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The green and the dark side of distance learning: from environmental quality to economic inequality

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Abstract

We assess the impact of e-learning during the COVID-19 analyzing a sample of Italian university students. In particular, we point out how the subjective distance learning evaluation is determined according to: i) students' profile and different proxies of monetary incentives favoring distance learning, ii) pro-environmental preferences and iii) socio-economic concerns in the light of potential unequal access to digital learning resources. Our results show prominent the impact that green preferences have in fostering a post COVID-19 e-learning era, while some doubts on the potential future economic inequalities generated by an unequal access to educational resources are raised. From here, different policy implications are proposed to balance the pros and cons of distance learning, considering both social, financial, and technological factors.

JEL code: D6, H8, I24, 044

Key Words: distance learning, pro-environmental attitude; economic inequality; public policy

1. Introduction

Distance learning- i.e. learning happening without the physical presence of students and teachers in the same place- vehemently revolutionized the educational world at the aftermath of COVID-19 (Qazy et al., 2021). On the one hand, it has offered the possibility to introduce a resilient school system, able to combine quality in learning and digital system, breaking down the borders of internationalization (Apolloni et al, 2021). On the other hand, it has led to several open questions on students learning and satisfaction of such methodology (Chica et al., 2021; Chatterji and Li, 2021). Different studies proposed efficient solutions to improve the quality of this teaching approach, discussing strengths and weaknesses. For instance, Alzharani and Seth (2021) discussed how to develop tools and strategies to acquire familiarity with the methodology, and how to overcome potential perplexity on the digital interactive system. All these ingredients are used to discuss the future academic activities after the COVID-19 (De Angelis et al., 2020). Conversely, the opportunities and treats linked to future perspective of this approach has been scarcely investigated. In this paper, we address two points that are directly connected to the permanent future adoption of distance learning: the impact on i) the environment and on ii) future accessibility in labor market and then, future emergence of higher/lower socio-economic inequality.

Green Transition and Technological change

A radical technological change is essential for the green economy, requiring policy interventions in different socio-economic contexts. In the post COVID-19 world, this aspect has been remarked by the European Council, that has called for recovery through "green transition and the digital transformation" (European Council, 2020). It is then easy to include in this debate the potential role that digital distance learning might have in lessening climate change, favoring the sustainability of the entire economic system. Indeed, as reported in different studies (see, among others, Versteijlen et al., 2017), online education reduces the impact of carbon emission due to the impact of students and staff travel. It is then worthwhile to analyze whether students perceived this advantage and if their positive feedback in distance learning measures is based on such positive environmental externalities generated.

Equal access to opportunity and Socio-Economic inequality

The equality of opportunity is crucial in lessen future economic inequality (Corak, 2013). Considering the education, it is meant as the fair and equal access to a good quality education, regardless of their own family condition, making it possible to have success in the matter only on the basis of his own effort and ability (Maclean, 2003). As discussed in Piff et al. (2018), there might be structural barrier in education that might lead to higher social inequality. In the case of distance learning, there might be different barriers, such as (i) the heterogeneity of the technological instruments of both students (Mirza et al., 2018) and school system (González-Betancor et al., 2021), and (ii) pedagogical obstacles (Bashitialshaaer et al., 2021) due to a change in the didactic approach. Devkota (2021) firstly links these aspects to social inequality during COVID-19, discussing how a lack of proper infrastructure, policies and the absence of strong pedagogic support for students from disadvantaged and marginalized spaces might foster inequality. To this end, we analyze, from a student perspective, if this problem is perceived as real and greater enough to reconsider and counterbalance the positive environmental effect.

Literature demonstrated how these spheres are interrelated, since several studies figured out an inverse relationship between environmental quality and inequality (Wilkinson and Pickett, 2010; Islam, 2015). In particular, Marsiliani and Renström (2003) discussed how subjects suffering from lower living condition would claim for more effort in redistributive policies at the expense of public policies targeted at improving environmental quality. These findings might be adapted to our research hypothesis: whether subjects perceived as real the threat of higher inequality due to an unbalanced access to learning resources, they will weigh more the need to lessen future inequality, at the expense of the potential environmental benefits. We thus investigate this potential relationship collecting the individuals' perceptions about the impact of distance learning on social economic inequality and environmental change.

2. Data and Hypotheses

The sample was collected through a social media online survey conducted at the end of the second semester, on the 7th of June of 2021. A total amount of 2787 Italian students filled the form, mainly i) female (59%), ii) with an average age of 23 years old and iii) studying from different Universities across the Country (Nord=51%, Center=24%, South and Isles=25%). These characteristics are in line

with national data provided by different data sources.[1] All participants declared to have experienced distance learning, predominantly with live on-line lectures.

We measure the distance-learning overall evaluation (henceforth *DLE*) on a likert scale from 1 to 5, resulting with an average value of 3.4 (SD=1.4). As announced, we consider different subject characteristics which might be related with *DLE*. In particular, we consider personal factors and incentives, such i) as the distance from the University, calculated as the minutes needed to reach the place[2] and the type of students, distinguishing between full-time and part-time/working student.[3] Additionally, we collect information on the subject financial wellbeing (1-5 likert scale), living conditions (e.g. the number of housemates) and on the technological instruments at the disposal to attend on-line courses. In this case, we asked whether they share their device with other flatmates in order to attend lectures.

The environmental preferences (*EP*) are measured though the question: "*Distance learning might reduce the impact of climate change"*, while the expectation towards future socio-economic inequality (*SEI*) have been asked as follows: "*Distance-learning might create difficulties in equal access to labor market and then, it can enhance economic disparities".* Both questions are collected on a Likert scale from 1 to 5.

Drawing on the mentioned literature, we can formulate the following the hypotheses:

-H1. As starting point, we examine if diverse sort of students differently evaluate distance-learning (DLE). In particular, we expect that the higher the savings deriving from staying at home, such as a reduction of the traveling cost and the possibility to spend more time in other alternative activities (such as those of part-time students), the higher is the distance-learning evaluation (DLE).

-H2. Climate change benefit (EP) is positively associated with those appreciating distance-learning, who see it as a technological solution to stimulate the green transition.

-H3. In accordance with the theories relating the equal access to opportunity and the reduction of economic inequality, those offering a negative feedback to distance-learning see it as a penalty for

[1] See, for instance, https://www.istat.it/it/archivio/192693, http://ustat.miur.it/dati/didattica/italia/atenei, http://www.eurostudent.it/PDF/ottava-indagine-2016%e2%80%932018/mobile/index.html#p=111, https://www.almalaurea.it/sites/almalaurea.it/files/docs/universita/profilo/profilo2020/almalaurea_profilo_rapporto2020.pdf. Here it is possible to observe the higher share of female, students in Universities from North Italy with an average age of 23 years old.

[2] We organize a numerical variable ranging from 1 to 5, indicating respectively 1= less than 10 minutes, 2= 10-20 min, 3= 20-40 min, 4=40-60 min and 5= more than 1 hour.

[3] Students are also classified in on-site (31%), out-side (31%) and commuter (38%).

those facing difficulties in learning. Such inequality of (learning) opportunity might be reflected in higher economic inequalities (SEI).

3. Results

We ran three separate OLS regressions with different specifications, in order to test our three hypotheses. Table 1 outlines the main results. In particular, the first column identifies *H1*, where individual traits are employed to explain *DLE*; the second column identifies *H2*, where we include the pro-environmental benefits (*EP*) as explanatory variable. Finally, in column three we change the dependent variable since, following the existing literature, we hypothesize that potential unequal access to resources, proxied by the *DLE* variable, might explain the variation in the socio-economic inequality (*SEI*) indicator. Here, following a similar empirical strategy of Caferra et al. (2021), we remove the effect due to the other potential variable explaining both *DLE* and *SEI*, including the residual of the model estimated in column 2 as the new variable identifying DLE preferences (hereafter *DLER*) .[4]

	(1)	(2)	(3)
Dependent Variable:	DLE	DLE	SEI
Part-time student	.327***	.228***	-.12**
	(.056)	(.05)	(.061)
Traveling time	.134***	.073***	-.086***
	(.016)	(.015)	(.017)
Age	.063***	.05***	-.048***
	(.004)	(.003)	(.005)
Female	.133***	.029	.046
	(.041)	(.038)	(.044)
Financial wellbeing	.04	.047**	.015
	(.026)	(.024)	(.027)
Housemates	-.011	-.015	.017
	(.016)	(.014)	(.017)
Device sharing	-.16**	-.126*	.242***
	(.079)	(.073)	(.077)
North	-.12**	-.089**	.079
	(.05)	(.045)	(.053)
South and Isles	-.095	-.12**	.205***
	(.058)	(.053)	(.062)
Environment		.427***	-.217***
		(.017)	(.022)
DLER			-.437***
			(.023)
Constant	1.516***	.352**	4.703***
	(.15)	(.142)	(.17)
Observations	2787	2787	2787
R-squared	.142	.3	.221

*Table 1. OLS results. Robust standard errors are in parentheses *** p<.01, ** p<.05, * p<.1*

[4] For robustness, we repeat a similar empirical exercise by employing an ordered probit model, obtaining identical conclusions. Results are available upon request. We expose the result employing a simple OLS for at least three reasons: i) the easier interpretability of the results, ii) the absence of excessive skewness and the resulting appropriateness of the model, as it happens for similar studies employing likert scale (see, for instance, Ferrer-i-Carbonell and Frijters, 2004), iii) we easily obtain the residuals of the *DLER* measure.

As one can see from Table 1, the estimated results support our hypotheses. Regarding *H1*, from the first column it is clearly visible that diverse sorts of students differently evaluate distance learning (*DLE*). In fact, the *DLE* significantly increases among part-time students respect to the full-time ones, and among those who take more time to reach the university, namely who lives farther. We expected these results because some students could benefit from staying at home respect to travel to reach university, both in terms of monetary savings given the reduction of the travelling cost, and in terms of time saving given the possibility to spend more time on alternative leisure activities. The latter reason might also explain the relatively larger DLE among part-time students. Other significant determinants of DLE are the age and the gender status (female). In particular, the DLE significantly increases with age, and this could be explained since older students might have acquired a stronger university experience during the previous years. This leads them to tackle the distance-learning activities and exams in a relatively quieter and more experienced way respect to younger students, who instead still need to get confidence in the university environment and with exams. Another important result is that hardware availability matters: students who share their devices during distance learning periods evaluate it relatively worse than the one who do not share them. Moreover, the subjective familiar's financial wellbeing positively affects the DLE, although its coefficient is statistically significant only when we consider the environmental benefits perception as control variable. In general, DLE significantly varies across country's geographical areas. Furthermore, increasing the number of flatmates negatively affects the DLE, although this effect is not statistically significant.

As regards our second hypothesis, *H2*, the estimated coefficient *environment* confirms that environmental benefits are positively related with students who appreciate distance learning, since they might see it as a technological solution to stimulate the green transition.

From the last column, it is visible that also the third hypothesis, *H3*, is confirmed: considering SEI as dependent variable, it significantly decreases when the individual's distance learning evaluation (*DLER*) increases, once we took away the other potential variables effects on both *DLE* and *SEI*. Moreover, the concerns about the distance learning effects on socio economic inequality are significantly lower among older students, part-time ones, and across those who take more time to reach the university. Rather, these concerns are stronger for students sharing their devices and living in southern regions and isles.

A crucial insight of the estimated results is that the coefficient *environment* negatively affects the proxy of socio economic inequality at 1% level, supporting the empirical trade-off between environmental quality and inequality (Islam 2015). We focus on this negative relationship in the following figure 1, which shows the distribution of the individual differences between SEI and EP score. A net positive value indicates a prevailing concern on future economic inequality, conversely, a negative one evidences how subjects weight more the potential positive externality on the environment rather than future possible income inequality. Results confirm the evidence of the regressions: moving from lower to higher DLE score, we observe a monotonic increase of the environmental positive effect, while the weight of future socio-economic uncertainty is higher for low level of distance learning approval. This further

confirms the negative correlation that links environmental and inequality preferences (Marsiliani and Renstrom 2003).

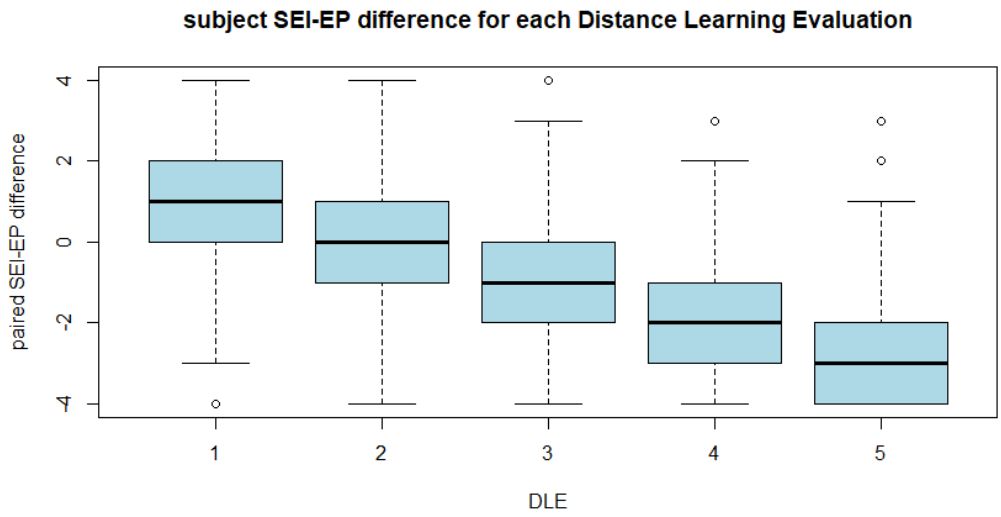

Figure 1. Distribution of the individual differences between the concern of increasing socio-economic inequality (SEI) and the opportunity of a climate change reduction (EP) for each level of Distance Learning Evaluation. T-tests report statistically significance at any level for each pairwise comparison.

4. Discussion and Conclusions

The impacts of a technological change could be essential in shaping the behavior and preferences of individuals, and they can differently affect production factors shares and, hence, the pattern of income level and its distribution (UN General Assembly, 2015; Van Reenen 2011). In fact, while some positive aspects can arise - as the positive environmental externalities mentioned- these might offset other potential priorities on the policy maker agenda -such as the reduction of income inequalities- and it is a policy maker's task to balance them in an efficient and socially desirable way.

Our results clearly show that diverse sort of individuals, although all students, differently evaluate the technological change (in this case represented by the distance learning) and that, according to the subjective perceptions, some negative aspects (potential rise in social and economic inequalities) may offset the positive ones (potential reduction of climate change).

It is not easy to balance these two aspects. Indeed, despite a lot of theoretical and empirical works attempted to grasp the relationship between income level and environmental quality (see, for instance, the well-known inverted U-shaped Environmental Kuznets Curve-EKC), it is not that clear which linkage ties together income inequality and environmental quality. One can argue that low pollution is obtained for higher level of economic development which, in turn, is characterized by low income

inequalities and higher level of well-being. Therefore, a sustainable growth and stable reduction of pollution goes through the crucial reduction of social inequalities. This is why, as discussed above, those suffering from higher inequalities prefer to investment in income redistributive policies (Wilkinson and Pickett 2010, Islam 2015). Hence, also for these reasons, the reduction of inequalities is becoming predominant in public policy goals, both at country and at international level (UN General Assembly, 2015). The reduction of inequality might be itself a policy that, in turn, will be reflected in future positive externalities: literature agrees on the fact that societies that are more equal have also smaller ecological footprints, recycle more, and their populations take less frequent flights, consume less water and less meat, and produce less waste (Wilkinson and Pickett, 2010).

In lights of our empirical results, which confirm that the negative relationship between environmental quality and inequality appears in subjects' preferences when they evaluate a technological change, it seems clear that, for public policy makers, it should be paramount to account for this trade off in setting the political agenda goals. All in all, it can be concluded that distance learning policies might have future perspective "without leaving anyone behind" and guaranteeing equal access to all the population classes since, in the opposite case, the expected positive environmental externalities would be neutralized by the flourishing of social inequalities, hence a consequent slowdown of the sustainable economic growth.

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