/2020 and 276 during the 2020/2021 year. The data show that students coming from Ancona represents more than the 50% of the overall students that have been enrolled at the first year of the bachelor degree for the three years considered, respectively 52%, 60% and 54%.

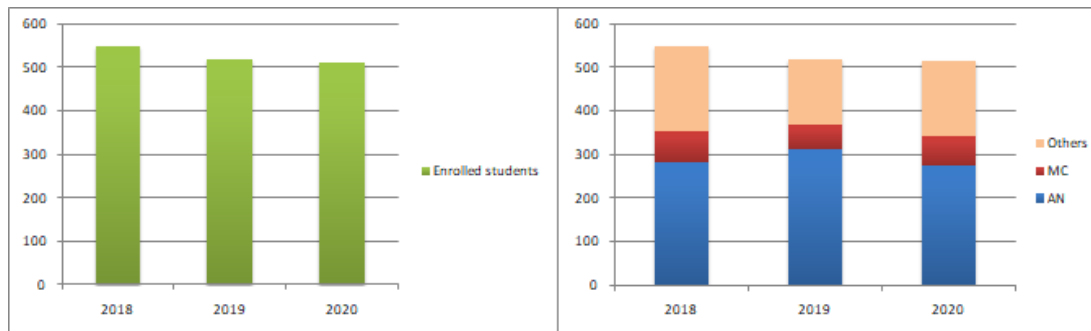


Figure 2-7: Province of student's residence

2.4.2 Performance data of the students

Before going through the analysis of the performances of the students it is necessary to highlight which data have been taken in consideration to do the comparison and measure the changes in students' performance. As said in the purpose of the study, the aim of the comparison is to comprehend how the Covid-19 affected the students in their academic results. To do that the analysis has to be made with the data of the year which has not been affected from the Covid emergency, in this case the academic year 2018/2019, and compare them to those data from those academic years characterized by the pandemic.

Putting as main factor of influence the Online teaching method it is important to compare results from periods where the exams were done in the same method while the difference has to be the way through which students attended the course. Specifically the analysis has been focused on those period where the examination has been in presence and the lectures has been either online or in presence, as highlighted by the table below. During the two academic years influenced by the emergency there aren't many periods on which exams has been taken in presence after an online teaching method due to the general lockdown and the increasing number of cases of Covid-19. In general the session characterized by exams in presence are the autumn session but they aren't significant in terms of number of students that take the exams on those periods. The only significant period that could have been compared with one of the year 2018/2019 and could be numerically significant it is the second semester of the academic year 2020/2021.

	2018/2019		2019/2020		2020/2021	
	First Semester	Second Semester	First Semester	Second Semester	First Semester	Second Semester
LECTURES	Presence	Presence	Presence	Online	Online	Online
EXAMS	Presence	Presence	Presence	Online	Online	Presence

Figure 2-8: Chosen comparison

The relative exams of the chosen semester are given by two compulsory exams:

-“Istituzioni di diritto privato”(Private law);

-“Economia Politica I” (Political Economy);

and an optional one to choose between:

-“Storia del pensiero economico” (History of economic thought);

-“Sociologia Economica” (Economic sociology).

One of the variable that has been used to analyzed this period is the “*sup_1* “ which indicates if students passed or not the exam at the first available session. This variable is important because students that have taken the exam of the second semester in 2020/2021 after the

appello in June and July 2020 may have sustained it in a period where exams came back to the online methodology and it would disappear the condition of the exam methodology in presence. Following it is shown the percentages of passing the exams of the second semester at the first available session for both the years considered by exams (2018/2019 and 2020/2021).

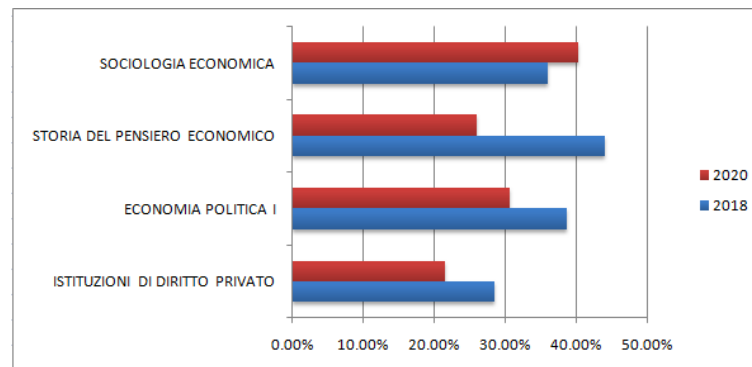


Figura 2-9: Percentages of students passing the exam of the second semester at the first available session

What emerges from the figure is that overall the percentages of students that passed the exam at the first available session decreased from the year 2018/2019, the only percentage that increased is the one of the optional exam “Sociologia Economica”. More interesting is that both the compulsory exams, Private law and Political economics, lowered their percentages respectively by 7% and 8%.

This information reveals that students attending class in presence in 2019 were more likely to passed the exam immediately during the summer session than the students from 2021, that attended lectures online.

After the variable sup_1 it is important to see the changes in the performance of the students in those exams. It will be shown the differences in the results of the students belonging to the percentages of passing the exams at the first available session. Before showing the descriptive analysis of each exam it could be useful to remind that each exam, due to number of participants, might has been divided in two or three classes, given that the results of the

analysis are divided by sub-classes. Also the graphs are made through the software R-Studio using the formula *density()* which is based on the KDE(Kernel Density Estimation).

The first exam that is going to be analyzed is “Istituzioni di diritto privato” (Private Law). This exam has been characterized by two different sub-classes for each academic year considered(AL, MZ). Below there is the representation of the students results: the red line represents the students results from the year 2018/2019 and the black line representing the ones of the 2020/2021.

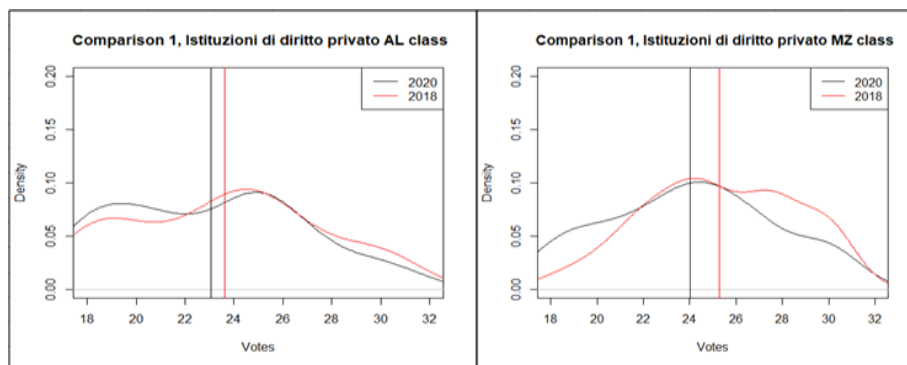


Figura 2-10: Results of students' performance in Istituzioni di diritto privato

In both of the sub-classes it is possible to find a worsening of the performance of the students which attended the lectures online, so the ones enrolled at the year 2020/2021. The vertical lines representing the averages vote per sub-class for each year. In depth, students from 2018 scored on average 23.61 in the first class AL and 25.28 in MZ class, on the other side students from 2020 scored respectively 23.06 in AL and 24.03 in MZ.

The second exam that will be analyzed is the other compulsory exam: Economia Politica I (Political Economics). The sub-classes in this course has been three for each of the years they were: class AE, FO and PZ. Also in this case the graphs give the distribution of the votes taken by the students during the summer session of 2018/2019 and 2020/2021.

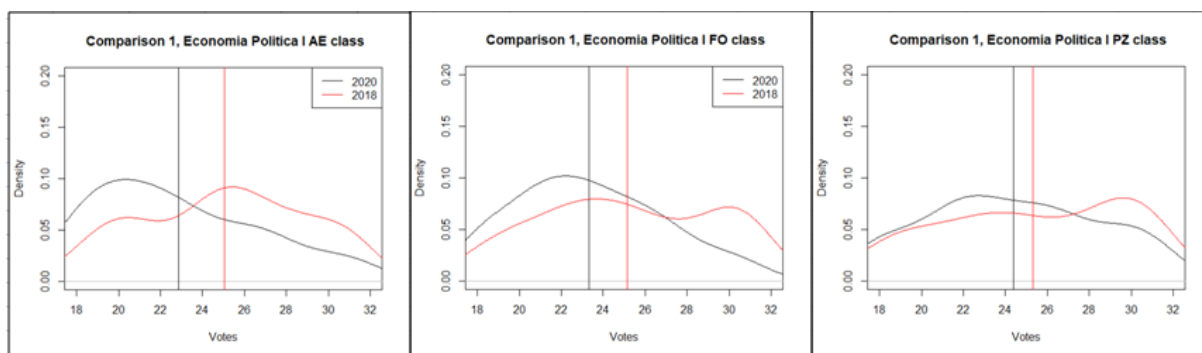


Figura 2-11: Results of students' performance in Economia Politica I

Remaining the black line for the students enrolled in 2020 and the red one for those enrolled in 2018, the results show another negative change in students performance. In this case the average marks of each sub-class in 2018 has been 25.04 in class AE, 25.15 in class FO and 25.31 in PZ. Respect to those the year 2020/2021 presents for the same sub-classes: 22.86, 23.32 and 24.37.

The last comparison that is going to be shown it's related to the exam of Sociologia economica (Economic Sociology), this course is an optional exam. Due to the number of participants it has been characterized by two sub-classes (AL, MZ) in each academic year. In this case, as it is possible to see from the figure 2-9, the differences in performance between the students enrolled in 2018 and those enrolled in 2020 is not that significant. Indeed comparing the two periods as for the previous exams the average of votes from 2018 is greater than the one of 2020, even if, in this case, the difference is relative small. Specifically the mean from the academic year 2018/2019 is 24.99 while the one of the year 2020/2021 is 24.67.

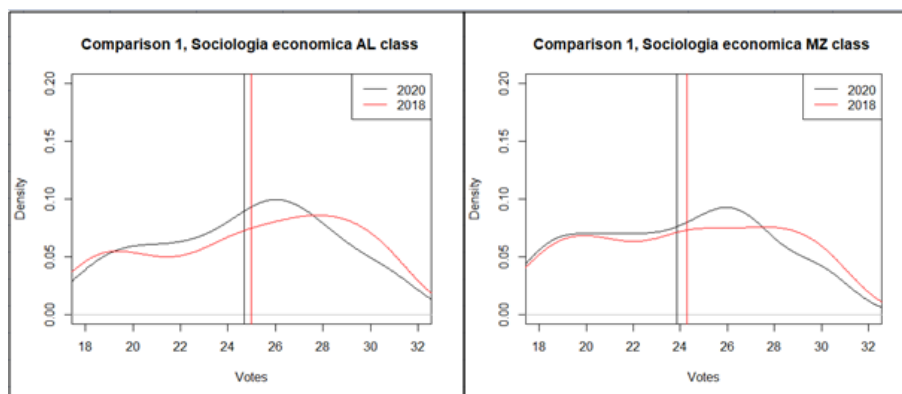


Figura 2-12: Results of students performance in Sociologia economica

For what concerns Storia del pensiero economico (History of economic thought), the other optional exam that students may choose instead of Economic sociology, it is not relevant to show the graphs of performance comparison due to the low portion of students that have chosen and more important have passed this exam at the first available session.

To summarize the descriptive analysis of the performance of the students during the second semester of the academic years 2018/2019 and 2020/2021 it is possible to see students attending lessons in presence (2018/2019) passed the exam with a better performance than those attending lectures online. Important to highlight it is also the fact that in 2018/2019 not only the performance were higher but also the percentages of the students passing the exams at the first available session are higher for each sub-class per exam except for two classes the AL class of Istituzioni di diritto privato and the MZ class of the Sociology economic as reported by the figure 2-13.

Exams	Classes	Academic years	
		2018	2020
SOCIOLOGIA ECONOMICA	AL	37%	38%
	MZ	30%	48%
ECONOMIA POLITICA I	AE	38%	29%
	FO	40%	35%
	PZ	35%	27%
ISTITUZIONI DI DIRITTO PRIVATO	AL	16%	19%
	MZ	41%	24%

Figura 2-13: Percentages of passing the exam at the first available session by sub-classes

Given the descriptive analysis in the next chapter will be explained the models used to predict how the votes and the probability of passing the exam on the first available session are influenced by the variables analyzed and in particular from attending the lessons online.

CHAPTER 3

ANALYSIS AND RESULTS

In this chapter are shown the analysis and the relative results on the students performance before and during the Covid-19 pandemic. The aim is to see the effect of Remote Teaching adopted due to government restrictions. The chapter starts by introducing the analysis with an overview of the models utilized and the variables considered. The first analysis is an Ordinary Least Squared Regression with the students' vote as dependent variable. The model analyzes if there are correlation between the students results and the independent variables such as the student gender, the different courses and the year of enrollment.

Noticing an influence of the year of enrollment on votes the analysis continued with a Probit model used to show if the same independent variable affected also the probability of the students on passing the exam at the first available session of the second semester during the first year of bachelor degree for the academic years considered: 2018/2019 and 2020/2021.

3.1 Introduction to the analysis

The descriptive analysis faced on the previous chapter gives an important suggestion, the year of enrollment might be one of the factor that influences the students performance. In this case, specifically, the effect of the Remote Teaching on students against the teaching in presence. In order to demonstrate the correlation between those two variables it has been considered two main models.

The first one is an OLS regression with the votes of the students as dependent variable while the second one follows a Probit model due to the fact that the dependent variable is a dichotomous variable and it indicates the probability of passing or not the exam at the first session available in the semester taken in consideration.

For the two models the function structure is:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki} + e_i \quad i = 1, \dots, n$$

where:

- Y represents the dependent variable;
- X s represent the independent variables, in our case the year of enrollment (aa_off_id), the gender of the student and the exams of the semester considered;
- β s are the estimated coefficients given by the regression;
- e_i is the vector representing the error term;
- k is the number of independent variables;
- n is the number of observations of the sample;

3.2 OLS Regression

The Ordinary Least Squared is one of the most used method to predict a dependent variable finding the parameters β s for which the error term is minimized. The beta parameters represent how the dependent variable change when the independent one increases or decreases by a unit, as it will be demonstrated later.

In this thesis has been argued if students, attending lectures online during the general lockdown and taking the exams in presence, have been worsening their performance or not respect to those students that in the same semester of 2018/2019 attended lectures in presence. The sample on which the OLS regression is based it is characterized by the students that passed the exams of the second semester at the first available session, since the semester was the second one the relative session is the summer session. The dependent variable is the votes taken by the students while the dependent ones are:

- *aa_off_id* indicates the year of enrollment of the students, if it is 2018 implied that the student attended the lessons in presence otherwise, if it is 2020, the student attended those online;
- *Sesso* represents the gender of the students;
- *des* shows the course name, in order to see if there are differences in performance among the different exams.

Following it will be shown the results of the regression, carried out in the R-Studio software with the relative comments.

To analyze those variable the observations considered were the ones which has 1 for the variable *sup_1*, meaning all those exams passed at the first available session, otherwise those who did not pass the exam wouldn't have the votes 'field filled out. Given that the number of observation is 1033.

Dependent variable:	
voto	
sessom	-0.739*** (0.242)
aa_off_id1	-0.977*** (0.241)
desECONOMIA POLITICA I	-2.192*** (0.679)
desISTITUZIONI DI DIRITTO PRIVATO	-2.388*** (0.690)
desSOCIOLOGIA ECONOMICA	-2.098*** (0.680)
Constant	27.500*** (0.669)
Observations	1,033
R2	0.037
Adjusted R2	0.032
Residual Std. Error	3.840 (df = 1027)
F Statistic	7.867*** (df = 5; 1027)
Note:	*p<0.1; **p<0.05; ***p<0.01

Figure 3-1: OLS results with vote as dependent variable

Looking at the figure 3-1 it is possible to notice that both R squared(0.037)and adjusted R squared (0.032) are very small. Those two can assume a value from 0 to 1 where the more are closer to 1 the better the variation of the dependent variable is explained by the independent variables. In cases of multiple variables it is suggested to look at Adjusted R2 to see the goodness of the model. In the case of the above regression Adjusted R2 is 0.032 which means that the 3.2% of the variance in the votes can be predicted from the input variables. All the independent variables seems to be significant in the regression at the level of 1% meaning that their p-values are less than 0.01.

The coefficients of the variables represent the variation of the vote corresponding to a true or false condition of the independent variable. The intercept shows the average vote in the optional course “STORIA DEL PENSIERO ECONOMICO” by female students.

The coefficient of the variable *sesso* manifests a negative correlation with the gender of the students. Specifically if the male students condition is true then on average the vote will be lower by 0.74. Respect to the courses also they show a negative correlation respect to the course of *STORIA DEL PENSIERO ECONOMICO* (Intercept). Indeed, on average students take two votes lower in the other courses which are *ECONOMIA POLITICA I* (-2.192), *SOCIOLOGIA ECONOMICA* (-2.098) and *ISTITUZIONI DI DIRITTO PRIVATO* . In particular in this latter one students take 2.388 votes lower.

To conclude, the coefficient of the variable *aa_off_id* , which has been the reason of the regression, demonstrates that among all the observations taken in consideration the ones belonging to students enrolled in 2020 get on average a vote lower than almost 1 point (0.98) respect to those enrolled at the year 2018.

3.3 Probit Model

The results of the previous linear regression have been confirmed that students attending lessons online took worse votes than those enrolled in 2018. Given that it might be interesting to see if not only the votes were influenced by the year of enrollment but also if it influenced the variable *sup_1* , which shows if the student has passed the exam at the first session available or not. Since the dependent variable (*sup_1*) it is a dichotomous variable the model that fit better the analysis is the Probit Model.

The purpose of the model is to predict the probability of an observation to fall in one of the two category that the dependent variable can assume. The goodness of model it is not indicated by R2 or Adjusted R2, as in OLS, but it is given by the PSEUDO R2 which is calculated considering the likelihood estimation of the model.

For what concerns the coefficients they can only represent if the dependent variable is more likely or less likely to belong to one of the two categories possible, in order to explain how

much each independent variable influence the dependent one is necessary to calculate and analyze their marginal effects.

```

=====
                                Dependent variable:
                                -----
                                sup_1
-----
aa_off_id1                      -0.122***
                                (0.046)

sessoM                          -0.045
                                (0.047)

desECONOMIA POLITICA I          -0.008
                                (0.135)

desISTITUZIONI DI DIRITTO PRIVATO -0.287**
                                (0.136)

desSOCIOLOGIA ECONOMICA         0.079
                                (0.135)

Constant                        -0.301**
                                (0.134)

-----
Observations                     3,179
Log Likelihood                   -1,979.031
Akaike Inf. Crit.                3,970.061
=====
Note:                             * p<0.1; ** p<0.05; *** p<0.01

```

Figure 3-2: Probit Model with *sup_1* as dependent variable

In this case the PSEUDO R2 is 0.127 given by:

$$1 - (\text{probit.official\$deviance} / \text{probit.official\$null.deviance}).$$

The quotient is the result between the log likelihood for the constant model and the log likelihood for the full model with constant and predictors.

The constant represents the exams of STORIA DEL PENSIERO ECONOMICO sustained by female students. The negativity of the coefficient shows that students are less likely to pass that course at the first available session and they are even less likely to pass ISTITUZIONI DI DIRITTO PRIVATO and ECONOMIA POLITICA I which have also negative coefficients. The variable *sesso* reveals that male students are less likely to pass the

exam at the first available session while it seems that students are more likely to pass the SOCIOLOGIA ECONOMICA exam.

Last but not least the independent variable *aa_off_id*, on which the analysis is more focused, reveals that students enrolled in 2020 are less likely to pass the exam at the first available session than those enrolled in 2018. Fundamental difference, as reminded before, is that the first type of students attended the class online while the second ones weren't affected by government restriction and so carried on the university activities in presence.

To understand better the effects of the independent variables on the dependent one have been calculated the marginal effects in R with the dedicated function: *mfx()*.

```

Marginal Effects:
                dF/dx  Std. Err.      z    P>|z|
dataset.probit$aa_off_id1 -0.0432216  0.0164717 -2.6240 0.008691 **
dataset.probit$sessom -0.0158927  0.0167755 -0.9474 0.343448
dataset.probit$desECONOMIA POLITICA I -0.0028453  0.0478023 -0.0595 0.952536
dataset.probit$desISTITUZIONI DI DIRITTO PRIVATO -0.1002884  0.0459757 -2.1813 0.029158 *
dataset.probit$desSOCIOLOGIA ECONOMICA  0.0283657  0.0488699  0.5804 0.561623
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

Figure 3-3: Probit model and the marginal effects of the independent variables

The outcome presents the significance at 0.1 percent level of the variable *aa_off_id*. The relative coefficient indicates that students enrolled at the bachelor degree in 2020 have 4.32 percentage points less of passing the exam at the first available session than the ones enrolled in 2018. The other variable that results significant is the one of the course ISTITUZIONI DI DIRITTO PRIVATO, its negative coefficient indicates that students have even 10 percentage points less on the probability of passing this exam at the first available session.

Summarizing the results obtained from this analysis it is possible to say that at the Faculty of Economics G.Fuà in Ancona there has been a worsening in terms of university students

performance, in particular the students enrolling at the first year of the bachelor degree “Economia e Commercio”. This decline regards the last two academic years 2019/2020 and 2020/2021. The main factor that brought this change is the Covid-19 which, forcing government restrictions, caused the adaptation to a new context by all the universities transferring classrooms on virtual meetings and so adopting the so called Remote Teaching. To test the efficacy of the Remote Teaching it has been analyzed the performance of the students enrolled before the pandemic (academic year 2018/2019) and the one of those enrolled on the last two academic years. All the exam considered have been taken in presence. Then, knowing that those from the year 2018 attended the lecture in presence and students from 2020 attended the lectures online, it has been carried out a OLS regression to see if the year of enrollment could predict the vote of the student and a Probit Model to see if the same variable could influence the possibility of passing the exam at the first available session.

The results show for both of the models that the students enrolled in the year affected by the pandemic (2020) are going to have on average a lower vote on exams (about 1 vote lower) than the students who took the exam in 2018. The negative correlation also has been shown in the probit model for the possibility of passing the exams in the first available session, resulting that students from 2018 are more likely to pass them.

CONCLUSIONS

The Covid-19 disease caught off guard many countries of the world, its power has swept the modern society to a point of questioning the organization of many activities in many fields. The main consequence, of what became a pandemic situation started in 2020, has been the reconsideration of the healthcare system first and foremost in Italy. The overwhelming of hospitals and the lack of medical equipments, as oxygen or masks, pointed out the inefficiency of the national health service. However the medical field hasn't been the only one to be reconsidered for example ,on the economic side, there has been a huge decline in many sectors that brought to the closure of small and medium companies as restaurants. The outbreak of the Covid-19 has caused countless of problems but those problems can also be seen as opportunities to change for a better future.

In particular in this thesis has been analyzed the challenge that educational institutes had to face in order to help their students to continue their activities and the reaction of the students to those changes. The general restrictions adopted by the Italian government as a solution to stop the increase of infection rate was the general lockdown. This latter one imposed to the citizens to remain at home with the possibility of going out just for first necessities(food , medicines or medical services). Given that schools and Universities at first were forced to stop their activities for two weeks. Then, with the threat of not being able to finish the academic year, Educational Institutions started to find a suitable solution for the situation: the Remote Teaching. The latter one consists in learning from home utilizing the new technologies available, in particular, it refers to platforms that allow live streaming meetings and the possibility to upload the material by students and professors to carry on the academic lectures.

The aim of the present thesis has been the one of analyzing the performance of the university students that attended lessons through Remote Teaching and understand, from the results, if this alternative method has been successful or if it needs improvements because of a worsening in students performance.

The analysis has been done for the exams taken in presence of the second semester for the students enrolled at the first year of the bachelor degree “Economia e Commercio” at the Giorgio Fuà Faculty in Ancona. The population considered for the analysis represent two different situations:

- the students from the academic year 2018/2019 that were attending lectures in presence because there wasn't any pandemic situation;

- the students from the academic year 2020/2021, affected by the second wave of the Covid-19, that have been attending lectures online but had also the possibility to take the exams in presence.

The variable that distinguishes the two context is basically the year of enrollment, with that variable there have been considered also the courses of the second semester and the gender of the students. Describing the variable “votes” has been noticed that apparently students from the academic year 2020 perform worse than the ones enrolled in 2018. This gave a hint to do a deeper analysis by using an OLS Regression and a Probit Model. The first one analyzed the correlation of the votes with the year of enrollment and with each course, while the second one analyzed the correlation between the probability of passing an exam at the first available session respect to the same variables. Results confirmed that students, that attended lessons online and passed the exams at the first available session, got a vote that on average is lower by 1(0.98) respect to those that attended lectures in presence. Also for the probit model the students from 2020 have less probability of pass the exams at the first available session than the students enrolled in 2018. From this analysis the most important take away is the worsening of the performance in the academic year 2020/ 2021 which is

correlated with the Remote Teaching method. By the way in order to explain better the dependent variables considered for the two models it should be taken in consideration other important factors. The first that has been treated also in the first chapter is the application of Remote Teaching in a context of emergency, meaning that the switch from lectures in presence to lectures online did not happened gradually but instantaneously and for that reason it should be called Emergency Remote Teaching. The ERT is different from a Distance Learning due to the fact that the time of organization and programming the new type of lectures wasn't that much so it was more an adaptation for the present situation. Also another factor that should be considered is the Covid-19 itself. Indeed students, other than feeling more stressed out due to the limitation of social interactions and the presence of the general lockdown, may have been infected during the second wave of the pandemic causing a loss in attending lectures and difficulties in taking the exams. The last describe situation does not regard only students but it also regards the professors making for them very difficult to carry on the lectures efficiently. Last but not least, even if the Emergency Remote Teaching has seemed to be not that successful it has introduced a big change and a big opportunity in Teaching methodology. Improvements and studies on this alternative method could change the view of Universities and could take important benefits removing obstacles that affect both students and professors.

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APPENDICES

Table 1: Distribution of votes for the exam ISTITUZIONI DI DIRITTO PRIVATO class AL

votos	ISTITUZIONI DI DIRITTO PRIVATO AL		Percentages	
	"2018"	"2020"	2018	2020
18	8	10	16.33%	20.41%
19	2	0	4.08%	0.00%
20	4	6	8.16%	12.24%
21	1	4	2.04%	8.16%
22	4	2	8.16%	4.08%
23	2	3	4.08%	6.12%
24	8	3	16.33%	6.12%
25	4	9	8.16%	18.37%
26	6	3	12.24%	6.12%
27	1	3	2.04%	6.12%
28	3	2	6.12%	4.08%
29	0	0	0.00%	0.00%
30	5	3	10.20%	6.12%
31	1	1	2.04%	2.04%
	49	49	100.00%	100.00%

Figure 1: Graphs of the votes distribution for ISTITUZIONI DI DIRITTO PRIVATO AL in number of students(left panel) and percentages(right panel)

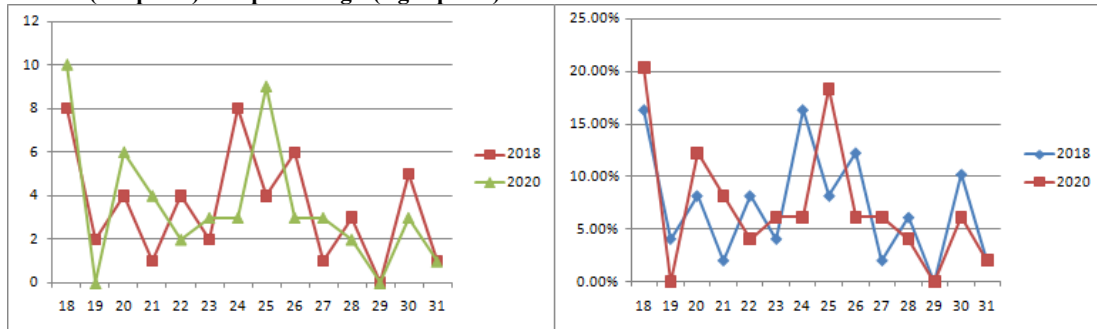


Table 2: Distribution of votes for the exam ISTITUZIONI DI DIRITTO PRIVATO class MZ

voto	ISTITUZIONI DI DIRITTO PRIVATO MZ		In percentuale	
	2018	2020	2018	2020
18	2	5	1.87%	8.20%
19	2	4	1.87%	6.56%
20	4	3	3.74%	4.92%
21	5	4	4.67%	6.56%
22	11	5	10.28%	8.20%
23	8	4	7.48%	6.56%
24	14	9	13.08%	14.75%
25	12	6	11.21%	9.84%
26	6	5	5.61%	8.20%
27	11	6	10.28%	9.84%
28	14	2	13.08%	3.28%
29	1	0	0.93%	0.00%
30	16	8	14.95%	13.11%
31	1	0	0.93%	0.00%
	107	61	100.00%	100.00%

Figure 2: Graphs of the votes distribution for ISTITUZIONI DI DIRITTO PRIVATO MZ in number of students(left panel) and percentages(right panel)

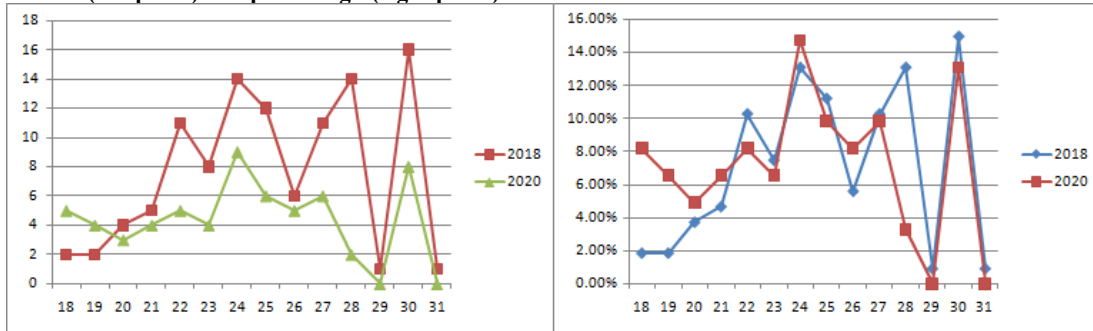


Table 3: Percentages of the votes for the two classes and academic year for the exam ISTITUZIONI DI DIRITTO PRIVATO

	voto	18	19	20	21	22	23	24	25	26	27	28	29	30	31
AL	2018	16.33%	4.08%	8.16%	2.04%	8.16%	4.08%	16.33%	8.16%	12.24%	2.04%	6.12%	0.00%	10.20%	2.04%
	2020	20.41%	0.00%	12.24%	8.16%	4.08%	6.12%	6.12%	18.37%	6.12%	6.12%	4.08%	0.00%	6.12%	2.04%
MZ	2018	1.87%	1.87%	3.74%	4.67%	10.28%	7.48%	13.08%	11.21%	5.61%	10.28%	13.08%	0.93%	14.95%	0.93%
	2020	8.20%	6.56%	4.92%	6.56%	8.20%	6.56%	14.75%	9.84%	8.20%	9.84%	3.28%	0.00%	13.11%	0.00%

Table 4: Distribution of votes for the exam ECONOMIA POLITICA class AE

ECONOMIA POLITICA I AE			In percentuale	
voto	2018	2020	2018	2020
18	3	6	3.85%	13.64%
19	4	4	5.13%	9.09%
20	7	5	8.97%	11.36%
21	6	5	7.69%	11.36%
22	2	3	2.56%	6.82%
23	3	5	3.85%	11.36%
24	8	3	10.26%	6.82%
25	8	0	10.26%	0.00%
26	10	4	12.82%	9.09%
27	3	3	3.85%	6.82%
28	7	2	8.97%	4.55%
29	5	0	6.41%	0.00%
30	2	1	2.56%	2.27%
31	10	3	12.82%	6.82%
	78	44	100.00%	100.00%

Figure 3: Graphs of the votes distribution for ECONOMIA POLITICA AE in number of students(left panel) and percentages(right panel)

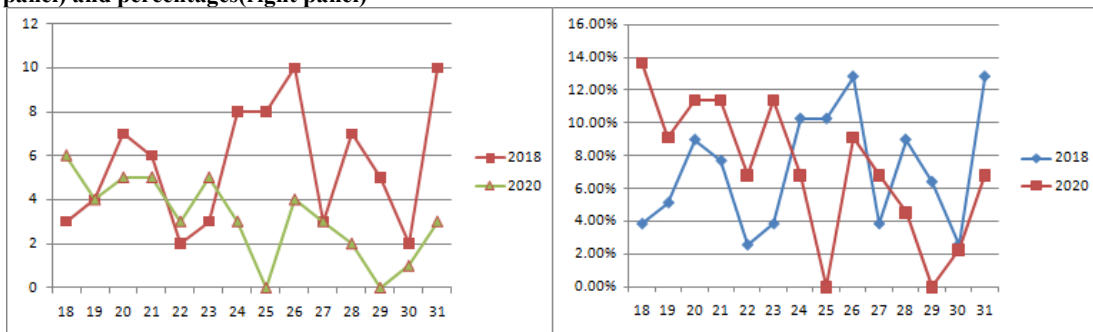


Table 5: Distribution of votes for the exam ECONOMIA POLITICA class FO

ECONOMIA POLITICA I FO			percentuale	
voto	2018	2020	2018	2020
18	4	7	5.56%	10.77%
19	3	2	4.17%	3.08%
20	5	6	6.94%	9.23%
21	3	7	4.17%	10.77%
22	6	7	8.33%	10.77%
23	7	7	9.72%	10.77%
24	5	6	6.94%	9.23%
25	7	5	9.72%	7.69%
26	4	5	5.56%	7.69%
27	5	5	6.94%	7.69%
28	2	2	2.78%	3.08%
29	4	2	5.56%	3.08%
30	7	2	9.72%	3.08%
31	10	2	13.89%	3.08%
	72	65	100.00%	100.00%

Figure 4: Graphs of the votes distribution for ECNOMIA POLITICA FO in number of students(left panel) and percentages(right panel)

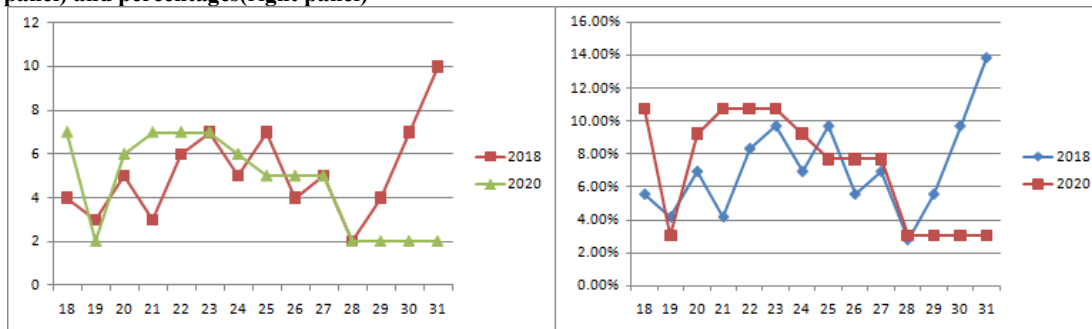


Table 6: Distribution of votes for the exam ECONOMIA POLITICA class PZ

ECONOMIA POLITICA I PZ			In percentuale	
voto	2018	2020	2018	2020
18	5	6	8.20%	12.50%
19	3	1	4.92%	2.08%
20	3	1	4.92%	2.08%
21	3	4	4.92%	8.33%
22	4	6	6.56%	12.50%
23	4	4	6.56%	8.33%
24	5	3	8.20%	6.25%
25	4	3	6.56%	6.25%
26	4	5	6.56%	10.42%
27	1	4	1.64%	8.33%
28	6	1	9.84%	2.08%
29	3	2	4.92%	4.17%
30	8	4	13.11%	8.33%
31	8	4	13.11%	8.33%
	61	48	100.00%	100.00%

Figure 5: Graphs of the votes distribution for ECNOMIA POLITICA PZ in number of students(left panel) and percentages(right panel)

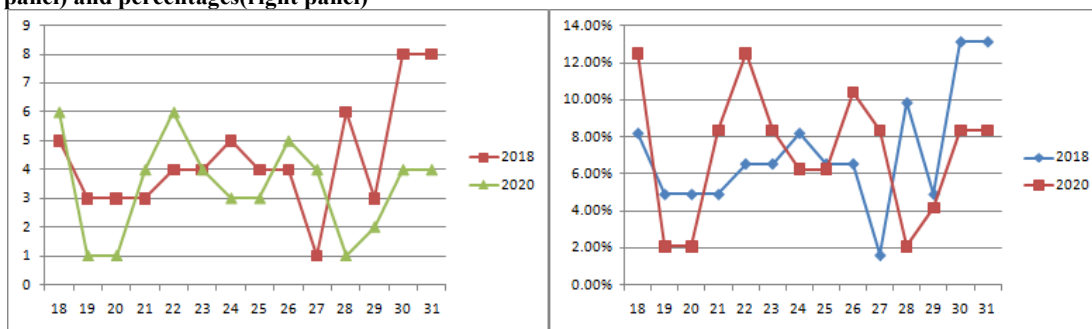


Tabella 7: Percentages of the votes for the two classes and academic year for the exam ECONOMIA POLITICA I

	voto	18	19	20	21	22	23	24	25	26	27	28	29	30	31
AE	2018	3.85%	5.13%	8.97%	7.69%	2.56%	3.85%	10.26%	10.26%	12.82%	3.85%	8.97%	6.41%	2.56%	12.82%
	2020	13.64%	9.09%	11.36%	11.36%	6.82%	11.36%	6.82%	0.00%	9.09%	6.82%	4.55%	0.00%	2.27%	6.82%
FO	2018	5.56%	4.17%	6.94%	4.17%	8.33%	9.72%	6.94%	9.72%	5.56%	6.94%	2.78%	5.56%	9.72%	13.89%
	2020	10.77%	3.08%	9.23%	10.77%	10.77%	10.77%	9.23%	7.69%	7.69%	7.69%	3.08%	3.08%	3.08%	3.08%
PZ	2018	8.20%	4.92%	4.92%	4.92%	6.56%	6.56%	8.20%	6.56%	6.56%	1.64%	9.84%	4.92%	13.11%	13.11%
	2020	12.50%	2.08%	2.08%	8.33%	12.50%	8.33%	6.25%	6.25%	10.42%	8.33%	2.08%	4.17%	8.33%	8.33%

Table 8: Distribution of votes for the exam SOCIOLOGIA ECONOMICA class AL

voto	SOCIOLOGIA ECONOMICA AL		In percentuale	
	2018	2020	2018	2020
18	10	6	9.62%	6.25%
19	6	5	5.77%	5.21%
20	5	7	4.81%	7.29%
21	6	5	5.77%	5.21%
22	3	6	2.88%	6.25%
23	5	6	4.81%	6.25%
24	9	7	8.65%	7.29%
25	8	9	7.69%	9.38%
26	7	13	6.73%	13.54%
27	10	8	9.62%	8.33%
28	10	9	9.62%	9.38%
29	8	5	7.69%	5.21%
30	9	3	8.65%	3.13%
31	8	7	7.69%	7.29%
	104	96	100.00%	100.00%

Figure 6: Graphs of the votes distribution for SOCIOLOGIA ECONOMICA AL in number of students(left panel) and percentages(right panel)

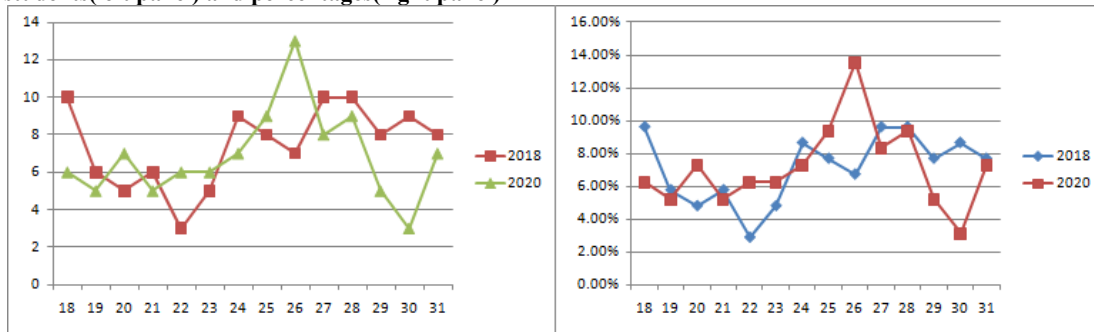


Table 9: Distribution of votes for the exam SOCIOLOGIA ECONOMICA class AL

SOCIOLOGIA ECONOMICA MZ		in percentuale		
voto	2018	2020	2018	2020
18	7	10	9.46%	11.11%
19	6	6	8.11%	6.67%
20	4	6	5.41%	6.67%
21	7	6	9.46%	6.67%
22	3	7	4.05%	7.78%
23	2	6	2.70%	6.67%
24	9	5	12.16%	5.56%
25	6	9	8.11%	10.00%
26	3	9	4.05%	10.00%
27	6	12	8.11%	13.33%
28	9	3	12.16%	3.33%
29	0	1	0.00%	1.11%
30	12	10	16.22%	11.11%
31	0	0	0.00%	0.00%
	74	90	100.00%	100.00%

Figure 7: Graphs of the votes distribution for SOCIOLOGIA ECONOMICA MZ in number of students(left panel) and percentages(right panel)

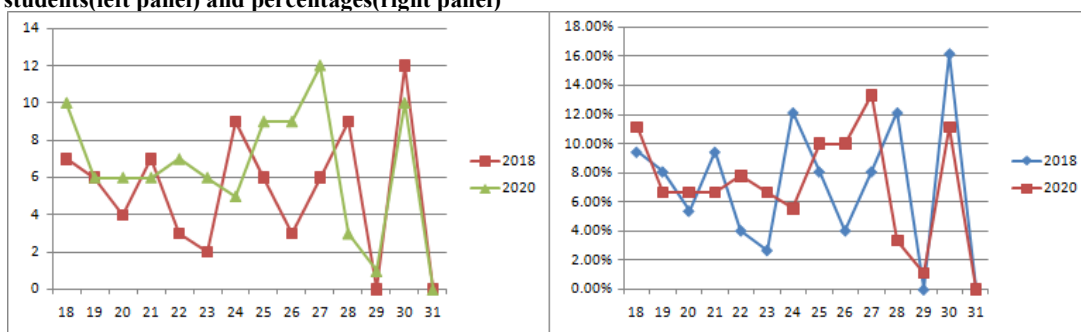


Table 10: Percentages of the votes for the two classes and academic year for the exam SOCIOLOGIA ECONOMICA

	voto	18	19	20	21	22	23	24	25	26	27	28	29	30	31
AL	2018	9.62%	5.77%	4.81%	5.77%	2.88%	4.81%	8.65%	7.69%	6.73%	9.62%	9.62%	7.69%	8.65%	7.69%
	2020	6.25%	5.21%	7.29%	5.21%	6.25%	6.25%	7.29%	9.38%	13.54%	8.33%	9.38%	5.21%	3.13%	7.29%
MZ	2018	9.46%	8.11%	5.41%	9.46%	4.05%	2.70%	12.16%	8.11%	4.05%	8.11%	12.16%	0.00%	16.22%	0.00%
	2020	11.11%	6.67%	6.67%	6.67%	7.78%	6.67%	5.56%	10.00%	10.00%	13.33%	3.33%	1.11%	11.11%	0.00%

Table 11: Distribution of votes for the exam STORIA DEL PENSIERO ECONOMICO

voto	STORIA DEL PENSIERO ECONOMICO		In percentuale	
	2018	2020	2018	2020
18	0	0	0.00%	0.00%
19	0	0	0.00%	0.00%
20	1	0	4.55%	0.00%
21	0	2	0.00%	15.38%
22	1	0	4.55%	0.00%
23	1	0	4.55%	0.00%
24	2	1	9.09%	7.69%
25	4	1	18.18%	7.69%
26	2	1	9.09%	7.69%
27	3	2	13.64%	15.38%
28	1	0	4.55%	0.00%
29	2	1	9.09%	7.69%
30	4	3	18.18%	23.08%
31	1	2	4.55%	15.38%
	22	13	100.00%	100.00%

Figura 8: Graphs of the votes distribution for STORIA DEL PENSIERO ECONOMICO in number of students(left panel) and percentages(right panel)

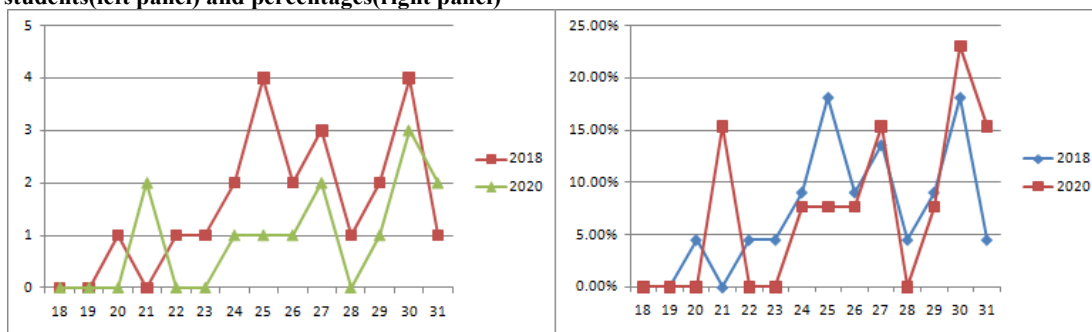


Tabella 11: Percentages of students passing at the first available session by exams

2018				2020			
ESAME	N.STUD SUP_1=1	TOT PER INSEGNAMENTO	% SUP_1=1	ESAME	N.STUD SUP_1=1	TOT PER INSEGNAMENTO	% SUP_1=1
ISTITUZIONI DI DIRITTO PRIVATO	156	547	28.52%	ISTITUZIONI DI DIRITTO PRIVATO	110	513	21.44%
ECONOMIA POLITICA I	211	547	38.57%	ECONOMIA POLITICA I	157	513	30.60%
STORIA DEL PENSIERO ECONOMICO	22	50	44.00%	STORIA DEL PENSIERO ECONOMICO	13	50	26.00%
SOCIOLOGIA ECONOMICA	178	496	35.89%	SOCIOLOGIA ECONOMICA	186	463	40.17%

