An exploratory study on the emergency remote education experience of higher education students and teachers during the COVID-19 pandemic

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Abstract
The COVID-19 pandemic situation has pushed many higher education institutions into a fast-paced, and mostly unstructured, emergency remote education process. In such an unprecedented context, it is important to understand how technology is mediating the educational process and how teachers and students are experiencing the change brought by the pandemic. This research aims to understand how the learning was mediated by technology during the early stages of the pandemic and how students and teachers experienced this sudden change. Data were collected following a qualitative research design. Thirty in-depth and semi-structured interviews (20 students and 10 teachers) were obtained and analysed following a thematic analysis approach. Results provide evidence on the adoption of remote education technologies due to the pandemic with impacts on the education process, ICT platforms usage and personal adaptation. The emergency remote education context led to mixed outcomes regarding the education process. Simultaneously, ICT platforms usage was mostly a positive experience and personal adaptation was mostly a negative experience. These results
INTRODUCTION

On 31 December 2019, China reported to the World Health Organization (WHO) an outbreak of a new coronavirus type (WHO, 2020a). Human to human transmission was identified shortly after, with Li et al. (2020) positing that “considerable efforts to reduce transmission will be required to control outbreaks.” In March 2020, WHO declared COVID-19 a pandemic and urged countries to take urgent and aggressive action (WHO, 2020b).

Following these developments and to avoid the quick spread of COVID-19, while continuing the academic year, educational institutions worldwide started to cancel face-to-face (F2F) classes and began the switch to remote classes (UNESCO, 2020). In April 2020, more

Practitioner notes

What is already known about this topic

- The COVID-19 pandemic has pushed the world's education environment into an unstructured, emergency remote education process.
- There is a lack of understanding of how ICT tools mediated learning during pandemic's early stages and how actors experienced this sudden change.
- In technology-mediated learning contexts, participant beliefs, knowledge, practices and the environment mutually influence one another and affect the lived experience.

What this paper adds

- The paper identifies and characterizes the educational process, the technological tools used in this new educational setting and personal adaptation of higher education students and teachers during these unprecedented times.
- The results show the following: an increase in teacher–student interaction (outside classes), new opportunities and content development; difficulties in control evaluation fraud, constraints in attaining the desired learning outcomes and lack of training; resilience to adapt and adopt the new technologies, despite the negative personal experience lived in terms of productivity, motivation, workload and mental health.

Implications for practice and/or policy

- The paper makes evidence-based recommendations on how higher education institutions can leverage this experience to prepare for future disruptions and increase the use of ICT tools in their regular learning environment.
than 1.5 billion students, representing 91.3% of the total enrolled learners, in 194 countries, were affected by the COVID-19 pandemic (UNESCO, 2020).

In higher education the impact of the pandemic was equally grievous. Globally, 91% of higher education institutions reported that in-person teaching had been replaced or was in process of being replaced, by remote activities (Marinoni et al., 2020). Information and communication technology (ICT) progress supported the shift from F2F to remote learning in higher education institutions, avoiding a more considerable interruption in the education process during the pandemic. This change was already underway before the pandemic, with research indicating that an educational model based solely on classroom interactions is becoming outdated (Ally & Prieto-Blázquez, 2014). Despite online learning (OL) being already adopted in some higher education institutions, for others, such adoption was a complete novelty that entailed many challenges. The uniqueness of OL during the pandemic relates to what Watermeyer et al. (2021) call ‘afflictions’ derived from the rapid and complete transition to online provision and early ‘entry-level’ use of digital pedagogies. This emergency transition brought many challenges, and research is already underway to analyse the impacts of the COVID-19 pandemic in educational institutions, mainly regarding the challenges and opportunities that arose from this emergency (Adedoyin & Soykan, 2020; Dhawan, 2020; Lassoued et al., 2020). Namely, it is of critical importance to evaluate the experience with emergency remote education (ERE) in higher education institutions to inform the design of future, well-planned, distance or OL efforts (Hodges et al., 2020).

This research contributes to the understanding of the extraordinary and emergency reality caused by the COVID-19 pandemic in higher education and captures the unique moment where higher education institutions engaged in an ERE situation. Furthermore, this research contributes to the context, input and process evaluation of the ERE, that are especially relevant to inform the design of future learning efforts by higher education institutions (Hodges et al., 2020). Therefore, framed by technology-mediated learning (TML) (Bower, 2019), this research aims to identify and characterize the educational process, the technological tools used, and the personal adaptation of higher education students and teachers who experienced an emergency in education for the first time. From this understanding, it is discussed how higher education institutions can leverage this experience to prepare for future disruptions and increase the effective use of ICT tools in their regular educational process.

LITERATURE REVIEW

Remote education in an emergency context

Over the last decade, ‘education in emergencies’ (EiE) has been advanced as a new and legitimate core of the humanitarian crisis response, advocacy and scholarly work (Aguilar & Retamal, 2009; Burde et al., 2017; Versmesse et al., 2017). Burde et al. (2017) conclude that school attendance is critical before other interventions can occur because conflict reduces education access. Crisis drive alternative learning systems such as accelerated learning programmes, community-based education and temporary learning spaces to support EiE. Research shows that providing students with structured, meaningful and creative activities in a school setting or informal learning spaces improves their emotional and behavioural well-being (Ager et al., 2011; Berger & Gelkopf, 2009; Kostelný & Wessells, 2008). Group activities in a school-like setting represent an important healing tool (UNESCO, 2003) and may redirect students’ energies and anxieties to acquire knowledge and skills. However, a significant body of literature in EiE focuses mainly on primary or secondary education groups in settings where the educational physical infrastructure is severely affected. This includes the
impact of natural disasters, such as Hurricane Katrina (Gardner et al., 2007; McCullar, 2011),
earthquakes (Wolmer et al., 2005) or armed conflicts, such as the Syrian war (Hos, 2016).

The COVID-19 pandemic crisis, on the other hand, has not affected the physical infra-
structure of education institutions, as in an armed conflict or a natural disaster, but caused
an unexpected worldwide disruption of traditional teaching and a learning methods migra-
tion (Adedoyin & Soykan, 2020). In the most similar situation in recent history, the H1N1
pandemic, research found a lack of preparedness of higher education institutions for OL
(Meyer & Wilson, 2011). However, the conceptualization of this learning method migration is
not consensual. OL is deeply rooted in adequate planning and instructional design and has
several available theories and models. However, the migration process of higher education
institutions to OL becomes questionable because these processes witnessed the absence
of adequately planning, design and development of online instructional programs due to
the pandemic (Adedoyin & Soykan, 2020). Hodges et al. (2020, p. 7) pointed out that “the
distinction is important between the normal, everyday type of effective online instruction and
that which we are doing in a hurry with bare minimum resources and scant time: emergency
remote teaching”. According to Mohmed et al. (2020, p. 2), emergency remote teaching
“comprises ultimate exploitation of the available remote teaching tools for delivering the
curriculum or educational materials that would normally be delivered physically or as hybrid
or blended courses [...].”

Within the scope of this article, considering our interest in teaching and learning during
this unprecedented time, this phenomenon is referred as ERE. This migration from F2F to
ERE came with several challenges and opportunities. One major issue is that the migration
has caused a compulsory modification in the attitudes of education administrators, instruc-
tors and learners on the significance of ERE (Ribeiro, 2020). Among ERE system major
disadvantages are the lack of direct interaction and communication between the teacher
and the learner. This is consistent with Lassoued et al. (2020) four categories regarding the
major barriers and obstacles to achieving quality in ERE under the COVID-19 pandemic:
(a) personal (self-imposed obstacles which indicate the students' resistance and rejection);
(b) pedagogical (obstacles conducting tests and the evaluation of electronic exams or ob-
taining feedback for identifying the weaknesses and strengths of students); (c) technical
obstacles (weak internet speed, security and confidentiality of data, piracy in websites); and
(d) financial and organizational obstacles (lack of capabilities to communicate remotely, and
the difficulty of obtaining computers by some students). This is also in line with Watermeyer
et al. (2021) regarding teachers' negative feelings and experiences about migration from F2F
to ERE during the pandemic, eg, preparedness, confidence, support from the institution, ac-
cess, impact on workload, afflictions, and affordances. Noticeably, the lack of faculty online
technology readiness and the disruption transitioning to online teaching are reported by sev-
eral studies as the main challenges in adopting technology for teaching in blended and OL
environments (Brown, 2016; Cutri et al., 2020; Hung & Chou, 2015; Rasheed et al., 2020).
Moreover, Adedoyin and Soykan (2020) summarize the challenges of this digital transforma-
tion during the COVID-19 pandemic for higher education institutions: (a) compatibility gap
of OL in some disciplines cannot be effectively and efficiently applied (remote laboratories
limitations for sports sciences, engineering and medical sciences); (b) technology (outdated
technological devices with accessibility problems); (c) academic performance of students
might be affected by racial, economic and resource differences, (d) while the majority of
students are digital natives and tech-savvy, the larger part of instructors were not effectively
ready to deliver high-quality instruction remotely; and (e) regulate and control evaluation
cheating is more complicated, strongly suggesting a considerable modification of grading
systems (Flaherty, 2020).

Additionally, Gillis and Krull (2020), while assessing the students' perceived barriers in-
hibiting the success of each course, find these are mostly associated with the following: (a)
COVID-19 (unmotivated, distracted, anxious, unmotivated mental health, sleeping troubles, personal finances worries and medical care access); (b) academic or course change (fewer opportunities for peer discussion and questions, unmotivated pass/fail option, and insufficient flexibility of coursework); and (c) new living situation (distraction and privacy concerning the new workspace or no dedicate workspace). This personal constraint concerning the new living situation is related with the unexpected appearance or interruption by family members, friends and or pets that may cause disruption or diversion of ERE participants' attention during the educational process (Adedoyin & Soykan, 2020), as some students have no dedicated workspace or separate OL studio/library (Gillis & Krull, 2020). Furthermore, instructional techniques (such as, Live Zoom lecture; Live Zoom discussion, individual worksheet/lesson, forums, small group video chat) are regarded by students as accessible rather than effective and less enjoyable (Gillis & Krull, 2020). These findings are also in line with Dhawan (2020) regarding radical transformation's weaknesses and challenges in all aspects of education. This quick and sudden digital transformation process of higher education institutions brought a huge workload (eg, full migration into external applications, increased tolls and communication overload) and added stress for teachers and students, leading to negative effects on their academic performance or, ultimately, on their mental health.

Technology-mediated learning theory

In this paper, based on Bower (2019, p. 1036), “the term ‘technology-mediated learning’ is used to imply that technology is how information is conveyed and people are linked together. For instance, when an educator designs a diagram on a computer and places it online for later interpretation by students on their laptop or smartphone, the communication act is entirely facilitated through digital technologies, and without the mediation of the digital technologies the communication and any associated learning would not occur.”

Bower's (2019) TML theory is an integrated and holistic theoretical framework that can be used for developing and analysing situations where technology mediates learning. Regardless of presenting a clear specification of the assumptions and premises for regular educational settings, TML can frame the understanding of this extraordinary ERE experience. TML proposes seven premises (P1–P7) to frame how technology mediates learning: (P1) digital technologies can perform a mediating role for participants in their attempts to achieve learning goals; (P2) participant beliefs, knowledge, practices and the environment all mutually influence one another (these premises impact, for example, on how teachers utilize technology to enhance learning, the design of learning environments, the skills expected); (P3) the role of the teacher in the process of creating effective learning tasks, resources and environment, the ‘designing for learning’, needs to be in a way that helps students achieve the learning outcomes that will be assessed; (P4) the affordances that provide functional options to users (eg, media access control elements), as well non-functional affordances (eg, reliability, aesthetics, usability and technical performance) can affect learning interactions between participants; this leads to (P5) the way in which modalities are used and combined influences the way in which meaning is processed, interpreted, created and interrelated (the multimodality effects that due to our limited information processing capacity, can cause a state of ‘cognitive overload’); (P6) the way in which technology is used to mediate interaction patterns and possibilities between networks of participants by enabling learners to contribute and share their ideas online; and (P7) the development of ‘communities of practice’ where participants mutually engage, jointly enterprise and share their repertoires within and beyond a course, resulting in a strong sense of presence and community, engagement or social connection.
Given the ERE situation that higher education institutions have faced, where the education process started to be entirely mediated by technology, TML brings a suitable theoretical framework to structure this research, as is described in the next sections.

METHODS

Qualitative research is especially suited to explore new topics where existing knowledge is still scarce (Creswell, 2013), such as ERE during the coronavirus pandemic. To understand how the learning was mediated by ICT tools and how students and teachers experienced this extraordinary learning context, a qualitative study based on semi-structured in-depth interviews was conducted. Within a qualitative approach, the goal of the research is to “rely as much as possible on the participants’ views of the situation” (Creswell, 2013, p. 24), guided by a flexible interview protocol that allows the researchers to collect open-ended data and explore participant thoughts, feelings, and beliefs about the topic (Cohen et al., 2018; Corbin & Strauss, 2008; Creswell, 2013).

Sample

A total of 20 students and 10 teachers from Portuguese speaking countries (Portugal and Brazil) enrolled in institutions that engaged in an ERE were interviewed, following a convenience sampling process. Students are mostly female, aged between 18 and 25 years old, from Master’s and Bachelor’s degrees, in different academic fields, such as engineering, applied sciences, Arts, and health sciences. The majority of teachers are also female with ages ranging between 26 and 50 years old. Both students and teachers are heavily using ICT platforms for communication purposes (e.g., lectures and meetings), followed by learning managing systems, content edition, and streaming, to name the most cited. Also, interviewees use ICT platforms for social networking and engagement, to overcome social distance imposed by the pandemic. Details regarding the full sample are depicted in Table 1.

Data collection

Constrained by physical distancing, most interviews were conducted remotely (23), and seven were conducted F2F. As it was also difficult to recruit interviewees because of social distancing and remote work, a snowball sample technique was employed, where one respondent suggested other respondents to be interviewed afterward (Goodman, 1961). Data were collected between 29 April and 9 June 2020, thus covering the initial process of adapting to the new teaching and learning format adopted by higher education institutions where the interviewees attend or teach classes. Each interview took, on average, 30 min. Bearing in mind the basic democratic principle that individuals have a right to make a free choice over if they want to contribute to a study or not (British Educational Research Association, 2011), the participants freely chose to participate in the research. They made clear their consent to record the interviews for further analysis and the 30 interviews totaled 15 hr and 37 min of recorded data.

TML theory (Bower, 2019) assisted the preparation of the interview scripts. For example, through the question “What do you think about this shift between face-to-face education to remote education?” for both students and teachers, it was possible to identify the participants’ positioning concerning the new learning environment (related to Premise 2). Premise 3, for example, helped to understand how teachers were using student feedback to improve
| Characteristics                  | Teachers | Students |
|---------------------------------|----------|----------|
| **Age**                         |          |          |
| 18–25                           | –        | 12       |
| 26–50                           | 7        | 8        |
| 50+                             | 3        | –        |
| **Gender**                      |          |          |
| Female                          | 6        | 11       |
| Male                            | 4        | 9        |
| **Residence country**           |          |          |
| Brazil                          | 4        | 8        |
| Portugal                        | 6        | 12       |
| **Field**                       |          |          |
| Applied social sciences         | 2        | 6        |
| Arts                            | –        | 2        |
| Engineering                     | 1        | 10       |
| Exacts sciences                 | 2        | –        |
| Health sciences                 | 2        | 2        |
| Human sciences                  | 3        | –        |
| **Ongoing degree**              |          |          |
| Bachelor                        | NA       | 9        |
| Masters                         | NA       | 10       |
| PhD                             | NA       | 1        |
| **Institution**                 |          |          |
| Universidade do Porto<sup>a</sup> | 2    | 12       |
| Instituto Politécnico do Porto<sup>a</sup> | 3 | – |
| Universidade Católica Portuguesa<sup>a</sup> | 1 | – |
| Universidade do Minho<sup>a</sup> | – | 1 |
| Pontifícia Universidade Católica do Paraná<sup>b</sup> | 1 | 1 |
| Centro Universitário Salesiano<sup>b</sup> | 1 | – |
| Centro Universitário Maurício de Nassau<sup>b</sup> | 1 | – |
| Escola de Ensino Superior do Agreste Paraibano<sup>b</sup> | 1 | 3 |
| Universidade Regional de Blumenau<sup>b</sup> | – | 1 |
| Centro Universitário de João Pessoa<sup>b</sup> | – | 1 |
| Centro Universitário UDF<sup>b</sup> | – | 1 |
| **ICT platforms**               |          |          |
| Communication (Zoom, Microsoft Teams, Google Meet) | 10 | 20 |
| Learning management systems (Moodle, Blackboard, Corujito) | 9 | 20 |
| Content edition (Microsoft PowerPoint, Excel, Word) | 6 | 10 |
| File management (Google Drive, Microsoft OneDrive, WeTransfer) | 2 | 8 |
| Engagement (Kahoot, Mind Master) | 2 | 2 |
| Social networks (Instagram, LinkedIn) | 2 | 4 |
| Streaming (YouTube, TED Talks, Netflix) | 4 | 3 |
teaching through the question “What are you doing to keep students interested in your classes?” Aiming to identify which technologies were being used and how to apply them, as suggested by Premise 4, teachers were asked, “How are you teaching your classes?” and for students, “Can you explain to me how you are attending your classes?”. The scripts used to guide the interviews are available in Appendix A.

Data analysis

Interviews were transcribed, and data analysis was supported by the software NVivo12 following a thematic analysis approach (Braun & Clarke, 2012). Data collection and analysis proceeded concurrently to ensure that insights from data analysis could support further data collection. The first author of this study performed the initial open coding of the data collected and, collaboratively with the second author, developed the axial and theoretical coding (Charmaz & Belgrave, 2015). As a result, themes of first, second and third order emerged, supported by TML theory (Bower, 2019) that was applied as a theoretical framework. TML offers a holistic framework to structure the categories that emerged from the thematic analysis, as depicted in Figure 1. Following a member–check procedure (Birt et al., 2016), a synthesis of the results was presented to eight interviewees that were available for this follow-up. These interviewees recognized their own experience in these results, without proposing any significant change.

Based on the thematic analysis performed, the ERE can be characterized by three main themes: (a) educational process, that describes how the interaction between students and teachers unfolded in this emergency context; (b) ICT usage, referring to the experience with the ICT tools that mediate the teaching and learning process; and (c) personal adaptation, that focuses on the changes on student and teacher’s practices, and their personal feelings. In the middle, the ICT platforms are detailed in Table 1. Following this structure, the next section presents the results of this study.

RESULTS

The main themes that emerged from studying students and teachers’ experience during the COVID-19 pandemic are related to the educational process, ICT usage, and personal adaptation. As previously mentioned, TML grounded the interviews' script and the results of this study. Table 2 shows the relation between the dimensions found through the thematic analysis and TML’s premises, definition and coding frequency of each theme.
Educational process

*Educational process* focuses on how the teaching and learning process was changed and adapted to the ERE. As can be seen in Table 2, this theme encompasses several dimensions, namely, *evaluation, teacher–student interaction, outcomes, opportunities, class content, and training*.

The *evaluation* of students was arguably one of the most impacted aspects of the education process during the ERE, as teachers faced the prospect of widespread student fraud. Despite the increase in continuous assessment during the semester, it was still necessary to have final exams. However, teachers had difficulties in avoiding unethical behaviour by students during the exams. Teachers faced a lack of dedicated ICT solutions to control fraud and had to resort to ad hoc solutions, such as reducing the available time for solving exams and developing more elaborate questions. This considered that students had greater access to information since they were outside the classroom and without F2F supervision.

They have no time freedom during the exam, they are all at the moment, online, for 90 min taking the exam, at a specific time as if they were inside a room. This is an improvement in control, why? Because each student is busy, each student has 90 min to take his test and no more, which is tight, so you cannot be there wasting time giving information to others. (Human Sciences teacher, about Evaluation)

However, this approach clashed with students, as they considered unfair this change.

I don't think it was enough time. Let's say they ... there is a clear possibility that we can consult the material because we are at home, but even so, it is not enough 15 minutes to elaborate an answer and write ... and to be able to put all the knowledge. It was a lot of pressure. (Master Applied Social Sciences student, about Evaluation)
| First-order themes       | Second-order themes (TML's premise) | Definition                                                                 | Teachers | Students |
|-------------------------|-------------------------------------|---------------------------------------------------------------------------|----------|----------|
| Educational process     | Evaluation (P3)                     | Challenges regarding the students’ assessment in the ERE setting           | 10       | 20       |
|                         | Teacher-Student Interaction (P6)    | Changes in the interaction between teachers and students                   | 10       | 20       |
|                         | Outcomes (P3)                       | Impacts of the ERE environment on the desired learning outcomes           | 7        | 18       |
|                         | Opportunities (P6)                  | New opportunities and lessons learned that arise from the ERE experience  | 7        | 12       |
|                         | Class content (P3)                  | Need to adapt the class support material due to ERE adoption              | 8        | 4        |
|                         | Training (P2)                       | Need for additional training to cope with the changes in the learning environment | 2        | 5        |
|                         | ICT usage                           |                                                                           |          |          |
|                         | Privacy (P2)                        | Issues related to privacy breaches caused by the ICT tools used           | 9        | 19       |
|                         | User experience (P4)                | Perceptions regarding the interaction with the ICT platforms              | 8        | 18       |
|                         | Reliability (P4)                    | Concerns regarding the consistent performance of the ICT platforms        | 8        | 15       |
|                         | Platform Features (P5)              | Richness of the features available on ICT platforms                       | 6        | 10       |
|                         | Resilience (P4)                     | Continuity of the learning process enabled by the ICT platforms           | 1        | 4        |
|                         | Personal adaptation                 |                                                                           |          |          |
|                         | Technology adoption (P2)            | Ease of adoption of new technologies                                       | 10       | 19       |
|                         | Productivity (P2)                   | Changes in personal productivity due to the remote learning environment   | 7        | 18       |
|                         | Motivation (P2)                     | Perception of motivation felt in the pandemic context                     | 6        | 16       |
|                         | Workload (P2)                       | Perception of workload due to the change in the learning environment      | 6        | 16       |
|                         | Health (P2)                         | Concerns regarding personal health                                        | 5        | 10       |

Note: N = 30 interviewees (10 teachers and 20 students).
Regarding the teacher–student interaction, it was greatly impacted by the new setting. Interestingly, this impact was both positive and negative. From the positive perspective, during this period, teachers showed greater availability to take students’ questions, both by providing more time by expanding the communication channels available for this purpose. Consequently, students had quicker and better feedback for their questions.

From a negative perspective, although some platforms facilitate the classroom dynamics, teachers and students reported a lack of interaction and human contact. Since most of the time students had their cameras turned off, teachers could not understand if they fully understood the content being taught. Small details such as facial expressions that express doubts, that were easily perceived in F2F classes, were not observable in this technology-mediated setting.

Seeing students' faces, which is something I miss in the classroom … because when we teach in class we can see on their faces, frowning, a semblance of doubt … (Applied Social Sciences teacher, about Teacher–student interaction)

On the part of the students, interaction is hampered by the fact that they are unable to find the appropriate window of time to ask a question or comment on the subject being taught now. Students also reported a strong feeling of shyness in front of the cameras, mainly when the transmission of the classes was recorded.

There are subjects that the teacher really is sometimes talking to only one person, and the rest are all silent, without a camera. (Master Applied Social Sciences student, about Teacher–student interaction)

This led to both teachers and students considering remote learning as a more impersonal way of teaching, while F2F teaching is viewed as a more involving and enriching interaction.

The desired outcomes of the education process were also impacted, as students faced a poorer experience than what they had envisioned. Laboratorial courses were especially frustrating for students as they were anticipating the opportunity to manipulate equipment that was not materialized in the remote learning environment.

My course, like some others, feels this cut of practical classes a lot, because it is an important component in the training of certain professions. (Master Engineering student, about Outcomes)

However, teachers and students could also identify new opportunities. Namely, this was a period of digital transformation, where teachers and students discovered new ways to improve the balance between their personal and academic life and increase the learning opportunities. For example, by allowing the organization and participation in webinars with people from other institutions (including foreign ones) that would not participate in such activities if they were conducted F2F.

It gives us the opportunity to have a seminar with a person who is in another place, to have more access to other people, more material … (Master Applied Social Sciences student, about Opportunities)

Besides the interaction problems, as the shift to ERE happened fast and unexpectedly, teachers did not have the necessary training with the remote education environment. This lack of training was clearly perceived by students and mainly impacted the teachers who are not
familiar with this environment before, as the remote classes do not have the same flow as F2F classes.

I mainly identify the fact that these teachers did not have any type of training. (Bachelor Engineering student, about Training)

Finally, considering the remote environment where the classes took place, teachers needed to adapt their class content to a remote environment (e.g., add more detail and interactivity to the slides).

I have tried to make the slides more textual, small paragraphs so that when they get the material, they at least have a place to study when they are looking for a subject. (Applied Social Sciences teacher, about Class content)

**ICT usage**

*ICT usage* encompasses the experience associated with the technological tools used in the remote education environment, and encompasses privacy, user experience, reliability, available platforms and resilience. Despite some platforms presenting a vulnerability related to the privacy of users' data, in general, the interviewees felt safe and carefree related to the use of digital tools for teaching and learning purposes.

I think the students felt comfortable, I also didn't feel that there were any major security problems at all levels, so for now I don't think it's going wrong. (Human Sciences teacher, about Privacy)

Regarding the user experience, the ICT platforms used during this period were considered organized and intuitive, which greatly facilitated their quick adoption. However, the number of available platforms damaged this experience as the interaction changed across platforms. As such, students felt it was important to define a standard platform to use to avoid wasting time on instructions given by teachers for multiple platforms.

I think the biggest difficulty is to be using different ones, because each one works more or less in a different way, so having to go from one to another is sometimes confusing at the time of class on the platform that has to enter, or how you have to enter, and ... at the beginning it was very difficult to enter. (Master Applied Social Sciences student, about User experience)

Regarding reliability, problems with the quality of the internet connection were reported by the interviewees. Situations where the connection failed, or when the system servers used were overloaded, made the experience unpleasant. The delay in the communication affected the natural flow of teaching, causing a decrease in student participation in classes and affecting the overall interaction between students and teachers.

The negative point is in relation to this, in relation to the internet, it fails a lot and often the teachers are communicating, ..., and we take a long time to either enter the class or to understand because it keeps failing. (Bachelor Applied Social Sciences student, about Reliability)

Teachers and students were satisfied with the range of platform features and the possibilities they enabled. They felt that these platforms have many useful features that were easy to
use. Namely, they enable screen and document sharing, sending messages and using virtual boards. Besides that, in some platforms it is also possible for students to create groups to organize their assignments, bringing the remote learning experience closer to the traditional classroom.

Finally, the ICT platforms were regarded as a great advantage since they brought a great resilience to higher education institutions. ICT platforms enabled higher education institutions to maintain academic activities, thus minimizing the damage of F2F classes suspension.

If we hadn't had the technology available to make up for the possibility to carry on classes, I think it would have been a lot worse without a doubt, because we'd be stuck (...). (Human Sciences teacher, about Resilience)

**Personal adaptation**

The sudden and unexpected changes brought by the pandemic meant a process of personal adaptation by the teachers and students that impacted the learning process. Several aspects of this adaptation emerged from this study: technology adoption, productivity, motivation, workload and health.

Most interviewees felt comfortable with adopting new technologies because they have used similar technologies in other contexts before, or the fact that they consider themselves ‘digital natives’. Even the ones more technologically averse had to adapt and started using technology to mediate the learning process. Nevertheless, resistance to move to a remote environment could still be observed, even with the impossibility of F2F classes.

Students and teachers mentioned a decrease in their productivity in this new remote environment, facing difficulties in concentrating on remote classes. Furthermore, without standard platforms for the remote classes, both in terms of platforms and in the classes format (ie, synchronous or asynchronous classes), students faced some difficulties regarding managing their schedule. However, staying at home also was mentioned as a good experience, because the time required to travel to F2F classes was saved, leaving more available time to do other activities. Due to the decrease of interruptions, teachers considered remote classes more productive than F2F classes. On the other hand, students felt some difficulties in following the teacher’s reasoning during the classes, because the content was transmitted very quickly.

It's going very fast, because with the (white) board I stopped and waited for everyone to copy, but now it's straightforward, there's no time to think about the exercise. (Bachelor Engineering student, about Productivity)

The positive point of the virtual one is that the class is more productive, since there are less interruptions, for example, I have been giving content that is three hours of class per day. (Applied Social Sciences teacher, about Productivity)

Motivation was one important issue in the ERE situation as teachers struggled to keep students' attention during remote classes and throughout the academic semester. Besides content adaptation, they used some engagement tools, simulators and videos to increase students' participation during classes and interacted in social media groups over the semester. On the other hand, students tried to keep a healthy study routine while focusing on the goal of graduating and on the temporary nature of the pandemic. However, many felt it was hard to maintain the motivation to attend remote classes.
In many of the moments I looked at the screen, I didn't understand anything, and I thought: oh, I don't understand anything, I can watch television, nobody will even know … (Bachelor Engineering student, about Motivation)

An increase in workload was also felt by interviewees, as teachers reported an increase in activities during this period, which resulted in an overload of work, often leading to exhaustion. Students also mentioned that they felt this overload, since the classes were happening uninterruptedly, without breaks.

It's been very exhausting for me, I'm exhausted, both physically and mentally. (Exacts Sciences teacher, about Workload)

Health, especially mental health, was also an issue addressed by the interviewees as they felt alone and anxious by the pandemic situation, especially those students who stayed in their campus residences and did not return to their family homes.

But it's really hard to study, it's complicated because of the whole scenario that we're going through … and since I'm far from my family too … there's a concern, a little anxiety. (Masters Engineering student, about Health)

These results show that the ERE situation brought a mix of post negative and positive experiences, as can be seen in Table 3. Interestingly, some aspects of the educational process contributed to a positive experience, namely, the increased teacher–student interaction and the awareness regarding the opportunities and new content development brought by this new remote context. However, the difficulties in the evaluation, the constraints in attaining the desired learning outcomes from the educational process and the lack of training hindered the ERE experience. The use of ICT platforms enabled a surprisingly good experience, only tarnished by reliability problems (mainly network failures).

Finally, while interviewees were mostly satisfied with their ability to adapt and adopt the new technologies required for the ERE context, the personal experience was mostly

| ERE experience          | (mostly) Negative | (mostly) Positive |
|-------------------------|-------------------|-------------------|
| **Educational process** |                   |                   |
| Evaluation (P3)         | Opportunities (P6)|                   |
| Outcomes (P3)           | Class content (P3)|                   |
| Training (P2)           | Teacher–student interaction outside classes (P6)|
| Teacher–student interaction (in classes) (P6) | |
| **ICT usage**           | Reliability (P4)  | Privacy (P2)      |
|                         | User experience (P4)|                   |
|                         | Platform features (P5) |               |
|                         | Resilience (P4)    |                   |
| **Personal adaptation** | Productivity (P2)  | Technology adoption (P2) |
| Motivation (P2)         |                   |                   |
| Workload (P2)           |                   |                   |
| Health (P2)             |                   |                   |

TABLE 3 Summary of the experience with the ERE
ERE EXPERIENCE ON HIGHER EDUCATION DURING COVID-19

negative, with the new situation negatively impacting many aspects of the interviewee’s life. These results are further discussed in the following section.

DISCUSSION

The results of this study showed that the ERE brought a mix of positive and negative experiences. As all learning was mediated by technology during the pandemic, this study resorted to Bower's TML theory (2019) to support data collection, data analysis and the discussion of the results. The results can be broadly encompassed by the first premise (P1), that states that ‘digital technologies can perform a mediating role for participants in their attempts to achieve learning goals’. However, when analysed in more detail, it is possible to see where TML excelled or lacked. Considering TML's second premise (P2), related to participants’ beliefs, knowledge, practices and the learning environment, it is possible to see that these were mostly related to the theme personal adaptation and were associated with a negative experience regarding ERE. These findings show that neither students, teachers nor the learning environment was prepared for such a momentous change. However, it is interesting to note that, at odds with related research (Lassoued et al., 2020), this study found that privacy was not a concern for teachers and students. Furthermore, these findings are aligned with some early research about the impact of the pandemic (Adedoyin & Soykan, 2020; Flaherty, 2020), namely, the constraints in attaining the desired learning outcomes given the considerable restrictions in some classes (eg, practical and laboratory classes), the added workload and the lack of regulation, control of evaluation, training, and overall preparedness for the ERE context. Additionally, teachers were having to adjust to the challenges of working from home whilst accommodating general workload intensification, affecting their work–life balance (Watermeyer et al., 2021). As such, the theme personal adaptation is especially relevant as it marks a clear distinction between ERE and regular, well-planned, distance and OL programmes.

TML's third premise (P3) encompasses the outcomes of technology-mediated education, as well as learning design, and was connected with the class content theme, which deals with the need to adapt the content that was previously taught F2F and became remote, and with the themes outcomes and evaluation, which deal more directly with accomplishing the learning objectives. Unfortunately, the latter themes are associated with a negative experience, showing that it was challenging to achieve the desired outcomes during the ERE, despite the positive experience with the adaptation of class contents.

Considering the impact that technology and affordances have on learning, Premise 4 (P4) was related to user experience, resilience and reliability. While reliability was an issue, overall, the required affordances for ERE seem to be enough for a successful experience. Nevertheless, building on Gillis and Krull (2020), technology was regarded mostly accessible, rather than effective, and enjoyable.

Regarding the combination of modalities referred to in Premise 5 (P5), platform features were mentioned as rich and, when used properly, can bring a kind of multimodality that brings the ERE experience closer to classroom teaching, with whiteboards sharing, or group work in dedicated subgroups within the same class session.

On a positive note, the way that technology is used to mediate the interaction between those involved in the remote educational environment and the network possibilities that Premise 6 (P6) proposes is associated with a positive experience, reflected in the theme teacher–student interaction and opportunities. New possibilities brought by remote participation,
such as the participation of international guests from other institutions in the classes, and the increased interaction between students and teachers, make the experience with ERE something that cannot be ignored in the future. In this scope, Educational institutions should seriously consider the implication of online education compared with in-person teaching (Williamson et al., 2020). Finally, Premise 7 (P7) posits the development of ‘communities of practice’, where there is a strong sense of presence and community, engagement or social connection. The absence of such premise in our results shows a severe shortcoming of ERE, that carries implications that are discussed in the next section.

CONCLUSION

The COVID-19 pandemic led to tremendous changes for higher education institutions. This research aimed to identify and characterize the educational process, the ICT tools used and the personal adaptation of higher education students and teachers during the pandemic's early stages. The results show an increase in teacher–student interaction, difficulties in controlling evaluation fraud, constraints in attaining the desired learning outcomes from practical or laboratorial classes, and lack of training and resilience to adapt and adopt the new technologies, despite the negative personal experience, lived in productivity, motivation, workload, and mental health.

This study's findings underscore the relevance of ERE response mediated by technology, in higher education, during COVID-19, highlighting one of the major conclusions of this study: TML leveraged the resilience of higher education during this period, and provided crucial support for students. Regarding the resilience to adapt and adopt the new technologies, several studies report that the lack of faculty online technology readiness and the disruption transitioning to online are seen as the main challenges in adopting technology for teaching in OL environments. However, Cutri et al. (2020) findings related to the faculty readiness for transitioning to online teaching during the COVID-19 pandemic pointed out that such transition during a crisis changed the typical perceptions of preparation and readiness. The negative connotations of risk taking and making mistakes while teaching and learning online seem to have been moderated by a combination of affective factors (such as humility, empathy and even optimism), bringing them into partnership with their students.

The importance of providing support to ERE became evident as education opportunities mitigate the psychosocial impact of crisis and disasters by providing a sense of routine, stability, structure, and hope for the future, promoting cognitive, emotional and social development improving student's psychological and behavioural well-being, which may improve educational outcomes (Burde et al., 2017). As such, universities need to be prepared for crisis before they occur (Stein et al., 2007), ensuring that they have the right affordances in place, before a crisis emerge. This includes reliable and adequate ICT platforms, namely, the development of remote evaluation instruments and grading systems. To minimize concerns about evaluation fraud or academic dishonesty, a combination of various assessment methods (eg, report submission with online presentation, oral examination, open questions) gives the teachers a chance to collect further evidence from the students' educational process. Furthermore, institutions that do not traditionally use online assessment can learn adequate practices from other institutions that already engage in such assessments.

Another major conclusion relates to the negative experiences with ERE that overwhelmed students and teachers with a sudden workload driven by unplanned learning activities, unstructured evaluation methods and lack of monitoring procedures and digital skills. Consequently, post-emergency education response requires higher education distance learning programmes and teacher training. Innovative approaches need to be explored to increase outreach, including distance education programmes, especially to leverage
teachers' newly gained competences and upgrading them quickly in the perspective of a post-pandemic world. Crisis such as this one provides an opportunity for change by teaching to all community members new skills and values. The shift to remote education is not about substituting the F2F for ERE, but to develop a new and transformational approach that can extend higher education institutions' reach, constituting an opportunity to alter and reflect upon their practices. Part of this shift may reflect the emergence of new bimodal approaches (blended learning, a combination of OL and F2F) to facilitate learning outcomes and integrate students and teachers. This will require a curation of learning experiences (Bryson & Andres, 2020) where appropriate and institutional-wide platforms need to be adopted, and training must be given to ensure that teachers and students are competent users of these platforms, while ensuring privacy and security.

Also, at the grass-roots level, considering the negative personal experience (lived in productivity, motivation, workload and mental health), it is necessary to train teachers and head teachers in new skills related to the unusual and stressful situation. It is crucial to provide guidance and training, to increase self-reliance, effectiveness and values, such as inclusive education, participation and peer collaboration.

Another important conclusion of this study arises from the link between ERE and TML premises. Even though most premises (1–6) matched the emerging ERE (sub)dimensions, there is a gap between Premise 7 ‘communities of practice’ and ERE context. This may be explained by the unplanned pandemic environment and the ultimate post-emergency recovering concerns. Consequently, this gap brings important implications for developing and maintaining communities of practice, within remote education environments. The design of new OL environments, such as the spaces (including digital spaces, virtual classrooms) in which learning occurs, can have a considerable influence upon learning outcomes (Bower, 2019). Furthermore, higher education institutions need to adjust their organizational design to meet the needs of the university community during a crisis (Zdziarski et al., 2007). As such, designing virtual learning spaces layout including chat or meeting rooms and coffee break areas for example will be vital to reduce the loss of sense of community or link to the community and the anxiety caused by the pandemic crisis, fostering collaborative action and social bonds. These interactions may be crucial to increase learner engagement with institutions. The longer the pandemic lasts, the more likely the students will lose strong ties to the institution and to the community they are linked to.

It is important to point out that this study captured teachers' and students' experience in an extraordinary but limited period immediately after the ERE start, offering an in-depth understanding of the Portuguese-speaking higher education students and teachers experience. Although the study participants' come from different academic fields (such as engineering, applied sciences, arts and health sciences), this study did not focus on the specificities of each scientific area taught at these institutions. Future research can explore how each scientific area adapted to the ERE context, especially those heavily reliant on laboratory classes.

COVID-19 pandemic is a global crisis, and the migration to ERE of university communities is undeniably huge. Although this study is an exploratory starting point for further and more extensive research on the impact of ERE on higher education, its findings provide implications not only for Portugal and Brazil but also for the other countries that suffer from the pandemic and lived similar experiences. However, this study did not cover all the higher education institutions in Portugal and Brazil, nor did it explore the cultural differences between these two countries. As such, this study can be further developed by more extensive research on the impacts of ERE on Portugal and Brazil, where a mixed-methods approach would be beneficial.

Finally, recognizing that “we are only at the earliest of beginnings of recognizing and understanding these impacts on the role of academics and the future of global higher
education” Watermeyer (2021, p. 638), this study’s findings need to be further pursued through research that longitudinally interrogates the change basis of COVID-19 across several countries’ higher education systems. Such a longitudinal perspective will go beyond this initial snapshot and provide a fuller and deeper analysis of higher education students and teachers experience during the COVID-19 pandemic following global trends about digital migrations.

ETHICS STATEMENT
The research was carried out following the ethical guidelines of the British Educational Research Association, 2011, the participants freely chose to participate in the research, and they made clear their consent to record the interviews.

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CONFLICT OF INTEREST
No conflict of interest.

DATA AVAILABILITY STATEMENT
The data are not accessible.

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**SUPPORTING INFORMATION**

Additional supporting information may be found online in the Supporting Information section.

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