Distance Learning in Higher Education in France during the COVID-19 Pandemic Chapter 4

Sebastien Jacques, Abdeldjalil Ouahabi

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4.1 Introduction

Since the start of 2020, the 1,674,700 students enrolled in French universities, like all students in universities around the world, have seen their education totally disrupted by the unprecedented health crisis caused by the Covid-19 pandemic. Since 31 December 2019, the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has affected nearly 1 French person in 20 and unfortunately claimed the lives of approximately 2.4% of those infected; this percentage is of the same order of magnitude for European Union (EU) countries (ECDC Europe, 2021). Around the world, the year 2020 was marked by numerous periods of containment and sudden closures of schools and universities (e.g. for the first containment period, from the end of January 2020 in China and other Asian countries; mid-March in most European, American, and Middle Eastern countries; and the end of March in most African countries). Faced with this situation, teachers around the world have had to adapt and even reinvent themselves to deliver virtual courses, communicate with their students on social networking platforms, and sometimes learn on the job how to deliver quality distance education (Viner et al., 2020).

In the face of this unrivalled health crisis, countries around the world have had to come up with an educational continuity plan able to be implemented as quickly as possible (Reich et al., 2020). In the event of the temporary removal of students or school closures, pedagogical continuity plans are designed to maintain the pedagogical connection between teachers and pupils. The main objective is to preserve the knowledge already gained by the students while helping them acquire new knowledge. The stakes are therefore high and the need to provide quality education continues, despite the many difficulties associated with distance education, both synchronously and asynchronously. These include, but are not limited to, issues relating to: physical distance and socio-emotional support; support for students who are at risk of dropping out; the successful mastery of information and communication technologies (ICT); access to a stable and secure Internet connection; and access to appropriate computer equipment (e.g. computers, tablets, smart phones etc.). For example, on this last point, according to the Organization for Economic Cooperation and Development (OECD), 95% of students in Switzerland, Norway and Austria have a computer on which they can do their schoolwork; in contrast, just 34% of Indonesian students have access to such a device (Bol, 2020; De Quervain et al., 2020; Yulia, 2020).

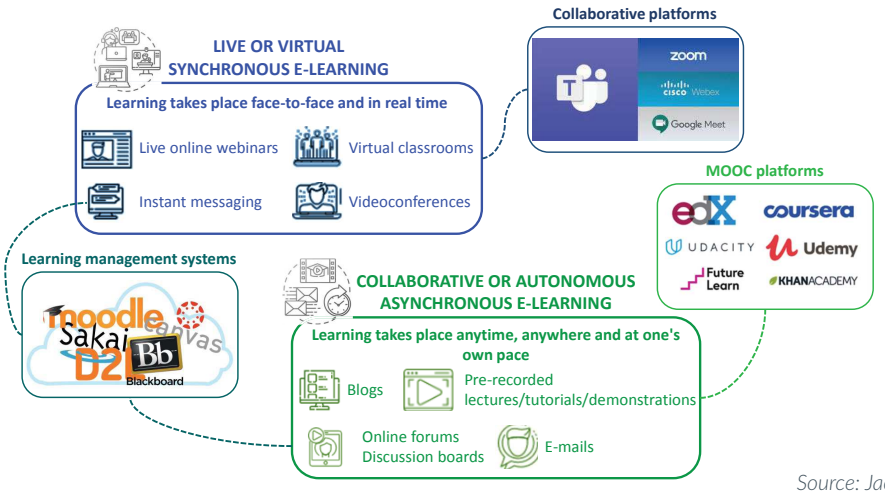
Thanks to the mobilization and unwavering commitment of the teaching and administrative staff, under the impetus of strong political incentives on both national and university levels, the vectors and tools used by educational teams have multiplied. These tools have included: websites; digital workspaces (DWS); email discussion lists; document sharing and homework management applications; group registrations for interactive applications; Padlet-type collaborative walls and other multimedia creation tools; videos; radio podcasts and online tutorials; and pedagogical challenges given via social networks (e.g. Facebook, Twitter) (Sistek-Chandler, 2020).

Today, a multitude of applications, platforms and educational resources are being used in higher education for both synchronous and asynchronous distance education (see Graph 1). Many classifications involving several categories have already been proposed in the literature.

As such, the following list, with illustrative examples, is by no means exhaustive (Henriksen et al., 2020):

- Digital learning management systems: one example is the globally supported open learning platform MOODLE (with more than 60 partners in the Asia-Pacific region, Europe and the United Kingdom, America, and Africa). During the Covid-19 pandemic, a wide range of activities (from the simple submission of documents, to forums, online exercises, and online chat etc.) have been offered to students.
- Massive open online course (MOOC) platforms, covering a wide spectrum of disciplines including engineering, medicine, economics, arts and culture etc. During the Covid-19 pandemic, nearly 200 higher education courses have been offered free of charge to students around the world.
- Self-directed learning content: one example is the Khan Academy's interactive platform, which since 2008 has delivered thousands of online tutorials covering many scientific fields for use by undergraduate students. During the Covid-19 pandemic, students from all over the world have been able to benefit from this platform.
- Collaboration platforms that support live-video communication: three good examples are Google Meet, Microsoft Teams, and Zoom. In fact, these two last tools were widely relied on in the study presented in this policy paper. Teams offers chat, dating, calling and collaboration features built into Microsoft Office software. Zoom, which can be used as a Teams application, is a cloud-based platform offering video and audio conferencing, collaboration, chat and webinars. Like the Proctorio platform, the use of Zoom in universities has raised many concerns, particularly in France, about both the confidentiality of the data it shares and how the tool is used, for instance, for the remote monitoring of exams.

Graph 1: Examples of applications, platforms and educational resources used for both synchronous and asynchronous distance learning



Source: Jacques et al., 2021

While the Covid-19 pandemic has accelerated the digital transformation of higher education, there are major issues concerning the quality of distance education, the learning process itself, and the evaluation of the knowledge and skills acquired over a distance. This policy paper is intended to provide some answers to these questions. The discussions proposed here are especially based on the qualitative and quantitative results collected in engineering schools in France.

The structure of this document is as follows. Section 2 looks at the development of digital skills in the face of the health crisis. In particular, in this section, we present the policy initiatives put in place, examine the perception of synchronous distance education, including virtual classrooms, within universities and, finally, describe the digital tools currently in use and the problems associated with the acquisition and evaluation of knowledge and skills. Section 3 presents feedback on how the health crisis was managed in French engineering schools during the first containment period (12 March 2020 to start of summer 2020). This analysis helps identify the problems faced by engineering students and to bring them to the level of authorities and university policies in order to improve their situation. Section 4 provides, for illustration purposes, a case study of the follow-up of approximately 100 electrical and mechanical engineering students during the first containment period. We detail the method established to ensure the effective acquisition and evaluation of knowledge and skills at a distance, and discuss the main results obtained. Section 5 presents conclusions and recommendations not to extol the virtues of distance education, but to reflect on common practices adapted to the sustainable and broadly accepted digital transformation of university education.

4.2 Developing of digital skills in the face of the health crisis

4.2.1 Political incentives in France

In France, in response to the unparalleled health crisis that has considerably affected higher education, the Ministry of Higher Education, Research and Innovation, from the first period of containment, i.e. declared on 16 March 2020, has made sure that the available training courses are built to be delivered over a distance. This pedagogical continuity must make it possible to support the good continuation of pedagogical activities, to ensure students are not penalized and, for teachers, to provide good teaching conditions. Although there have been many individual actions during this period, France has made available a digital toolbox containing three main pillars to meet the above challenges:

• "France Université Numérique" (FUN): We are particularly interested here in two digital platforms: FUN-MOOC and FUN Campus. Since 2013, FUN-MOOC is the French platform for MOOCs. It offers the best of higher education online through a rich catalogue of training courses designed by professors from universities, schools and their partners. Students can train for free, acquire skills interactively and above all at their own pace. FUN Campus, intended for HEIs, is implemented to enable teachers to deploy online courses as part of a curriculum and to integrate, for example, small private online courses (SPOCs) into their teaching practices.

• Virtual university: The Digital University is an association composed of six thematic digital universities in France. Its purpose is to provide teachers and students in HEIs, as well as their governance, with peer-reviewed digital scientific and educational resources that can be used in different pedagogical forms: the inverted classroom, enriched face-to-face, complementary resources, distance learning etc. In the vast majority of cases, these resources, which cover a wide range of fields (e.g. arts, economics and management, literature and languages, health and sport, engineering sciences, humanities and social sciences etc.), are easily accessible and free of charge. For the governance of HEIs, the concept of digital university is very important because it should enable them to support them in the development and implementation of their digital strategy/policy.

• Connected Campuses: Places labelled "Connected Campuses" are individual/collective work spaces where students can follow higher education courses at a distance near their homes, with local support. They aim

to help young people succeed in a higher education they would not necessarily have undertaken, by giving them the means to overcome geographical, urban and social barriers, without forgetting psychological barriers (e.g. self-censorship, fear of failure, ...), which create inequalities. This scheme's success is due to the personalization of the support: each student is supervised, motivated and supported by a qualified professional. Like the digital university, connected campuses offer numerous distance learning courses and certifications (BTEC Higher National Diploma, bachelor's and master's degrees) and all the main disciplinary fields are accessible (e.g. law, human and social sciences, engineering sciences, sciences and techniques of physical and sports activities etc.). The experiment, which began in 2019, involved 13 connected campuses accredited by the French Ministry of Higher Education, Research and Innovation. In February 2020, a new call for projects with a budget of EUR 25 million was launched in order to have 100 connected campuses by 2022 at the latest, with 25 projects being selected. In total, 33 connected campuses have been labelled and 31 are open and welcoming students in 11 regions.

4.2.2 Current perception of the virtual classroom in higher education

One key to successful distance education during the Covid-19 pandemic is the maintenance of strong interaction both between students and teachers and among students themselves. Many experiments recently reported in the literature show this level of interaction is much more intense in a virtual classroom, i.e. when distance education is conducted synchronously (Basilaia et al., 2020). The authors further explain that students may, in this case, feel less shy to ask questions when they are separated by the barrier of a computer tool. Some authors also note that distance learning can significantly reduce absenteeism. However, some forms of teaching, like practical work and projects, which require specific laboratory equipment, do not lend themselves well to distance learning. These authors also point out that in these cases, the quality of human interaction in a physical classroom is difficult to match in a virtual environment.

Despite the many positive points made about it, several authors indicate that the teaching style of virtual education must make use of various innovative methodologies to fully involve students and help them achieve the main pedagogical objectives, namely successful learning and the acquisition of relevant skills. The effort required by teachers to design effective virtual classrooms is huge and takes much more time than with face-to-face teaching.

Another extremely important point addressed in the literature concerns the management of knowledge assessments and measurement of class participation and attendance. In both face-to-face and distance learning, teachers need effective ways to measure their students' performance. This is usually done through the submission of homework, the administration of tests, exams and quizzes, and the creation of participation points. In a distance learning environment, table-top examinations and classroom participation and 'attendance' are more difficult to measure.

To conclude this section, distance education is not new – many prestigious universities around the world (e.g. in the USA, Europe, the UK, China, India, Australia, South Korea, Malaysia, South Africa) have been practising it for many years. What is new, however, is the extent to which universities are using collaborative digital platforms and online resources to teach both synchronously and asynchronously while ensuring their students remain motivated.

4.2.3 Overview of current digital tools for conducting virtual courses

Although originally intended for commercial applications, collaborative platforms such as Google Meet, Microsoft Teams and Zoom have been widely used around the world in recent years, particularly for the digital transformation of higher education. For example, Microsoft Teams, available on its own or as part of an Office 365 package, is a customizable collaborative platform that integrates many features, including: video conferencing; scheduling team meetings via Microsoft Outlook, as well as sharing contacts and emails; file storage and transfer with SharePoint; and note-taking using OneNote. Many applications, such as Forms and Zoom, can be directly integrated into the tool. As another example, the Zoom video

communication tool provides a remote conferencing service that combines video conferencing, online meetings, chat, and mobile collaboration using proprietary applications. This tool has pedagogical potential as it allows the creation of a virtual room accessible to a large number of participants and offers many features useful for the realization of an online course, including: the creation of a videoconference for a large number of participants; the ability to record a videoconference and chat, allowing students to learn at their own pace; audio and chat interactions; screen sharing with teachers; as well as content sharing, real-time co-notation, and a digital whiteboard.

Long before the health crisis brought by Covid-19, many authors were already emphasizing the integration into education of technological innovations in networking and communication. Microsoft Teams permits the creation of rich and functional learning environments where students play a proactive and constructive role throughout the learning process, as well as in/during all interactions in fully interactive computer-supported collaborative learning (CSCL) environments. Its use has become even more visible during the period of Covid-19, allowing us to also test the robustness of computer networks. Despite this, the use of Microsoft Teams is still in its infancy, especially in higher education. Crawford et al. point out that, with regard to the assessment of knowledge and skills, further study is needed to ensure that distance education does not degrade student performance. To this end, it is necessary to compare, for a given study programme and with classes of equivalent size, the performance of students in face-to-face and distance education. This is the chief motivation for the work presented in this policy paper.

The Zoom platform has been used by many universities around the world during the Covid-19 pandemic. This California-based application has seen its number of downloads grow drastically since March 2020. Nevertheless, it is now being criticized for its lack of security and shortcomings in terms of personal data protection. For example, on 26 March 2020 the American media outlet Vice revealed that the iOS version (Apple's operating system) of the application had, until recently, been sharing some of its users' personal data with Facebook without informing them – a practice the company immediately assured it had put an end to. Over the same period, the NGO Access Now asked Zoom to publish a "transparency report" on its policy for managing and sharing user information. Still, these examples have not prevented prestigious universities such as Harvard, Princeton and Stanford from widely using Zoom for all their students, in particular because of its simplicity and user-friendliness. In France, its use seems less systematic. On a case-by-case basis, it is often left to the discretion of teachers to work with the tool that suits them best, especially in classes preparing students for university entry. Yet, Zoom is clearly highlighted on the social networks of certain institutions, including the NEOMA Business School, the University of Evry, and the EM Normandie Business School.

To conclude this section, the choice of a distance learning tool relies on the balancing of sometimes contradictory criteria, including: efficiency, quality of service, data protection, parameterization possibilities for different types of user, user ergonomics, and cost. A particularly critical point concerns the organization of assessments of the knowledge and skills acquired by students. Several questions arise: Which are the best digital tools to use? How to ensure equity among students, in terms of both the provision of hardware and software resources and the examination conditions? Which measures are needed to protect personal and/or sensitive data? So many questions, as to which we will attempt to answer in the last part of this article.

4.3 Health-crisis' impact on distance higher education in 2020

4.3.1 Foreword

In this section, we analyse the results of a survey offered to engineering students in France by the National Office of Student Engineers; the survey aimed at sharing their experience and feelings on how the Covid-19 crisis had been managed by the 165 engineering schools since they had closed (Jacques et al., 2020). The 11,107 responses obtained are compared with recently published European and global data (Aristovnik et al., 2020), (Covid-19 Social Science Lab, 2021). In particular, we compare our results with those of our

neighbour Germany (although the number of responses there should be taken with caution), Europe's leading economic power, whose university education system is close to ours. As an indication, we also compare our results with those obtained on the global level, i.e. with the article by Aristovnik et al. who conducted a survey of 31,212 students from 133 countries and 6 continents.

After addressing the issue of students' access to computer resources, both hardware and software, we discuss how they feel about the shift from face-to-face to distance education. Students expressed their views on how universities and policies should manage this transition.

4.3.2 Access to computer resources

Table 1 shows that access to the Internet, as well as to hardware and software computing resources, was not only satisfactory in France during the period under consideration, but that the figures are, for example, comparable to those of our German neighbour.

Table 1 shows that 12.3% of French students felt their Internet connection was of poor quality, which had an impact on the conditions for distance education; 2.6% of students did not always have a computer available; 5.9% of the engineering students considered they did not have all the software required for the smooth running of the teaching activities (in half the cases, for technical reasons: insufficient computer performance and problems accessing licences and with installation).

Table 1: Access to computer resources – Comparison between data from engineering schools in France (Jacques et al., 2020) and the literature (Aristovnik et al., 2020)

Percentage of students with access to a personal, professional or shared computer	Percentage of students with an adequate Internet connection	Percentage of students with access to software needed to conduct educational activities
97.4% (engineering students in France (11,107 responses collected))	**87.7%** (engineering students in France (11,107 responses collected))	**94.1%** (engineering students in France (11,107 responses collected))
98.0% (higher education students in Germany (between 200 and 500 responses collected))	**81.0%** (higher education students in Germany (between 200 and 500 responses collected))	**91.0%** (higher education students in Germany (between 200 and 500 responses collected))
84.0% (higher education students worldwide (17,192 responses collected))	**59.0%** (higher education students worldwide (17,192 responses collected))	**73.0%** (higher education students worldwide (17,192 responses collected))

Source: Jacques et al., 2021

4.3.3 Transitions between face-to-face and distance courses

Table 2 reveals that 27.4% of the engineering students (see Q1 in Table 2) found the shift from distance education to face-to-face teaching too abrupt. There are two main reasons for this. The first relates to the ability to work and concentrate. Indeed, nearly 59% of the students (see Q2 in Table 2) consider they are less effective in distance than in traditional courses. The second relates to workload; 23.4% of the students surveyed (see Q3 in Table 2) consider that the workload is much less important when over a distance and they therefore lose all motivation to continue their training.

Despite all the measures put in place to ensure the pedagogical continuity of higher education in France (see Section 2), students feel they lack information from their professors, universities and national institutions. Of the engineering students surveyed, 19% consider they had not received enough information about continuing their studies during the Covid-19 pandemic, with 45% thinking the imposed measures should have been more thorough.

Table 2: Transition between face-to-face and distance courses

	1 (Not good at all)	2	3	4	5 (Perfectly good)
Q1–How did students experience the sudden transition between face-to-face and distance education?	**7.8%**	**19.6%**	**35.9%**	**26.2%**	**10.5%**
Q2–How did students perceive their ability to work and concentrate at a distance compared to traditional courses?	**20.0%**	**38.8%**	**21.4%**	**15.4%**	**4.4%**
Q3–How did students perceive the workload of distance education compared to traditional courses?	**7.6%**	**15.8%**	**28.8%**	**27.6%**	**20.2%**

Sources: Jacques et al., 2020; National office of student engineers, 2020

4.4 Case study of a French engineering school

4.4.1 Research objectives

Although the Covid-19 health crisis reveals the critical need for digital technologies in many areas, particularly in higher education, three key questions arise, which may be formulated as follows:

- How can we ensure that the knowledge presented through a distance learning course is of sufficient quality?
- How can we make the distance learning process as smooth as possible for all parties involved (i.e. students and teachers)?
- Which are the best tools for assessing knowledge and skills acquired over a distance and how can we guarantee their relevance?

This section of the policy paper aims to provide a qualitative and quantitative assessment of the tools put in place in engineering schools during the current global health crisis to make sure of the quality and continuity of higher education pedagogy (Jacques et al., 2021). The feedback is complemented by an assessment of the students' knowledge and skills. To this end, about 100 students in the field of electronic and mechanical engineering from the University of Tours in France were monitored for several months. The objective was to discuss the relevance of the evaluation of the knowledge and skills acquired by the

distance students. We accordingly compared the distributions of the results obtained by the students in the face-to-face and distance courses. Finally, the feelings of these students were analysed at the end of the distance education period and the results were compared with currently available national data.

4.4.2 Methodological aspects

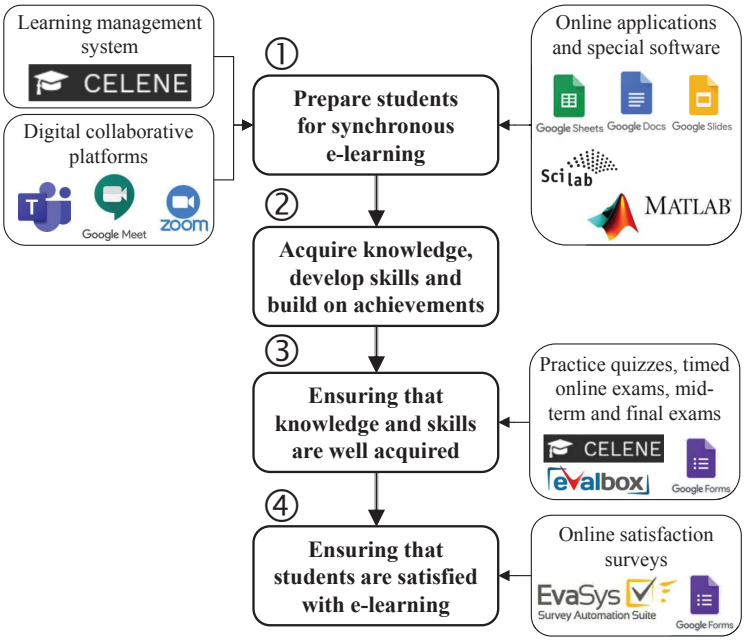
The research presented in this case study was conducted with the participation of 97 first-, second- and third-year students in electrical and mechanical engineering at the College of Engineering of the University of Tours, France. These engineering students were divided into four groups; each group took a specific course given by distance learning. Group 1 (26 students) and Group 2 (26 students) each took a course in engineering sciences. Each of these two courses consisted of lectures, tutorials and practical work; the latter did not require the use of specific materials and therefore lent themselves well to distance learning. The 16 students in Group 3 took a course in numerical analysis, mainly taught in the form of practical work using appropriate computer tools available free of charge online. Finally, the 29 engineering students in Group 4 carried out a project on the design and construction of an electronic system for audio applications. Confronted with the unprecedented health situation, the students did not have access to the school premises, let alone all the laboratory equipment needed to design their final project. As a result, attention was focused on applying an analytical approach to the design of the architecture of such an electronic system. They were also able to apply what they had theoretically seen in their teaching of project management (e.g. definition of milestones and deliverables, team management).

Before starting the experiment, a survey was sent to determine the proportion of engineering students with sufficient computer equipment and software to take the various courses through synchronous distance education. The survey results showed that only 8.2% of the students felt they did not have adequate computer equipment (e.g. personal or shared computers, graphics tablets and smartphones) to comfortably take these courses at a distance. Besides, just over 6.2% of the students surveyed felt they lacked much of the software they needed to participate in synchronous e-learning. These figures (below 10%) are of the same order of magnitude as those obtained on the national level (see Table 1).

The approach to remote knowledge acquisition and assessment described in this case study entails four key phases (see Graph 2):

- Phase 1: Preparing students for distance learning. This phase consists of giving each student access to different collaboration platforms (i.e. CELENE, Microsoft Teams, and Zoom), as well as online applications (Google Drive) and specific software (MATLAB, Scilab).
- Phase 2: The actual learning phase, during which pupils are expected to acquire knowledge, develop skills, and build on their achievements. The first two groups tested a teaching method that sees the reversal of the traditional pedagogical sequence “Lectures; Tutorials; then Practical Work”. The third group benefited from a traditional approach to university education. The fourth group carried out a project; at least, only with regard to the functional definition of the system and organization studied (milestones, deliverables, team management).
- Phase 3: Assessment of knowledge and skills through synchronous knowledge tests
- Phase 4: Student evaluation of the distance learning experience through online satisfaction surveys

Graph 2: Proposed method for the remote acquisition and evaluation of knowledge



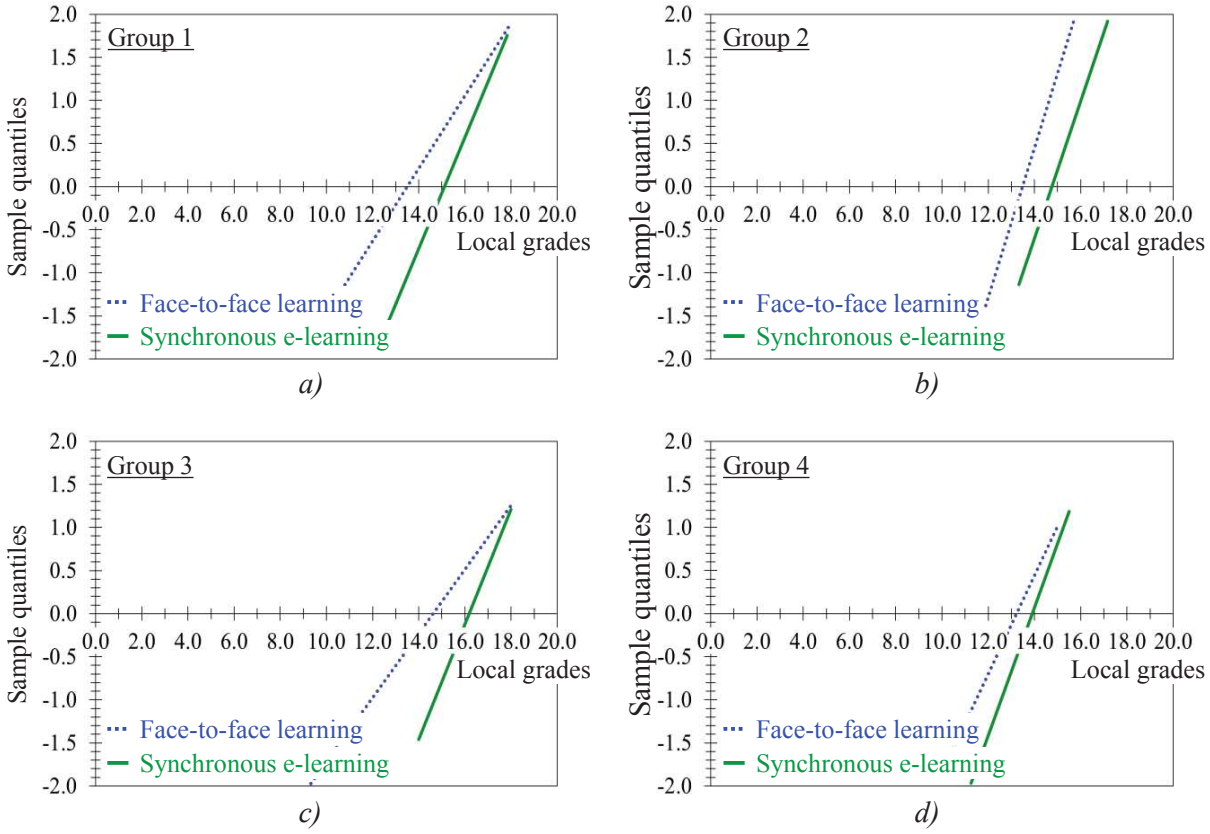
Source: Jacques et al., 2021

4.4.3 Main results

Graph 3 shows the distribution of local scores (from 0 to 20, with 0 being the lowest and 20 the highest) for the four groups of engineering students who took the distance education (see the solid green line in each graph in Graph 3). The results for each group are compared with the results of a class of equivalent size that took the same course, but face-to-face (see the dashed blue line in each graph in Graph 3). Regardless of the groups, the results in Graph 2 show that synchronous distance education does not degrade the performance of engineering students. On the contrary, and this is evident for groups 1, 3 and 4, the consistency of student performance is closer (i.e. the standard deviations of the local grade distributions are much smaller).

Finally, the 97 students completed a satisfaction survey to assess the quality of their distance education (see Table 3). The questions asked concerned the teaching itself (clarity of the course, prerequisites, content, selected illustrations), its organization (coordination of teaching activities, preparation for knowledge evaluation), the teacher (dynamism, mastery of distance learning tools, interactions between teachers and students) and the general satisfaction of engineering students. The results in Table 3 reveal this experience was overwhelmingly positive and that only 2% of the 97 engineering students surveyed were not completely satisfied with the quality of their distance education experience. The results in Table 3 show that 2% of the 97 students surveyed were not entirely satisfied with the method used to ensure the quality of their engineering education at a distance. Although these results are overwhelmingly positive, four points of vigilance were identified by students: the dynamism of synchronous e-learning, the coordination of pedagogical activities, exam preparation and the interaction between students and teachers. The last point is moreover one that has been broadly identified at the national level, i.e. by the 11,107 students of the 165 French engineering schools (National Office of Student Engineers, 2020). Indeed, distance generates significant difficulties in conducting group work, such as projects, especially when students do not have access to specific laboratory equipment.

Graph 3: Comparison of student performances in face-to-face and synchronous e-learning: a) Group 1 (26 students); b) Group 2 (26 students); c) Group 3 (16 students); d) Group 4 (29 students)



Source: Authors calculation based on valid responses.

Table 3: Satisfaction survey results (97 responses collected)

Attributes	CA*	A*	D*	CD*
1. The syllabus for this teaching was clearly presented	77%	23%	0%	0%
2. The prerequisites for this teaching were clearly presented	68%	32%	0%	0%
3. The content of this teaching has been adapted to your knowledge	64%	35%	1%	0%
4. This teaching was presented in a stimulating and motivating manner	47%	41%	12%	0%
5. Coordination between lectures, tutorials and practical work was not difficult	59%	40%	1%	0%
6. Illustrations (i.e. exercises, case studies and practical work) were sufficient	56%	44%	0%	0%
7. Instructions for preparing knowledge assessments were clear	68%	30%	2%	0%

Attributes	CA*	A*	D*	CD*
8. You have been well prepared for the various knowledge assessments proposed by your teacher	44%	52%	4%	0%
9. The skills demonstrated by your teacher are unquestionable, despite the distance	64%	36%	0%	0%
10. Despite the distance, your teacher was available and listening	73%	27%	0%	0%
11. Your teacher seems to have mastered digital tools at a distance	77%	23%	0%	0%
12. Despite the distance, the interaction between teacher and students was quite good	62%	28%	10%	0%
13. You are generally satisfied with the quality of the education provided	52%	46%	2%	0%

Note: *CA: completely agree; A: agree; D: disagree; CD: completely disagree

Source: Authors calculation based on valid responses.

Regarding the dynamism of synchronous e-learning, the students participating in the project insisted that this form of education did not lend itself to distance learning, even synchronous, because they could not build and test the functioning of their electronic system. Nevertheless, they stressed that a functional analysis was crucial before designing and dimensioning an electronic system. With regard to the coordination of the different pedagogical activities, the students pointed out the sometimes overloaded agendas that mixed many activities of the same nature on the same day. With respect to the evaluation of knowledge and skills, only the final exams were questioned. Intrusive methods, involving remote control of students' materials, were very poorly perceived. The survey results show the students attach great importance to the trust placed in them by the teachers. An examination format where the student composes on a topic for a limited time and the student must hand in the assignment in a drop box seems to be a solution to be further explored.

To conclude this section, the findings described in this case study show that the question of how best to undertake knowledge assessment and distance learning is a real headache. Distance necessarily implies a relationship of trust with students because it is almost impossible to control the conditions in which individual work is carried out unless artificial intelligence is used. Several approaches are currently being explored to help teachers assess student performance, including: stopping all assessment; focusing on self-assessment; developing a portfolio of skills to be acquired at the end of a course; and developing online quizzes (accessible via smartphones, tablets and computers) before the start of each course (for example, the Wooclap tool has been made available by the University of Tours).

4.5 Conclusion

Since the beginning of 2020, in the face of the Covid-19 pandemic, which notably led to the widespread closure of universities, and under the impetus of academic and political authorities, educational teams and students around the world have radically played a major role in accelerating the digital transformation of higher education. To maintain close student–teacher interactions, virtual classrooms have therefore become a reality, but without a genuine consensus on the pedagogical practices to be implemented to ensure quality teaching. The studies described in this policy paper confirm that certain pedagogical forms, such as lectures and tutorials, lend themselves well to synchronous distance learning. On the other hand, practical work and projects must be conducted face-to-face for both material (e.g. access to laboratory or specific equipment) and psychosocial reasons (e.g. to maintain social contact between the students themselves, as well as between students and their teachers).

With respect to the assessment of the knowledge and skills acquired by distance students, the case study proposed in this policy paper shows that distance education does not reduce the performance of engineering students. Indeed, they achieve local scores similar to those expected from face-to-face teaching. The results of the various satisfaction surveys reveal that the 97 engineering students participating in this study are generally satisfied, especially when the forms of education do not require practical implementation.

With the emergence of variants of the virus, it is clear that the current global health crisis is far from over. Thus, distance education will continue to grow. The widely shared observation is that blended learning can offer many opportunities and the great flexibility required for tomorrow's higher education. Still, its implementation will not be possible without an efficient and local IT helpdesk (i.e. within each teaching chair), in particular for access to computer networks, for troubleshooting computer equipment, for access to virtual machines, for the implementation of new digital technologies etc.

4.6 Recommendations

The challenges of digitization of higher education concern digital sovereignty and control of learning data; questions especially arise about the nature of educational content, the control of learning data and the necessary openness of systems. There are also economic issues in a world in which we want to preserve access to education for all, regardless of budgetary constraints. Finally, there are the challenges of digital training throughout life, underlining the importance of generic or transversal skills that enable people to adapt, to learn to learn.

This policy paper intends to contribute to this by actively formulating seven recommendations grouped under three main themes: research, digital training, and public action.

Recommendation 1. Developing Scientific Research Projects: Digital Technology for Academic Success:

There are many areas around academic achievement where digital science research could bring benefits, including engaging students in the learning process through computer-based approaches. The first question is how to promote academic success. It should be answered by developing research programmes in connection with cognitive, educational and digital sciences based in particular on AI, automatic language processing, robotics, and virtual/augmented reality with a view to developing learning environments adapted to individual characteristics and even more clearly for people with academic adaptation needs, especially according to their disability situation.

Recommendation 2. Develop Rigorous Methodologies for the Evaluation of Digital Education:

Digital inclusion has been achieved without any evaluation of its impact on learning or in experiments of too limited scope. There is hence a need to develop multidisciplinary research leading to rigorous studies producing robust results on the effects of digital literacy. Another limitation of some research on the effects of digital literacy is its a posteriori evaluation, trying to compare situations with and without the use of technology. The development of educational digital education has relied on technological developments sometimes achieved through collaboration between digital and education actors.

Another point is the evaluation of students using remote digital tools. This issue remains the weak point in the use of digital distance learning, although the integration of artificial intelligence (AI) technologies is tending towards an acceptable solution (Adjabi et al., 2020), (Adjabi et al., 2021).

Recommendation 3. Training Teachers in the Digital Technologies of Tomorrow:

The training of teachers must allow for the development of their digital culture and development of their digital skills for different age groups and professions.

Recommendation 4. Towards a 'Civic and Popular Digital University' Capable of Training Everyone in the Digital World:

Digital training is a civic issue that must give rise to actions aimed at developing digital culture and skills.

Recommendation 5. Create Conditions for the Development and Maintenance of Digital Educational Resources as a Common Good:

It is necessary to create educational common goods that are modular and based on resources that are free and able to be modified by the actors of education. These resources must be indexed in order to facilitate their use by teachers.

Recommendation 6. Guaranteeing the Portability of Personal Educational Data and Developing the Interoperability of Software Solutions, and Providing Optimal Hardware Solutions:

The legal aspects relating to the portability of personal data in the field of education must be arranged. In addition, it is important to ensure that students and teachers are equipped with top-of-the-range equipment in terms of computers accompanied with high-end peripherals (headphones, lighting, graphics tablets), sensors (microphones, cameras etc.), 5G or even 6G wireless networks.

Recommendation 7. Transitional Provisions: A Hybrid Education System:

Lectures and tutorials will be given over a distance, but projects and assignments will be done in person.

4.7 References

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