Effect Induced by the Covid-19 Pandemic on Students’ Perception About Technologies and Distance Learning

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Abstract This paper represents the first investigation conducted in Italy at university level to detect the effects induced on students by the swap of the educational processes from physical to fully virtual, caused by the Coronavirus epidemic. The study involved 101 students attending a bachelor course in Educational Science. The results show that, although students seem to miss physical settings and face-to-face activities, the sudden switch from physical to fully virtual setting has been positively absorbed. The overall emerging scenario indicates that a large part of the present generation of university students is ready for novel educational processes, largely grounded on blended learning activities. The results of this study, beside representing an historical documentation, question the nowadays organization of the physical learning ecosystems, that date to few centuries ago and suggest to re-think both their organization and functionalities.

Keywords Distance education · Distance learning · Perception about technologies · Smart learning ecosystems · Covid-19 pandemic

1 Introduction

Due to the rapid diffusion of the Covid-19 pandemic, a large part of the world is experiencing a lockdown that affected also all educational ecosystems [1]. The closure of the educational institutions affected more than 70% of the world’s student population [2] and in Italy is has been adopted since the beginning of March as a non-pharmaceutical intervention to contain the spread of the pandemic. Consequently, all didactic activities, suddenly, had to be transferred within virtual settings. The swap from physical to virtual has been quite fast: usually few days at university level, where
the decisions have been largely centralized; from one to few weeks in the schools due to several concurrent criticalities (lack of technical competences and support, lack of already available local or cloud webservices, lack of a vision and/or of an expert governance of “digital” aspects, etc.). One month after the lockdown, however, also the schools start to be almost fully operational, while at university we are already in the position to perform preliminary studies on the effects induced by the “swap to digital.” This situation can be considered, in fact, a unique “experimental setting” because without the pandemic it would not be ever possible to force institutions, professors and students to swap, in a so short time, from physical to virtual. We decided, thus, to investigate: (a) to which extend a shock like the abrupt swap of the educational processes from physical to fully virtual has been metabolized by students and (b) how, after one month, such shock has impacted on their opinions on distance learning. We decided, thus, to prepare a questionnaire and submit it to a consistent sample of students attending the bachelor course in Educational Science of the University of Rome Tor Vergata. This choice has been guided by the fact that such students are expected to work as educators in either schools, or social challenging environments or private companies. They have been deemed more motivated than other students to reflect on this new and unexpected situation and, thus, capable to fill a questionnaire with a sufficient level of commitment.

Due to the uniqueness of the “experimental setting,” we have no previous works or guidelines to refer to: the last disruptive pandemic was the Spanish flu that outbroke about one century ago and, at that time, Internet was far to be even imagined. In the literature, we were able to found only few papers devoted to the effect of pandemic outbreak on schools written during the Internet age—e.g., [3]—all dated at the time of the SARS (2003) and of the swine flu (H1N1-2009). Most of them deal with the closure of the schools as a “non-pharmacological” measure for the containment of the epidemic and do not consider learning processes and/or the effects induced by the use of technologies [4, 5]. Only in a one of them [6, 7], the author reports on “teachers’ perspectives about the role played by digital technology to meet the challenge presented by the closure of 1302 schools in Hong Kong.” The paper is based on eight interviews to teachers and narrates about the difficulties to adapt the learning strategies in an era (2003) where most of the potentialities of Internet were not yet fully exploited. At that time, still very relevant was the use of phone and post as communication channels, since many teachers did not feel trained enough to use Internet. At that time the use of this latter was dominated by email exchanges and forum just started to be perceived as a tool capable to support collaborative learning. With regard to the present pandemic, we have found only one recent paper dedicated to the effects of Covid-19 on education but it focus mainly on emergency policies, their implementation and the associated risks [8]. After the completion of this paper, an additional couple of preprints started to circulate but their focus is on guidelines to manage at best the process to swap to distance learning and, thus, not relevant to the present work.

In absence of any helpful guideline, we decided to focus the questionnaire on the following aspects: (a) the operational conditions; (b) the feeling about activities
and settings; (c) the change of perception about technologies; and d) the expectations for the future (e.g., about learning ecosystems and the individual professional placement). In the following, we will discuss the outcomes of the survey for each of such aspects, together with the implications that they may have for the future of the learning ecosystems and their smartness [9].

2 Experimental Setting

The questionnaire is composed by 40 questions and includes qualitative (open answer), quantitative (linear scale plus open comment) and multiple-choice questions. The questionnaire has been realized and made available, after one month from the lockdown, in an electronic form within the learning environment LIFE, because it was already in use to support the course on didactic technologies and all students were already registered in. The student-set that took part in the survey was composed by 101 elements attending the bachelor in Education Science of the University of Rome Tor Vergata. Almost all the students were women (98%) attending either first (15%), second (40%) and third year (46%) of the bachelor course; 40% were younger than 22 years old, 50% between 22 and 26 years old and the remaining 10% older the 26 years. The questionnaire has been filled anonymously.

3 Feelings About Operational Conditions

The first interesting effect of the lockdown is that laptops replaced smartphones as preferred device to connect and participate in online learning activities. As shown by Fig. 1 before the lockdown students, being free to get out of their home and most of the

![Fig. 1 Percentage of the devices used by the students to participate in virtual didactic activities](image)
time on move, preferred to connect mainly or exclusively by smartphone, 90%. After the lockdown, the percentage of students that continue to use also the smartphone reduced to 45% while that using also, or predominantly, a laptop increased from 53% to about 90%. Coherently, we observed also a decrease in the use of tablets and an increase in that of desktop computers, although the use of these latter can be considered nowadays overall marginal.

A large part of students, 65%, resulted to be engaged in online learning activities between 2 and 4 h, and slightly more than 70% think that the swap to distance education did not increase their working load. Indeed, some of them feel that they are sparing time: that usually spent in commuting and/or in waiting for lectures (due to a not optimized timetable of the face-to-face (f2f) activities). Most of the students did not feel to have undergone particular changes, either because some courses were already delivered in blended configuration or because a certain amount of teachers tend to reproduce the classroom dynamics, i.e., ex-cathedra lectures by mean of videoconference tools.

4 Feelings About Activities and Settings

The observations reported in the previous section already allow us to answer the first of our questions. Infact the lock-down and the closure of the campus did not shocked the students that, apparently, switched smoothly from a physical to a fully virtual educational process.

This is also due to the prompt answer of the learning ecosystem that in few days swapped between the two modalities (it is worth noting that the average swapping time for the Italian campuses has been one week). In our case, both the campus promptness and the quality of the technological setting were judged quite good (see Fig. 2), with a mean value of respectively 7.39 ± 0.14 and 7.22 ± 0.13 over 10. Also the technological and didactic adequacy of the teachers have been judged positively—respectively with a mean values of 7.22 ± 0.16 and 7.43 ± 0.15. The initial difficulties of some teachers to adapt themselves to the new technological setting have been noticed by the students and clearly affect the distribution shown in Fig. 3 (small peak at 5). On the other hand, teachers have been deemed capable to adapt promptly their didactics to the new situation although, in some cases, by simply reproducing the traditional classroom dynamics.

Students appear not to have experienced any technological barrier: about 90% of them declared that the digital skills they already owned were enough to swap to the new setting.

Although all—institution, teachers and students—reacted positively to the shock, most of the students start now to miss the physical setting, 7.28 ± 0.21, and declare to prefer face-to-face (f2f) setting with respect to the virtual one for all categories of didactic activities considered by our questionnaires, a feeling that increases in going from lessons to practice, to question time and, finally, exams, see Fig. 4.
The f2f contact with the teacher is still deemed very relevant, despite the possibility offered by videoconference tools to answer questions both publicly and privately. Also the large preference for f2f exams is somewhat surprising if one considers that one of the main concerns arisen by institutions against distance exams is the possibility for students to cheat. By analyzing the comments, one realizes that the main reasons to prefer f2f activities are: (i) the fear about possible malfunctioning of the connection; (ii) a possible reduction in concentration that could be induced by other concurrent stimuli; (iii) the concern about the coldness of the interaction with the teachers, due to the limited possibility to use the non-verbal cues of the human communication; this despite of the recognized comfort offered by connecting from home. As far as the distance exams, unexpected were the concerns about efficacy.
Fig. 4  Students’ preferences (%) about educational setting (distance versus f2f) for some categories of didactic activities

and correctness of the evaluation that are deemed to be higher in the case of f2f exams. These latter, moreover, are considered also as an experience capable to foster a personal growth. Possibly it can be ascribed, again, to the incompleteness of the virtual communication that is considered to prevent the establishment of a fully psychological contact and contract between student and professor. This is also the reason that makes students prefer largely f2f Q&A events. One may note, however, that during these latter the visual contact is often loosen because people switch off the camera to preserve “good” connections or preserve their own privacy.

These outcomes underline the need of additional efforts to develop further the communication cues offered by the online environments and justify, as well, the growing relevance assumed by the study on human–humanoid interaction.

Despite of the above criticalities, about 60% of the students declare that there are no f2f activities to which they cannot renounce to. Moreover when students have been asked which would be their preferred configuration for their future educational activities, only 32% indicate the f2f one; the large majority, 56%, indicate the blended one, while the fully online would be preferred only by 12% of the students.

This confirms the positiveness of the present experience that, although have been forced by the pandemic, allowed students to reflect on weaknesses and strengths of online activities that, now, start to be considered as a meaningful integration of f2f ones.

Among the strength of the online activities, the students indicate the comfort and the spare of time, the possibility to follow more courses than in f2f configuration, the avoidance of crowded halls and the impression to sit always in the first row, the straightforward availability of contents, the possibility to see again recordings also to counteract possible timetable overlapping, the possibility to interact in parallel with peers without disturbing the lesson (despite the possible payback of a loss of concentration).
5 The Change of Perception About Technologies and e-Maturity

As noted in the previous sections, a large part of the teachers were not fully prepared to redesign and adapt their didactic to the new situation. They are possibly lacking of an adequate pedagogical and didactic expertise to tackle with distance learning and, thus, as first answer to the emergency, tend to remain in their comfort zone and reproduce the standard transmissive f2f classroom dynamics (in fact $6.60 \pm 0.19$ over 10 is the mean value associated by students to the use of classical didactic dynamics during the delivery of online educational processes). Going into details, students ranked the activities carried on by teachers as follow: content sharing 83%, synchronous and asynchronous communication 50%, content production 47%, delivery of recorded lessons 42%, collaborative and team working activities 40%, delivery of real time lessons 37% and so on. Last in the ranking is the personalization of didactics, 4%. Not strange, thus, that students have only moderately changed their overall idea on the educational experience, in average $5.89 \pm 0.23$. Nevertheless, due to the parallel exposition to alternative approaches and strategies, the detected increase of interest for the didactic technologies is quite high, mean value $6.62 \pm 0.18$, as well as the perceived increase of their digital skills $6.80 \pm 0.16$, see Fig. 5. Possibly, this latter tends to influence the former.

The overall result is that students consider the use of didactic technologies very useful to increase the level of their digital-self, 72%, while less relevant is considered their contribution to the community building 40%, to the process management 39% and to learning efficiency 31%. Even less relevant is considered the support of technologies to the interaction (largely covered by other parallel communication channels), to the learning efficiency and to the quality of the educational experience.

![Fig. 5](image-url) Distributions of the students’ increase of interest in technologies (mean value ± standard error: $6.62 \pm 0.18$) and of the perceived level of their digital competences (mean value ± standard error: $6.80 \pm 0.16$)
With regard to the benefits that technologies may offer in improving learning activities, the answers of the students appear somewhat conservative and are certainly influenced by the teachers’ mainstream usage of the technological settings (see above). Coherently with the answers given to other questions, students ranked, in order of relevance, the support to: content sharing 78%, synchronous and asynchronous communication 50%, production of content 46%, collaborative and team working activities 44%. Less relevant is considered the support that technologies may provide to: diversification of the didactic approaches 39%, management of the processes 30%, self-evaluation 28%, planning of the processes 24%, evaluation and monitoring 24% and, at the bottom, support to personalization 13%.

*These results clearly demonstrate how relevant could be the preparedness of university teachers about digital pedagogy, that nowadays is, unfortunately, completely overlooked.*

Despite of that, students declared that applications and devices that up to the lockdown have been used only for amusement and socialization appear now very useful also in didactics, and that they start to glimpse new perspectives.

New applications/environments have been “discovered” and their functionalities appreciated. As a consequence, increasing skills in using the devices have been developed and laptops started to be used more frequently than before (see Fig. 1). Overall students got aware of new technological and individual potentialities. These are effects that have been reported also in [6, 7] from the school teachers’ perspective.

Getting more in details into the perceived increase of digital skills, the students indicate an increase in: the abilities to take part in virtual classes 58%, digital communication 53%, using digital tools to download, organize and share digital contents 45%, using collaborative working environment 44%, critical analysis and filtering of digital resources 39%, production of digital content 38%, video making 31% and photo elaboration 25%, knowledge representation 26%, managing personal spaces

![Campus e-maturity](image)

**Fig. 6** Distributions of the students’ perception on Campus e-maturity, detected during usual time, mid February (mean value ± standard error: 6.83 ± 0.11), and after one month of lockdown, first week of April (mean value ± standard error: 7.09 ± 0.15)
on the Web 22%, data treatment 19%, process planning 18%, evaluation 15%, use of online tools for the personal productivity 15% ... and so on.

A side, but not irrelevant, effect caused by the smooth swap of the learning process from physical to fully online is the observation of a meaningful increase of the perceived e-maturity of the campus: the mean value of the distribution, in fact, has jumped from $6.83 \pm 0.11$ to $7.09 \pm 0.15$ in less than two months. The e-maturity is actually a complex construct [10] that is determined by several factors—infrastructures, devices, competences of all relevant actors, services and processes, strategic vision—and can be also connected to the campus smartness [9]. Here, it has been evaluated only as a whole and compared with an equivalent overall evaluation that was provided by the students at the beginning of the semester (mid February, Giovannella unpublished).

6 Expectations for the Future Learning Ecosystems and Professional Placement

The landscape that emerges from the previous sections demonstrates, all in all, a positive acceptance and an equally positive attitude toward didactic technologies and distance learning. This is confirmed by the positive opinion they have about the impact generated by the didactic technologies on learning processes (mean value: $7.00 \pm 0.16$).

Such positive perception together with the self-perceived increase of digital skills has induced also a modification of students’ perspective about their working future. Before the forced swap to fully online learning activities, the students of the bachelor course in Educational Sciences indicated as target for their future job nurseries and kindergartens or critical social environments like family houses; only few units considered the possibility to work in distance learning. Now, after one month of forced online experience, the situation has changed quite a lot and working in distance learning is not consider any longer a taboo. Figure 7, in fact, shows there are at least 6% of the students that consider it as a very desirable opportunity (values of 9 and 10 on a scale of 10) while about 55% of the students (peaked between 6 and 8) consider it as a viable one. The amount of students that are not considering at all such opportunity is now very low (about 11%).

The increased interest for the working opportunities offered by the distance learning is possibly due also to the strong perception of sustainability of the online didactic processes developed during this forced experience: average value $6.92 \pm 0.15$.

As final provocation, we asked to the students if, and to which extend, universities and schools, in the future, could be replaced by their virtual counterparts.

Figure 8 shows that while the replacement of universities with virtual campuses is considered somewhat realistic by students, and by some of them even desirable (actually this is already a concrete possibility since few decades), as far as schools
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Fig. 7 Distribution of the students’ level of consideration for distance learning as their possible future working domain

Desirability of a future swap to fully virtual

Fig. 8 Distribution of the desirability of a future full swap from physical to fully virtual of university (mean value ± standard error: 5.70 ± 0.23) and schools (mean value ± standard error: 3.96 ± 0.22)

the opinions are highly controversial and a large part of the students thinks that it is not desirable at all. This latter is a very understandable and sharable position since children and, even more, pupils need physical environments and social relations to develop an equilibrated personality.

The point, thus, becomes: to which extend schools could go virtual and how progressively with the age of the students? A question that would imply also a detailed investigation on what activities could be transferred to virtual environments and/or supported by didactic technologies. It would be certainly very interesting and useful to explore such topic in the present lockdown conditions because it offers a unique real setting where one could observe criticalities and identify potentialities. However, such investigation goes beyond the limits and scope of this paper and it is left for future studies.
Here after having answered to our initial questions and verified that the swap from physical to fully virtual educational processes has not shocked the students but, rather, induced a higher appreciation of didactic technologies and distance learning, we can only speculate on possible future scenarios.

Probably universities and schools—as they have been designed accordingly to the Enlightenment principles and expectations of the industrial revolution, and handed down until today—need to be rethought. Despite some attempts to redesign the “physical containers” (building and halls) and transform them in “functional” spaces [11–13], a progressive transition toward a rationalized blended configuration of the activities has not yet been taken in serious consideration, neither the integration between institutional, home and other external spaces to compose an enlarged learning ecosystem. Efforts have been payed mainly to integrate digital devices into physical spaces and to dematerialize the administration. Considering another perspective, we may ask how much all present institutional physical spaces are really needed and, overall, in they need to be used as they are currently used. Probably, we can reduce their number and/or transform most of them in large co-laboratory, co-working and “co-gimm” spaces to be used only for activities that due to their intrinsic nature and/or social function should/could not go virtual. Of course we are also fully aware that schools, apart from their main educational function, have also to: satisfy the “children-parking” function to allow parents to work; exert a mitigation action on teenagers during their period of critical development; and, overall, act as a knot of what we may be considered the last physical territorial network that is still in place (provided that we still need one). Nevertheless we think that, while keeping in mind all societal needs, we should try to optimize the “phigital” spaces and try to support the progressive students empowerment toward self-regulation and full responsibility about their learning and development path. The increase of the percentage of distance learning activities, in fact, should go in parallel with an increasing level of student self-regulation and self-empowerment, that is with the development of skills and competences, rather that simply with the age. Unavoidably, this would imply also the transformation of learning processes and didactics. This latter should pay more attention to the transformation of knowledge and abilities in competences, rather than to the transmission of knowledges and procedures. Any attempt to go progressively virtual, however, will not be possible if we do not recognize that the access to the web should be considered a human and a student right [14] and that SDG4 [15] can be achieved only under such preliminary condition.

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