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The Use of Interactive Communication Technologies for Collaborative E-mentoring
MASTER DISSERTATION

Duarte Luís de Sousa
MASTER IN INTERACTIVE MEDIA DESIGN

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To VV

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Abstract

This document investigates COVID-19's impact on the education system by gathering data on how interactive digital technologies mitigated such disruption. Moreover, the study also analyses how and if education's approaches were modified during the pandemic and what issue(s) arose in that process. The procedures consisted of the analysis of evidence retrieved from three surveys delivered to a broader group of teachers, students, and parents (N=215) crossed with an examination of a set of 5-week longitudinal interviews (30) with three stakeholder groups - teachers, students, and parents (N=6). Results of the analysis are used to derive a set of important design implications that: (1) highlights shortcomings of the distance learning strategies used during COVID-19 and how they can be mitigated; (2) empowers teachers, students and parents with innovative pedagogical approaches that can be fostered by interactive digital technologies that are optimized for distance learning; (3) promotes positive learning experiences supported with scientific evidence. The interactive system's design derived from a collaborative reflection expressed on the stakeholders' daily needs while teaching and learning during the unpredictable circumstances created by the pandemic. The OWL CLUB mobile app system seeks to curate the knowledge exchange in a more humane and positive digital experience among an education community. This application also allows the creation and growth of a space that encourages new genuine connections in a digital learning environment for students, with the pursuit of knowledge as their main objective.

Resumo

Este documento investiga o impacto do COVID-19 no sistema educacional, reunindo dados sobre como as tecnologias digitais interativas mitigaram tal disrupção. Além disso, o estudo também analisa como e se as abordagens educativas foram modificadas durante a pandemia e qual ou quais as questões que surgiram nesse processo. Os procedimentos consistiram na análise de evidências obtidas através de três questionários feitos a um grupo mais amplo de professores, alunos e pais (N = 215) cruzadas com uma análise de um conjunto de entrevistas longitudinais de 5 semanas (30) com três grupos de atores - professores, alunos e pais (N = 6). Os resultados da análise são usados para obter um conjunto de importantes implicações de design que: (1) destacam as deficiências das estratégias de ensino à distância usadas durante o COVID-19 e como elas podem ser mitigadas; (2) capacita professores, alunos e pais com abordagens pedagógicas inovadoras que podem ser promovidas por tecnologias digitais interativas, otimizadas para o ensino à distância; (3) promove experiências de aprendizagem positivas apoiadas em evidências científicas. A criação do sistema interativo deriva de uma reflexão colaborativa expressa sobre as necessidades diárias das partes interessadas durante o ensino e a aprendizagem durante as circunstâncias imprevisíveis criadas pela pandemia. O sistema de aplicativos móveis OWL CLUB procura assegurar a troca de conhecimento numa experiência digital mais humana e positiva entre uma comunidade educativa. Esta aplicação também permite a criação e o crescimento de um espaço que estimula novas conexões genuínas num ambiente digital de aprendizagem para os estudantes, tendo a busca pelo conhecimento como objetivo principal.

Palavras-chave

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List of Acronyms

AEI	American Enterprise Institute
AEO	Apoio Escolar Online
DE	Distance Education
HCI	Human-Computer Interaction
ET	Education Trust
ICT	Information and Communication Technologies
IDE	Integrated Development Environment
IHM	Interação Homem-Máquina
IM	Instant Messaging
INE	Instituto Nacional de Estatística
ITP	International Telementoring Project
K-12	Kindergarten to High School level
NUTN	National University Teleconferencing Network
OECD	Organisation for Economic Co-operation and Development
STEM	Science, Technology, Engineering and Mathematics
SUS	System Usability Scale
UK	United Kingdom
UN	United Nations
UEQ	User Experience Questionnaire
USA	United States of America
VL	Virtual Learning
VS	Virtual School

1 Introduction

1.1 Motivation

1.1.1 Education's International Disruption

The impact of the COVID-19 pandemic[1] all over the world is still a complex and challenging phenomenon to understand, especially in the beginning when contradicting information spreads as fast as the virus itself. The lockdown and self-isolation, as non-pharmaceutical solutions, seemed to be the only solution in order to "flatten the curve."[2] This fact resulted in the closure of schools in more than 190 countries by mid-April, thus impacting 1.6 billion students; that is, 94% of the world's student population is currently affected by the pandemic, according to the United Nations (UN).[3]

The pandemic crisis disclosed several shortcomings in the educational system. Despite all innovative methodologies, technologies accessible and the potentialities of a teaching community who could mentor the students, they failed to implement flexible education protocols or strategies in time for such disruptive events, especially in impoverished countries, according to the UN. Like many other countries, the Portuguese educational system is going through an unexpected, severe, and irreversible shift, bringing the whole educational process into uncertain territory.

1.1.2 Education Continuity via ICT amid the Pandemic

In some countries, the inability to meet face-to-face with teachers and classmates was mitigated by Distance Education (DE) through Interactive Communication Technology (ICT), now playing an essential role in maintaining prior bonds. According to the UN, most countries implemented DE guidelines to support students' instruction continuity during the pandemic. At the same time, almost 40% of least developed nations failed to adopt supportive solutions for the confined learners (Lima et al. 2020).

Communication is an essential element of education which is intrinsically assumed as face-to-face, now happening with the student(s) and teacher(s) separated, physically, and temporally (Mehrotra, Hollister, and McGahey 2001). So, DE is "the term that correctly describes an interaction between

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[1] WHO (World Health Organization) n.d. 2020. "Coronavirus Disease (COVID-19) Pandemic." Retrieved October 28, 2020 from https://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/novel-coronavirus-2019-ncov

[2] Cordis. 2020. "Trending Science: Why Has 'Flatten the Curve' Become the Public Health Mantra in the Global Fight against Coronavirus?" Retrieved October 10, 2020 from Cordis.Europa.Eu/, 26 Mar. 2020, cordis.europa.eu/article/id/415751-flatten-curve

[3] United Nations. 2020. "Policy Brief: Education during COVID-19 and beyond" Retrieved November 12, 2020 from https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2020/08/sg_policy_brief_covid-19_and_education_august_2020.pdf

two sides, teacher and learner" (Michael G. Moore and Kearsley 2012) and such interaction is aided by a myriad of mediums, usually linked to the time's dominant communication technology. So, any instruction can happen through interactive technology, thus becoming a form of DE "when it is used as the sole or primary means of teaching" (Michael G. Moore and Kearsley 2012; Holmberg 2003). DE encompasses distance learning and distance teaching, virtual education, or Virtual School (VS), and online education. Even though DE is used as a generalized term for remote learning, the term VS gained momentum when referring to Kindergarten to High School level (K-12) education.

From early on, there was scepticism regarding DE as the answer to school closures, even if it is well-established, as a less effective method than face-to-face instruction. Previous comparisons between these two methods were not conclusive or found negative effects on student's Virtual Learning (VL). While other studies found zero or minimal positive results in DE compared to face-to-face learning, even though Covid-19 presents deeper issues that add to the previous studies (Kuhfeld et al. 2020). Moreover, studies and debates over the role of technology and educational media are flawed due to the lack of understanding of its role on education for the past 60 years, leading to "unrealistic claims about the impact of technology on learning" (Simonson, Smaldino, and Zvacek 2015). In addition, the research on this matter seems to overestimate the importance of media-based instruction technology as innately better for instruction. Thus, reducing the medium to nothing more than an instrument "that deliver instruction but do not influence student achievement" (Simonson and Schlosser 2014).

1.2   Research Questions and Methodology

This study aims to understand COVID-19's unique impact on the current education system by gathering insightful data on how different means and infrastructures of interactive media influences individual and collective behaviour throughout its transitional period. This study also aims to analyse how learning methodologies were modified using ICT, considering the prior and new methodology, teachers, students, parents, and the system as a whole. Therefore, a longitudinal mixed-method study is paramount to understand this unique and disruptive period

This research's methods consisted of the analysis of evidence retrieved from three surveys delivered to a broader group of teachers (presented in Appendix A), students (presented on appendix B), and parents (presented in appendix C) crossed with an examination of a set of 5-week longitudinal interviews with three stakeholder groups - teachers, students, and parents (a sample is presented on appendix D).
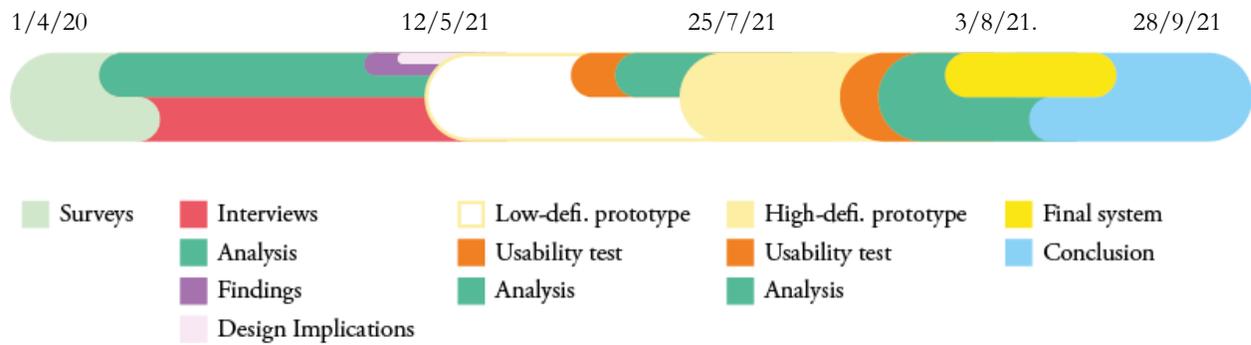
Figure 1. Thesis' work process divided per tasks, either sequential or overlapped.

Results of the analysis are used to derive a set of pertinent design implications that: (1) highlights shortcomings of the distance learning strategies used during COVID-19 and how they can be mitigated; (2) empowers teachers, students and parents with innovative pedagogical approaches that can be fostered by interactive digital technologies that are optimized for distance learning; (3) promoting the particularly positive learning experiences supported by scientific evidence.

So, in this study, we seek to address the following research questions:

> RQ1: How the 8th-grade stakeholders (teachers, students, and parents) used ICT to mitigate the school closure during the pandemic?
>
> RQ2: What are the stakeholders' pressing issue(s) identified in the DE process?
>
> RQ3: What tech-driven solution(s) exist to mitigate such issue(s)?
>
> RQ4: Can a personalised learning interactive system be used to diminish the constraints found in the longitudinal study?

1.3 Contribution

This research was conducted from a collaborative reflection on understanding the stakeholders' daily needs and emotional experiences with the educational system during the pandemic's unpredictable circumstances. The preliminary results are founded on a qualitative-quantitative analysis, observation and interviews implemented throughout the study and provide the following design implications:

> • **An innovative pedagogical system to assist the students' academic chores**
>
> Creating an open line of communication with an emphasis on establishing an education community that can mitigate the possible lack of family support. Also address the students' individual learning difficulties is fundamental for some pupils without a strong support system from family members and friends.

• A system to mitigate the student's learning variability

Several constraints may occur and prevent the student's natural learning progress which may not be fully addressed in the school settings or the student's household. A space conducive for a humanized and centered learning is paramount to impede the pupil's diverse and individual's academic difficulties.

• Collaborative and positive learning environment

The development of a virtual community that becomes a knowledge supportive in a collaborative process, facilitated by a digital tool, could be used by any student who would have a community to help clarify some doubts or misconceptions. The communal activity enables the student to have ample feedback that the student could timely rely on, according to the pupil's learning specificities. Additionally, the fellowship created in such a setting diminishes the participants', especially the students' sense of isolation, which increases when constraints arise. This medium permits a greater sense of belonging and exchanges that surpasses the knowledge transmitting, which will increase the probabilities of a more prolonged engagement with the set community.

• App-based system

An app solution augments the system's applicability and the student's use, so this format provides support more in line with the 'learners workflow', which grants the possibility of being used anytime, anywhere. The pertinent and timely academic assistance intermediated by a mobile system could be used to generate and disseminate knowledge, experience, skills and expand the participant's network (Tinoco-Giraldo, Torrecilla Sánchez, and García Peñalvo 2020).

1.4 Publications

A publication was created throughout this study, which was blind-reviewed and evaluated by international panels of experts:

Duarte L. Sousa, Pedro Campos, Sónia Matos. 2021. *The Use of Interactive Technologies for Education in Pandemic and Post-Pandemic Contexts: Design Implications.* In Proceedings of the 14th Biannual Conference of the Italian SIGCHI Chapter (CHItaly 2021).
[0.1145/3464385.3464737]

1.5   Master Thesis' Overview

This research focuses on an ongoing case study that seeks to understand DE in the context of the Covid-19 pandemic. The confinement measures that led to the generalized school closures caused a particular impact on the educational system and community that is paramount to comprehend. Some of this issue's specificities are discussed in this chapter, considering the international and national contexts. Also, the use of technological mediums, more specifically ICT, to intermediate the education process are briefly addressed in this chapter and will be further examined in the following ones.

This study is systematically organized into nine main chapters and subchapters that seeks to provide a clear depiction of the OWL CLUB system's development. This system aims to intermediate a teaching community (a mentor's network) with a student community in order to help them with their academic challenges in a specific and personalized way.

The following chapter – *Background* – describes distance education's procedures and methodologies. Next, the third chapter – *Education amid a Pandemic* – presents the distance education's negative consequences found during this study, like learning loss and learning variability, and connects to the subsequent fourth chapter – *Related Work*, which addresses e-mentoring as an answer to mitigate the before-mentioned learning issues. Chapter 5 and 6 – *Method and Findings* – describes the longitudinal mixed-method approach and the analysis that established this dissertation's direction. Overall, the data shows some disruptive effects on the student's education progression and, more specifically, the learning process's continuity. Chapter 7 – *Design Implications* – present the suggestions derived from the data analysis, divided into three parts: *Levelling the playfield*; *Managing learning experiences*; *Communication and collaboration*. The main design implication is presented in Chapter 8 – OWL CLUB system – which aims to address the central issues detected in the analysis. This section presents the system's prototype, its concept, and its development. The evaluation, discussion and limitations are presented in chapter 9, while the conclusions and future work to this study and its approach are drawn afterwards.

2 Background

2.1 Distance Education definition and context

2.1.1 Distance Education's Characterization

Communication is an essential element of learning which is historically assumed as face-to-face. The core aspect of DE is the physical and temporal separation of educations' stakeholders, such as the teachers and the student(s). DE might be defined as "any approach to instruction in which the majority of the instruction occurs while educator and learner are not in each other's presence" (Mehrotra, Hollister, and McGahey 2001; Kariri and Rodríguez 2019). Therefore, the interaction between teacher and student must be facilitated through various mediums, usually connected to the dominant communication technology of that time. Therefore, any instruction can be given through any technology, thus becoming a form of DE "when it is used as the sole or primary means of teaching" (Michael G. Moore and Kearsley 2012). So, the main characteristics of DE are the "mediated subject-matter presentation and mediated interaction between students and tutors" (Holmberg 2003).

2.1.2 Distance Education's Classification

The term was coined in Germany in the 1960s, when researchers theorized about 'fernstudium' ('distance study'), referring to specific technological tools used in education. DE, as a phenomenon, has existed for more than 150 years. The DE's foundations were built upon a stable international activity based on exchanges among European and North American scholars. DE is a general term that encompasses Virtual Education or Virtual Schooling and On-Line Education. DE includes distance learning and distance teaching and defines the position in which one relates to the other; therefore, distance education is "the term that correctly describes a relationship that has two sides, teacher and learner" (Michael G. Moore and Kearsley 2012). Although DE is used as an umbrella term for learning at a distance, the term Virtual School has gained momentum when alluding to K-12 schools. The ever-evolving communication technology allows the growth of DE. Yet, this expansion is detracted by those who emphasize the importance of the teaching/learning personal closeness setting. A third group encourages a blended learning approach, which sees the potential of both face-to-face and distance learning methodologies, thus uniting the "best of both worlds" (Schlosser and Burmeister, 1999; Simonson, 2003).

2.2   Distance Education's historical background and evolution

DE's methodological and procedural historical development was framed according to five stages. The phases correspond to the overall medium in which DE was conducted, like the initially printed format to the internet setup. Throughout the phases, it is observed that broader educational levels use the DE's methodologies, permitted by the technological resources' evolution and consequent availability to a broader public. It is also recognized the DE's emphatic presence in higher education, unlike the lower academic levels, throughout its history.

2.2.1   First Stage: Printed supported medium

DE early phase refers to the beginning of the 1800s Swedish newspaper advertising composition lessons through post correspondence, originating 'correspondence' courses. So, the instructor would mail the lessons for students to complete and would receive them again to grade and return to the learner with the following lesson. In the United States of America (USA), the Society to Encourage Studies, founded in Boston in 1873, attracted 10,000 students, primarily women, in their 25 years' mark. Meanwhile, the University of Chicago established the first significant correspondent program in the country, and in the late 1800s, academic degrees were granted in the USA and Europe. After including this method in higher education, DE reached the high school curriculum in the early 1920s in the USA (Michael G. Moore and Kearsley 2012; Simonson, Smaldino, and Zvacek 2015).

2.2.2   Second Stage: Broadcast radio and television supported medium

The radio broadcast was used as a tool for DE in some universities by the 1920s in the USA. Feelings of great optimism and enthusiasm motivated the creation of K-12 programs for the public-school audiences as well. Yet, this tool proved to be subpar due to the "lukewarm interest shown by the university faculty and administrators, and the amateurism of those few professors who were interested" (Michael G. Moore and Kearsley 2012). By the mid-1930s, television broadcasting was used for educational purposes in North America, and by the end of that decade, educational television broadcasted almost 400 programs. Twenty years later, several American cities established television channels orientated to instruction (tele-education) as a supportive medium to print-based. In the late 1970s, about 150 educational TV broadcasters transmitted instructional programs from K-12 to postsecondary education (Michael G. Moore and Kearsley 2012).

2.2.3 Third Stage: Open Universities

In the late 1960s, the British government assessed the idea of providing higher education to the adult population through television and radio. The Open University is created with the USAs examples, whose "ideas were incorporated into the design of the then-revolutionary" (Michael G. Moore 2019) institution. A complete university curriculum was offered by "employing the fullest range of communications technologies to teach" (Michael G. Moore and Kearsley 2012). Several other countries followed the British example and conceived similar institutions dedicated to distance and open education, reaching a massive audience.

2.2.4 Fourth Stage: Telecommunication supported medium

In the late 1980s and early 1990s, multimedia technology would replace part of the first-generation print-based format for one containing CD Roms, audio, and video. The group orientated telecommunication technology allowed to narrow the gap between distance education and face-to-face education by appealing to those who would see similarities with the education's conventional perception. With the arrival of satellite communication technologies, DE has gained unprecedented momentum. The audio-conferencing, used in the late 1970s, granted and stepped further into the interaction between teacher and student. The latter could answer back to the former in real-time, independently of the geography. In the USA, the Office of Education designates funds to the Educational Satellite Communication Demonstration project to provide education assistance to remote areas. Technical growth granted a direct reception of the programs in the student's homes (Mehrotra, Hollister, and McGahey 2001; Michael G. Moore and Kearsley 2012).

The National University Teleconferencing Network (NUTN), created in 1982, would share the costs, work, and the results of creating, delivering, and instructing educational courses, like many other consortiums. A network was conceived with 66 universities and institutions as members, growing to more than 250 organizations in the following decade. It would provide a myriad of programs in very diverse areas, like ageing, agriculture, AIDS, international affairs, and medicine, among others, to 6,000 people at a time. In the early 2000s, the NTU School of Engineering and Applied Science was created by merging NTUN and Walden University. Such development allowed a broader assortment of courses dictated by the student's needs that would be satisfied through satellite-delivered programs, with diverse interactive accessibility between teachers and students (Mehrotra, Hollister, and McGahey 2001; Michael G. Moore and Kearsley 2012).

2.2.5 Fifth Stage: Internet supported medium

Personal computers evolved from large mainframes that would occupy entire rooms in the 1960s and 1970s to ones that could be installed on a desk. According to the Bureau of the Census in the USA (United States of America), in 1989, 15% of all households had a personal computer, and half of the American children could access a computer either at home or at school. The need to assist students found a new impetus with the publishing of thousands of educational software programs covering all school levels and subjects.

The broadband and the World Wide Web technologies' creation and subsequent dissemination brought a new setup for education. In 15 years, the American population with internet access was only 9% in the mid-1990s grew to 77% by 2010, which education institutions tried to benefit from. With, web-based learning allows institutions' lectures to be taught, share documents independent of the distance, operating system, or browser. Interactive formats like videoconference calls and virtual reality supported the introduction of synchronicity in DE and required a "stimulated new thinking about how to organize distance teaching" (Michael G. Moore and Kearsley 2012). This new setup allows a face-to-face component to distant learning and "restore eye-to-eye contact electronically, and to teach groups as well as individuals at a distance" (Keegan 2002) on a global scale.

The synchronous method combined with the asynchronous one supports increased flexibility to students' and instructors' schedules. This societal and technological shift reframes "the institutional-based learning structures of the past few centuries to open architecture education that will occur at a time, place, and in a configuration suitable to the learner" (Willis 1994).

2.3 Opportunities for mobile education

Is mobile education DE's sixth stage? Nowadays, a significant number of higher education institutions offer integrated digital media in an online environment to support flexible learning opportunities. Yet, the digital divide is emphasized as a pressing issue that prevents students from taking advantage of mobile technology solutions to take increased responsibility for building their learning.

The mobile telecommunications' revolution in the late 1990s created the emergence of new didactic structures that could exploit its diffusion. The mobile devices with internet access offer a myriad of "possibilities for keeping the distance student in touch with the institution's student support services, in contact with learning materials and fellow students" (Keegan 2002). But despite the exponential growth of DE, students refer that "their first choice is not to learn at a distance" (Simonson, Smaldino, and Zvacek 2015), thus posing a critical issue on this matter.

The ever-evolving market presents ed-tech products and services to institutions with an array of possibilities to choose from. But these solutions do not comprehend all students' needs, as some of them are left out due to the lack of or poor internet access. Moreover, these solutions combined with pedagogical and design approaches result in materials delivered through technology for a mass audience. They do not comprehend the student's specificity or the existence of learning impairments. The weak internet access can be solved with smartphone applications, which more students have access to. Still, equality among students will diminish as long as remote learning continues if such issues remain (Michael Garrett Moore 2013).

The involvement of a learning group plus the formal and informal interactions are indicated as fundamental for the overall learning experience. Yet, students also mention the preference for an additional learning method that could support their supplemental learning needs. The freedom brought by the recent technological innovations allows students to assume the "responsibility for managing their learning, in such matters as deciding when they will study, how much they want to learn, and seeking out information and resources" (Michael G. Moore and Kearsley 2012) to build their intellectual structures. For constructing these structures, students may resort to a less abstract and more human connection with the knowledge to one that can improve and be improved by "relationships with other people encountered in the learning process" (Papert 1993).

2.4   Virtual school implementation

The early technological devices, in the 1970s, despite their basic aspect, served as an inspiration for wondrous journalistic pieces that imagined a pervasive presence of these machines in the day-to-day world. The examples were primarily focused on games and entertainment, income tax, electronic mail, e-commerce, and banking. On the other hand, education didn't capture the imagination of these journalists who failed to see the personal computer as a teaching tool (Michael G. Moore and Kearsley 2012; Papert 1993; Michael Garrett Moore 2013; Cuban 2001; Silva, Mora, and Straubhaar 2018).

In the early 1980s, a consensual group made of parents, public officials, policymakers in the USA aimed to reform the education system by introducing technological tools into the learning process. The objective was to diminish the "thorny problems that historically have crippled education" (Cuban 2001) and decrease the digital divide among students. With the support of local, state, and national governments, schools could assimilate technological innovation into their systems. The result was a staggering growth in students' access to personal computers and the internet. By 2007, the largest online virtual school, Florida Virtual School, instructed more than 60,000 students. But there seems

to exist a gap between the use of technology in traditional classrooms due to a "persistent gap in terms of physical access to technology" (Silva, Mora, and Straubhaar 2018), either to devices or internet connection, in certain communities. However, despite the gradual erosion of these inequities over the years, it observed disorientation of "exactly what computer literacy is" (Cuban 2001) and technology's purpose to the students' academic achievements.

Virtual school's tools and programs are essential for the ever-growing home-schooling movement and the students who attend school and need supplemental instruction. Even though access to technology has rapidly increased since 1980, its use in schools is still rare. Moreover, according to Cuban (2001), the school's computer education is usually out of step with the students' and workforces' needs. Also, the schools' infrequent use of technology in classrooms makes the correlation between the students' academic accomplishments and the technological tools used for those achievements hard to understand. In addition, data indicate that despite the support to implement technical mediums in K-12 schools, most teachers maintain the use of technology to a minimum. The scarce application is limited to tech introduction, keyboarding, and basic computer programming, which does not fully utilize the available technology to support its learning. Overall, teachers, on all levels, have been using the technological tools "to continue what they have always done: communicate with parents and administrators, prepare syllabi and lectures, record grades assign research papers" (Cuban 2001; Michael G. Moore and Kearsley 2012; Michael Garrett Moore 2013).

2.5 Summary

The unprecedented and historical shift of the world's education system forced a methodological swift to progress the student's instruction continuity. The evolving DE solutions, from analogue mediums to digital ones, examined in this chapter, it is not consensual despite the proven effectiveness, even compared with face-to-face methods, which were ambiguous or slightly better. Despite the pervasive focus on the DE's implementation in higher education, VS gained momentum, which could be emphasized by the natural evolutive transition to mobile technology, thus reaching a wider audience who could use this tool to address their specific learning requirements.

3 Education amid a Pandemic

3.1 Scarce research on K-12 education system's disruption

The unprecedented non-pharmaceutical measures, such as social distancing, taken to diminish the expansion of SARS-CoV-2 led to a historic disruption of the world's education system. Most of the 190 countries affected by the Covid-19 pandemic forced a swift change in the teaching and learning methodologies in order to progress the student's instruction continuity through DE. Moreover, the solution provided for the school closure does not have consensus as well, due to the ongoing apprehension of DE as a valid and effective education method even though former comparisons with face-to-face methods proved to be inconclusive or marginally better. These previous studies on DE did not comprehend the pandemic's added difficulties such as lack of resources, for example, detrimental to the student's learning progress or its impact on the technological mediums, seen merely as tools to "deliver instruction but not influence student achievement" (Simonson, Smaldino, and Zvacek 2015; Van Lancker and Parolin 2020; Kuhfeld et al. 2020).

Well-informed decision making during a pandemic event is paramount to its management. The proficient literature on crisis management does not generally comprehend the education system, from the lower to the higher levels. Such information is rare and seldom "addressed in 'medical' journals and more recently boosted by the 'knowledge management' scholars" (Ammirato, Linzalone, and Felicetti 2020). Additionally, other studies examined the issue from the perspective of macroeconomic effects on regions affected by pandemics or near-pandemics (Sangster, Stoner, and Flood 2020; Verikios et al. 2012). Research on school closure's effects due to a myriad of events, although not as disruptive as Covid-19, like weather-related school closures or Hurricane Katrina in New Orleans, "can provide a rough sense of how additional time out of school" (Kuhfeld et al. 2020) will reflect on fall 2020 and subsequent years. Yet, a distinction must be made between a disease outbreak and floods, earthquakes, fires or snow hazards due to its particular dynamics and possible recurring nature (Ammirato, Linzalone, and Felicetti 2020).

3.2 K-12 Education Pandemic Consequences

The UN claims that instructional loss will occur and jeopardize the effort of many decades, especially for the underprivileged children and adults, mostly young girls, and women, who saw their learning opportunities diminished due to the pandemic. The Organisation for Economic Co-operation and Development (OECD) refers to other authors who allude to the minor effects of school closures in

student's achievements, found in the literature; namely, the prolonged school closure period 2011 derived from Christchurch earthquakes, mainly due to the teachers' focus on what students should learn. Although shorter in duration, such sudden closures disturbed the learning process; therefore, they might pose some analogous consequences in the school system and how the set process should continue.

Even though insightful, Kuhfeld et al. (2020) refer that some of these studies could have several flaws like not studying the impact on different demographics, school poverty, or the impact of the current technological solutions used for remote learning. Another critical issue is the pressing potential wave patterns and re-infection of SARS-CoV-2 in certain areas or populations, so the correlation now being made with education lost time with what happens on those events might not be entirely appropriate. Students' accomplishments are difficult to determine in such a climate, as well as their impacts on their academic future.

3.3   Pandemic crisis' effects on the school community

The uncertainty of this pandemic crisis is generalized from the "effectiveness of school closures on virus transmission" (Van Lancker and Parolin 2020) to the effects on children's education, sociability, and health, especially those living in poverty. According to the UN, most countries implemented DE guidelines to support student's instruction continuity during the pandemic. At the same time, almost 40% of the sub-developed nations failed to adopt supportive solutions for the confined learners.

3.3.1   Learning loss and variability among students

Despite the constraints and shortcomings imposed by DE methods, "students who did not receive online instruction may have gotten no instruction at all" (Kuhfeld et al. 2020). In fact, according to Chen et al. (2021), most Chinese public K-12 schools, like the ones present in this longitudinal study, lack specific platforms and devices for DE. Moreover, many teachers and students had to find "their own ways to deal with challenges in such an urgent transition" (Chen et al. 2021). For example, the Education Trust (ET), as referred by Kuhfeld et al. (2020), indicates that schools in high-poverty areas were not inclined to provide online teaching, especially synchronous teaching, and referred to a complete absence of a more significant number of students than in low-poverty schools. According to Kuhfeld et al. (2020), some authors correlate DE and participation decline and absenteeism challenges. Evidence emphasized by the American Enterprise Institute (AEI), which refers to solely one-fifth of American school districts reached high standards for their DE approach. Leading to a

national understanding from teachers that their students "spent half as much time on learning as they did before the Covid-19 school closures" (Kuhfeld et al. 2020).

In Europe, 5% to 8% of the French students were unsuccessful in interacting with their teachers two weeks after the school closures. While in the USA, there is evidence of complete disconnection between teachers and their students, wherein early April, 39% of educators contacted, every day, mainly by email, their students. Also, in the second-largest school district of the USA, Los Angeles, approximately 13% of students failed to reach teachers and their schools (Kuhfeld et al. 2020).

Additionally, Kuhfeld et al. (2020) estimate the student learning loss and learning variability during Covid-19, in line with summer learning gaps, resembling a lengthened out-of-school period and considers the possibility of future decreased learning gains. Namely, reduced academic achievement will cause greater variability in students' average school gains in the next school year than in former years due to the unequal support from teachers and/or parents and relatives. Moreover, in the abridged school year, students are expected to have between "63% and 68% of learning gains in reading, but only 37% to 50% of the average gains in mathematics" (Kuhfeld et al. 2020), while 30% of students were absent during the same period. While OECD (n.d.) and Hanushek and Woessmann (2020) project, based on prior studies about critical periods and their aftermath, the post-Covid-19 time will bring a rise in child poverty and school abandonment. It seems that both issues continue to be inseparable despite the technological progress we witness today.

3.3.2 Student's familial and socioeconomic background

According to Miller and Ashdown (2020), the misunderstanding of the "socioeconomics that many students face may result in them failing" to complete their school year successfully. Even though the school system tried to cope with the tempestuous process, many "students and their families likely bore the brunt of the responsibility for ensuring that learning continued during the closures" (Kuhfeld et al. 2020). Some parents with low education who could not aid their children's school duties resorted to their older children, other family members, or acquaintances for help. Moreover, the ET indicates that the subsequent low achievement of students may also be due to the lack of access to ICTs, that affected 50% of low-income families. In addition, the loss of the household income and the cut of nutritious meals added to the students "struggle to meet the academic year's outcome goals after the reduction in educational time" (Miller and Ashdown 2020).

The parents who kept their jobs were also conflicted to balance their work, remote or not, with their children's needs, as in another stress factor that will alter their academic accomplishments. The

student's caregivers became their children's learning supporters and their motivators amid such crises. The OECD's studies indicate that 95% of Korean students referred to their parents as learning helpers and emotional supporters to cope in this stressful period, which is 6% higher than the OECD average. While in Portugal it is 94%, the USA and Australia is 93%, in the UK (United Kingdom) it is 92%, Sweden and Japan with 89%, Chile with 87%, Turkey with 87% and Germany with 86%. (OECD n.d.; n.d.; Hanushek and Woessmann 2020).

3.4 Summary

After examining the above literature, it's possible to observe insufficient research on learning loss and learning variability associated with education's inequalities during a pandemic event. Yet, the projections, based on prolonged school closures caused by natural disasters, clearly indicate the learning gains and opportunities will decrease, mainly among the disadvantaged children and adults. Students' socioeconomic background and school's location were found to be essential to a quasi-normal progression of instruction on a disruptive phenomenon like the Covid-19 pandemic and the consequent school closure. Despite the discussions on the effectiveness of DE, a complete lack of school engagement due to absent widespread technological infrastructure and resources associated with disfavored backgrounds and inability to be assisted seem to emphasize previous learning inequalities.

4 Related Work

4.1 Addressing learning variability among students

In DEs context, many barriers may arise and impede the student's proper learning process. Emerging ICTs proved to be very useful on the multilayered education's systems amid the pandemic and could be used for e-mentoring to address the learning variability, thus responding to the students' specific learning needs (Homitz and Berge 2008).

4.2 What is e-mentoring?

4.2.1 E-mentoring predecessor

Humankind often resorted to the wiser individuals among the community for guidance, knowledge, and inspiration to achieve specific goals. Mentoring is the form in which those goals can be easily

accomplished. The 'Mentor' figure first appears in Homer's *The Odyssey*, a chronicle of King Odysseus's journey home after the Trojan war. During his return, the goddess Athena appears disguised as Mentor, Odysseus's old friend, to guide and support his son Telemachus, thus representing the first form of mentoring. More recently, in the 1970s, the mentor figure obtained specific responsibilities, usually linked to the mentees' academic, career, and psycho-social growth. Mentoring's popularity in the Anglo-Saxon academies and other institutions is strongly extending to the European context (Kelsey and St. Amant 2008; Bierema and Merriam 2002; Samuel, Barroso, and Santos 2017; Williams, Sunderman, and Kim 2012).

Currently, the mentoring interaction is described as a mutually beneficial relationship driven by one of two participants. One individual is supported (mentee or protégé) personally, academically, or professionally by a more experienced or knowledgeable one (mentor or coach). When this relationship is auspicious, DuBois (2002) refers to the existence of five positive outcomes for the mentees, such as "emotional/psychological, problem/high-risk behaviour, social competence, academic/educational, and career/employment" (Bierema and Merriam 2002; Shrestha et al. 2009; Samuel, Barroso, and Santos 2017; Single and Single 2005).

4.2.2 E-mentoring format

E-mentoring, also known as cybermentoring, telementoring, virtual mentoring or online mentoring, is a primarily computer-mediated mentorship (Rowland 2012). That is, harnessed by web 2.0, e-mentoring overcame the offline form by providing the advantages linked with mentoring. Moreover, the online format impartiality allows a more open, trustworthy, and flexible relationship in an informal and unstructured manner. So, unlike face-to-face mentoring, the online setting does not have a rigid hierarchy and provides a more significant engagement, progression, and goal achievement, therefore, levelling the playfield (Rowland 2012; Single and Single 2005; Homitz and Berge 2008; Liu, Macintyre, and Ferguson 2012; de Janasz and Godshalk 2013).

Like early mentoring programs, e-mentoring ones also seek to address the same issues like the lack of family support, the scarcely qualified mentors or role models nearby, while addressing the low contact frequency due to geographical or time constraints. Such issues are particularly challenging for middle school students who might need parental help to get to a face-to-face mentoring site. Moreover, e-mentoring focuses on early educational support, socialization, and enculturation opportunities to at-risk youth, girls or women, and ethnic minorities. This "underprivileged or underrepresented population" (Single and Single 2005) can, through e-mentoring, tackle their

requirements in different 'developmental levels'. Moreover, they can do so by reaching an essential informal learning community, thus expanding their network and access to different information beyond a myriad of boundaries (Stoeger et al. 2013; Homitz and Berge 2008; Shrestha et al. 2009; Rowland 2012).

4.2.3   E-mentoring process

Although mentoring programs have increasingly grown since the 1970s, it is often confused with tutoring or teaching. Mentoring happens when the mentee 'brings to the table' their concerns and goals. While teaching's objective is for the pupil to be evaluated on the knowledge they have gained; therefore, there is a well-defined power structure (Kelsey and St. Amant 2008).

Samuel et al. (2017) allude to Wong and Premkumar mentoring process consisting of 4 stages (Figure 2). The first one deals with the individual's internal motivations to participate in mentoring programs. In e-mentoring, dyads must occur organically and not forced, so trust, respect, and honesty can be pervasive throughout the relationship. The second phase is where the negotiation occurs, in which the bond will be defined as well as the dyad's expectations. Moreover, the mentees' expectations and outcomes must be clearly articulated and be the basis for a commitment between the parties. The mentee should document these commitments and is often in charge of organizing the meetings and providing feedback on the actual outcomes. Two mentoring sessions per week are usually established in formal long-term programs, but the participants should agree on these issues to create a mentoring relationship. In the third stage, this bond is implemented and developed. Finally, the final phase or closure, regardless of the positive or negative process, where the outcomes' evaluation occur, that is, the learning gains or goals agreed on in the second stage (Premkumar and Wong 2010; Bierema and Merriam 2002; Schlager and Fusco 2003; de Janasz and Godshalk 2013).

Stage 01
Preparation
Assess internal
motivations

Stage 02
Negotiation
Agreement on
expectations and
agenda

Stage 03
Preparation
Longer stage of
implementation
of the expecta-
tions in the
agreed agenda

Stage 04
Preparation
Relationship's
closure and
gain's evaluation
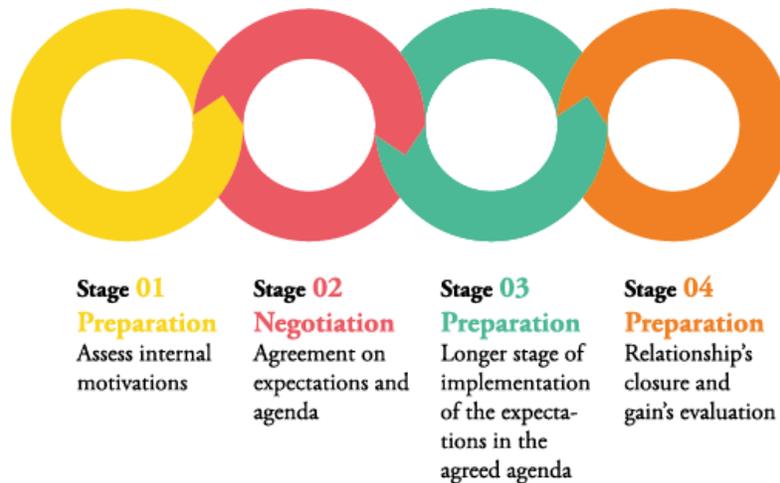
Figure 2. E-mentoring relationship cycle, according to Premkumar and Wong 2010.

It is acknowledged that the mentor/mentee traditional bond should go beyond the mere instruction passing, from the first to the second participant, for the set bond to prolong in time. Furthermore, in the longer and higher-quality bonds, it was found that stronger emotional ties were "associated with better outcomes such as improvements in perceptions of scholastic competence and feelings of self-worth" (Spencer 2006). Relational authenticity and empathy are essential requirements for this process that happens when spontaneous and personal moments occur, often initiated by the mentor. Also, it establishes a collaborative setting based on the mentor's intention to nurture the protégé's growth and development. Such benefits were found to increase the mentor/mentee's bonds rather than the number of shared activities. As the relationship progresses, the mentors gradually offer tailored support for the mentees' specific needs (Stoeger et al. 2013; Spencer 2006; Single and Single 2005).

4.2.4   E-mentee's role and outcomes

Several studies found that mentees preferred to be assisted by a 'complete stranger' with no concealed reasons to assist or inspire them. The pairings must occur naturally to create an honest relationship based on trust and respect. The shared experience with a non-family and older role model focused on the youngsters' interests seems to kindle a pleasurable feeling linked to the companionship that grows between the participants. This bond contributes to the protégés' emotional and psychological well-being, a greater sense of self and confidence-building, adding to the knowledge and educational guidance. While in the peer-to-peer settings, the equality and need for similar information make it more prone to rise some form of rivalry and competitiveness (Spencer 2006; Samuel, Barroso, and

Santos 2017; Kelsey and St. Amant 2008; de Janasz and Godshalk 2013; Schwartz, Lowe, and Rhodes 2012).

The mentees' expectations and outcomes must be clearly articulated with the e-mentor and be the basis for a commitment between the parties. The mentee should document these commitments and organize the following meetings and provide feedback on the actual outcomes. The online format offers a safer environment and has the "potential to erode some of the traditional power dynamics that tend to structure mentoring relationships" (Bierema and Merriam 2002). The consequent impartiality permits the mentee to "share self-doubts, express concerns and ask 'silly questions,' in a way that is almost impossible when the mentee and mentor are from the same organization" (Shrestha et al. 2009). According to Stoeger (2013), the increased effectiveness of e-mentoring is related to mentee/mentor equal gender, which is especially pertinent to female students interested in STEM areas (Samuel, Barroso, and Santos 2017).

4.2.5 E-mentor's role and outcomes

Even though the e-mentor's role is not recognized as a tutor or teacher, the education system acknowledges and implements this individual's actions. The e-mentor's function is to work alongside the e-mentee, and structure the protégés' learning process through formal or informal settings and successfully achieve their goals. The e-mentor acts as a positive and encouraging advocate of the e-mentees' learning progress and provides valuable insights in a 'boundaryless' and 'egalitarian' manner. Despite being different from the face-to-face setting, the e-mentor's assistance should be as fast as possible, in a positive, friendly, and honest manner (de Janasz and Godshalk 2013; Homitz and Berge 2008; Bierema and Merriam 2002; Tominaga and Kogo 2018).

	Teacher	Mentor
Primary role	Instruction	Learning support
Specific job	Teach, instruct, evaluates, gives grades	Encourage, support progress management and effective learning method
Characteristics necessary for job	Authoritative, good presentation	Friendly, good response and advice

Table 1. Differences between teachers and mentors, according to Tominaga and Kogo (2018).

The mentees' and organization's benefits are well established and studied. At the same time, for the mentor, the outcomes are often regarded as derivative and concerning the gain of fresh perspectives on technological skills, new methods, or practices. Studies about the mentor's motivation find a general satisfaction in advising others, though, in the beginning, there is a sense of reciprocity in which the "newcomers develop an obligation to help others in the future through the valuable help and advice they receive as newcomers" (Liu, Macintyre, and Ferguson 2012). Other known advantages include psychological and social benefits and deeper learning due to their knowledge's reflections and consolidations by preparing for the instruction, affecting their regular practice. These views are consistent with many teachers' beliefs that "the best way of learning something is teaching it to somebody else" (Hrastinski et al. 2014; Williams, Sunderman, and Kim 2012; Shrestha et al. 2009).

4.2.6 Educator's community

The one-on-one mentoring solution has restraints, like the protégés' loneliness and lack of timely feedback due to an over-reliance on one mentor, which does not aid the e-mentoring relationship's growth. Additionally, some mentors allude to the uncomfortable feeling of providing assistance about other disciplines than their own to their mentees. Unlike the one-on-one setting, either online or offline, the presence of an online community would share their knowledge and insights appropriately and efficiently because the responsibility would be divided amongst all community members, according to predetermined guidelines (Spencer 2006; Shrestha et al. 2009; McLuckie and Topping 2004; Schwartz, Lowe, and Rhodes 2012).

An e-mentoring closed social community system ensures a safe learning environment that allows 'spontaneous discussion'. In the e-mentoring community, individuals see and examine each other's 'social traces', personal interests and activities on social media to get access to pertinent information and form bonds. The 'perceived similarity' generates concurrent interactions "based more on shared interests than on visual cues that can lead to bias and stereotypes" (de Janasz and Godshalk 2013) and builds more honest relationships due to the awareness of the participants' interests and potential. The access to a broader group would ensure a diverse role model for mentees granting a sense of belonging. The e-mentors assist according to their expertise and could also disseminate pertinent resources beneficial to the community and gain credit and reputation through high rates and badges (Liu, Macintyre, and Ferguson 2012; Stoeger et al. 2013).

4.3 Technology-mediated interaction in e-mentoring

Early studies on mentoring being associated with ICT appeared in the late 1980s and have been growing globally. According to UNESCO's World Communication and Information Report, referred by Kelsey and St. Amant (2008), e-mentoring programs are a promising setting, emphasizing that "virtual collaborations between individuals are an effective way for senior members of a community to teach, inspire and support newcomers". Nevertheless, e-mentoring continues 'reasonably new' and 'understudied.' Also, the existent research on e-mentoring frequently focuses on its structures and effects, primarily in higher education and private sectors. Moreover, the initial comparative analysis with offline mentoring did not comprehend the role and evolution of interactive communication technologies. In addition, e-mentoring research mainly focused on "the most tentative forays into this potentially rich medium" (Bierema and Merriam 2002), thus failing to fully acknowledge the potential of novel ICT for mentoring (DuBois et al. 2002; Single and Single 2005; Stoeger et al. 2013).

ICT has been detrimental to knowledge democratization for the last two decades, thus improving educational possibilities in all education's layers worldwide. Despite the "little thought that has been given to how interactive communication technology might be incorporated into the mentoring process" (Bierema and Merriam 2002), the development and spread of new ICT tools grant new possibilities for the e-mentoring movement. Although this medium might be perceived as impersonal, these tools enable a more accessible connection to 'candid communication' regularly. ICTs must be seen as a means that creates a learning environment rather than solely transmitting information (Kelsey and St. Amant 2008; Bierema and Merriam 2002; de Janasz and Godshalk 2013).

The interaction between mentors and mentees can occur in written format, over email or online chats, which can be saved for the mentors to have time to respond appropriately to the mentees' doubts. The asynchronous communications create a more 'reflecting environment' in which the participants can assess the educational process and their objectives, feelings, and doubts for a longer timeframe. However, the use of the telephone might be advantageous for the success of the mentorship's bonds and other formats like wikis, blogs, vlogs, forums, podcasts, virtual conferencing tools. More recently, online social networks "may represent an important modern source of or vehicle" (Cole et al. 2017) to expand this educational environment. Thus, enabling the most appropriate interactions, generate and collaboratively share personalised content. Also, it can foster or promote mentor/mentee relationships, especially to the more socially anxious or introverted people who generally will experience more significant positive psychological effects (Stoeger et al. 2013; C. Shrestha et al. 2009; Snelson 2015; Tominaga and Kogo 2018).

4.4 E-mentoring challenges

E-mentoring is not a panacea for student's learning impairments and should not replace other forms of tutoring or face-to-face mentoring but could address specific necessities and learning variabilities. Furthermore, the ubiquitousness of various technological mediums and their fundamental role in e-mentoring programs are not synonymous with success. The explanation might be the "unenthusiastic response by individuals who are not technologically savvy" (Rowland 2012) and those who do not have the necessary resources to participate in such programs. Some authors emphasize the need for an awareness of the digital divide and its role in the lack of learning opportunities for the most disadvantaged students. Also, the possible malfunction, confidentiality and privacy challenges are cited as important issues to be addressed (Single and Single 2005; Homitz and Berge 2008).

The lack of visual cues, like tone and body language in virtual communication, is considered disadvantageous to proper communication between participants, thus jeopardizing the efficacy of e-mentoring systems. A successful relationship requires some degree of virtual intimacy gained through the development of confidence and trust, which takes time to build. Videoconference tools and emoticons can mitigate these issues to convey a few forms of social cues (Rowland 2012). Some programs advise the mentors to foster the bond with the mentee by sharing personal experiences as a discussion starter. At the same time, others compel the participants to write a biography to share commonalities, strengthen their bond, and mitigate the gradual participant's disengagement, both mentors and mentees (Tominaga and Kogo 2018; Spencer 2006; Shrestha et al. 2009).

4.5 E-mentoring technological solutions

4.5.1 Early computer-mediated mentoring

Since the early 1990s, mentoring has been defined by being mediated, at least to some degree, by computer communication, usually using email or computer conferencing systems. The first e-mentoring systems were web-based and created in the USA in the early 1990s by pairing K-12 students with experts via email, in educational settings or corporations, in computer-related disciplines. The International Telementoring Project (ITP), piloted in 1995 by the 'Hewlett Packard Email Mentor Program', would weekly connect Hewlett Packard's employees to a group of K-12 students worldwide, interested in technology and engineering. (Bierema and Merriam 2002; Bellinger 1998) Likewise,

'MentorNet'[4], a free e-mentoring program via email, also emerged in 1995 in North America. This program still focuses on female high education students' interaction with Science, Technology, Engineering and Mathematics (STEM) professionals, thus addressing their scarce presence in such fields (Single and Single 2005; Bierema and Merriam 2002).

4.5.2 K-12 e-mentoring technology

According to Bierema and Merriam (2002), e-mentoring programs focused on K-12 are scarce, and the existing ones have timid attempts to address specific content. Recently, e-mentoring systems are becoming hybrid web-based and mobile applications, like 'iCouldBe'[5], 'Math coach' (Hrastinski et al. 2014), 'Homework coach' (Hrastinski et al. 2014), and Apoio Escolar Online[6] (AEO) aimed at the K-12 demographics (Bai 2019). Whereas 'MOOSE Crossing' (Bierema and Merriam 2002) is a blended web-based and face-to-face solution that also addresses K-12's students' needs. However, a crescent migration is occurring, from desktop experiences to the ever-growing popularity of mobile devices. The new solutions can be used for learning support and flexibly increases the mentees' autonomy, considering the protégés' rhythm and learning methods (Bierema and Merriam 2002).

4.5.2.1 E-mentoring Interactive systems

'ICouldBe' connects at-risk middle and high school pupils to an online community. Similarly, 'Math coach' and 'Homework coach', two university projects initiated in the late 2000s, facilitate university student's mentorship to K-12 math students. Unlike the previous three platforms, the 'MOOSE Crossing' is a blended program, virtual and face-to-face, that creates a peer and mentor supported environment for students of varying ages with older mentors. The participants would act as a "key source of motivation for learning" (Bruckman 1997) in an environment that contextualizes the learning process instead of being a mere passage for information. While AEO platform, created by Madeira's regional government in 2009, provides academic assistance to students from 5th to 12th grade. This system facilitates the connection to an e-learning platform and a team of teachers to promote equal access to knowledge and learning opportunities.

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[4] https://mentornet.org/
[5] https://www.icouldbe.org/
[6] https://apoioescolaronline.madeira.gov.pt/ and https://teducativas.madeira.gov.pt/apoio/index.php

'ICouldBe' provides a one-hour weekly structured e-mentoring through group activities. All interactions are internal text-based asynchronous, for safety reasons, and the counterpart is notified and encouraged to reply by a system's prompt. Similarly, "Math coach" and "Homework coach" address the same issues in slightly different manners. The e-mentoring happens via Instant Messaging (IM) like MSN Messenger or Skype. However, in the Swedish projects, the digital whiteboard drawing feature is often cited as an essential tool to express more accurately and freely some concepts that are difficult to clarify in plain text. For this reason, some mentors attach a website link or a good answer or appropriate graphic, image, or video.

The AEO has a hybrid access and grant access to the full content, namely short videos, presentations and animations or online exercises. However, free content on all cycles (2nd, 3rd and high school) is displayed as a demo. The students have a limited number of classes available, which increases gradually as they advance in their academic life. The 'multi-age community' on 'Moose Crossing' would embody a persona, learn computer programming languages and enhance their learning skills via text-based virtual reality settings (Hrastinski et al. 2014; Bierema and Merriam 2002).

In 'ICouldBe', the registered mentees select the recruited and trained mentors according to mutual interests and are encouraged to lead the discussions through 'conversation prompts'. Similarly, in 'MOOSE Crossing', adult and teenage mentors apply to be 'Rangers' and 'Junior Rangers' respectively. Whereas the Swedish projects, the K-12 protégés' are linked anonymously to higher education students. In the 'Math coach' project, the paid mentors were co-located and would first have math mentoring training and tools to provide e-mentoring like math books or electronic tools. Whereas the 'Homework coach', the mentors would tutor voluntarily at any time, usually twice a week, using their resources, and would often mentor due to their interest in math and teaching. In both projects, the mentors would assist several students by answering their questions, who would use this service freely, mainly before exams. However, if the e-mentor did not enlighten the mentee, they could ask the same question to another e-mentor. The Swedish mentors stress the complexity of tutoring several students from different grades simultaneously, especially without knowing their academic or personal background. In AEO, the students need to subscribe to the platform during the school year they are enrolled, and the interaction with the tutoring support is only made during a pre-determined period (9 am to 5:30 pm). The pupil may look at the content produced by the AEO's teachers or directly contact one tutor that could clarify the student's doubts in a personalised manner through the class's general forum, chat with the designated teacher or send a private message through the platform.

Platform \ Features	Math coach	Homework Coach	ICouldBe	MOOSE Crossing	AEO
Subscription	No	No	Yes	No	Yes
Costs	Free	Free	Free	Free	Free
Profiles displayed	No	No	Yes	No	No
Type of dyad	One-on-One	One-on-One	Group	Group	One-on-One / Group
Randomly paired	Yes	Yes	No	Yes	Not applied
Duration of dyad	Instantaneous	Instantaneous	School year	Long term	School year
Discussion prompts	No	No	Yes	No	No
Synchronous or Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Both
Type of interaction	Text-based	Text-based	Text-based	Text-based	On platform Chat /Phone/IM
Mobile or Web-based technology	Hybrid	Hybrid	Hybrid	Web-based	Hybrid

Table 2. Succinct comparison between K-12 e-mentoring systems.

4.5.3   Other e-mentoring systems

Tinoco-Giraldo et al. (2020) allude to the lack of mobile app systems that serve exclusively to intermediate the mentor and mentee's relationship within the education realm, especially for the K-12 stage. The scarce examples were mainly designed for higher education contexts, which some examples are presented in Table 3. The app system 'SCPD Mentorship Programs'[7]or 'UCLA Mentor Match'[8], fall under the education's 'umbrella' despite fulfilling varied purposes, including academic and personal assistance and transition to the workforce. While 'Connective Project' (Samuel, Barroso, and Santos 2017), 'Mutual Agreement' (Neureiter et al. 2017), 'MentorTokou' (Ligadu and Anthony 2015) or 'MentorNet' (Single and Single 2005; Bierema and Merriam 2002) also assists the varied student's needs with an older mentor or peer in a web-based setting.

'MentorTokou' is a private portal directed to higher education students and mentors with a direct invitation. 'Mutual Agreement', 'UCLA Mentor Match', 'Connective project', 'SCPD Mentorship Programs' and 'MentorNet' link students and older mentors to aid their academic and personal goals and the transitional process to the workforce. The latter program is focused on connecting female

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[7] https://www.csulb.edu/college-of-business/student-center-for-professional-development-scpd/programs/corporate-mentoring
[8] https://alumni.ucla.edu/alumni-mentor-program-2/

higher education students' interaction with STEM professionals, thus addressing their scarce presence in such fields (Single and Single 2005; Bierema and Merriam 2002).

Both 'Connective project' and 'Mentor Tokou' are closed learning communities. But unlike the 'Connective project', the 'Mutual Agreement' recruited and paired the participants according to their information and their requirements regarding the field they would like to support or be supported. In 'MentorNet', 'SCPD Mentorship Programs' and 'UCLA Mentor Match', the participants have to apply, add personal data, and, in the mentors' case, professional data as well, to be accepted by the program and the mentee. Although in the 'SCPD Mentorship Programs', the profile remains anonymous and serves for the system to create mentor matches through the given data, to which the mentee could accept or reject.

Programs like 'Mutual Agreement', 'MentorNet' and 'UCLA Mentor Match' assists the dyads by giving 'trigger questions' which may alter throughout the process if the protégé's goal changes. In 'Mentor Tokou', the participants may "engage collaboratively in discussions, feedback and reflections" (Ligadu and Anthony 2015) via IM. This system has three mentoring environments: a public group forum for all participants, a mentor/mentee group, where a mentor can create a group of mentees by invitation, and finally, a private mentor group setting for all mentors. The freedom to interact in the public forums and private chats allows a "non-intimidating environment as it makes the mentees more self-confident and reduces their anxieties when meeting their mentors face-to-face" (Ligadu and Anthony 2015). The 'Connective project', 'UCLA Mentor Match', 'SCPD Mentorship Programs', or 'MentorNet' advises to have face-to-face meetings regularly or by several ICT mediums and share documents via cloud-based tools. Likewise, the 'Mutual Agreement', MentorNet also provides a multimedia platform, although a text-based exchange is preferred to initial contacts and later shifted to audio/video calls.

Unlike the other e-mentoring programs that promote a long-term mentor/mentee interaction, the 'UCLA Mentor Match' is limited in time because the e-mentoring occurs during the school year. Likewise, 'MentorNet' is also defined by a four-month cycle; when a cycle ends, the pairs may continue another cycle or change according to their academic or personal needs.

Platform \ Features	SCPD Mentorship Programs	UCLA Mentor Match	Connective Project	Mutual Agreement	Mentor Tokou	MentorNet
Subscription	Yes	Yes	Yes	Yes	Yes	Yes
Costs	Free	Free	Free with limited credits	Free	Free with invitation only	Free
Profiles displayed	No	Yes	Limited	Yes	No	Limited
Type of dyad	One-on-One	One-on-One	One-on-One	One-on-One	Group	One-on-One
Randomly paired	No	No	No	No	No	No
Duration of dyad	Long term	School year	Long term	Long term	Long term	Four months
Discussion prompts	Yes	Yes	No	Yes	No	Yes
Synchronous or Asynchronous	Both	Both	Both	Both	Both	Both
Type of interaction	ICT Or F2F	ICT Or F2F	On platform Video or audio call	On platform And ICT	Text-based	On platform Chat. ICT
Mobile or Web-based technology	Mobile app	Mobile app	Hybrid	Hybrid	Web-based	Hybrid

Table 3. Succinct comparison between higher education's e-mentoring systems.

4.6   Summary

This chapter consisted of an overview of the state-of-the-art regarding this project, which started by addressing the learning variability as an impediment for some students to successfully progress academically. Followed by the context in which this project is included, that is, e-mentoring – its historical background, methods, processes, applications, participant's roles, and the use of technologies to intermediate the dyads along the e-mentoring process and outcomes. Third, I provided a state-of-the-art that compares the scarce K-12 e-mentoring systems where it is displayed with a table summing the overall features. Additionally, I also examined six other e-mentoring mobile or hybrid systems, primarily devoted to higher education, complemented the previous k-12 system comparison analysis. Moreover, this examination provided pertinent insights into the concept and design of the system developed in this study, like the focus on a mobile system heavily based on asynchronous text-based interactions, for the students' security, and the openness to a broader mentor network instead of relying solely on one person.

5   Method

5.1   Longitudinal study's procedures

I collected data amid the compulsory school closures that affected Portugal between March and May of 2020. This data provided valuable insight into stakeholders' (teachers, students and parents) use of interactive communication technologies to mitigate school closure in response to the pandemic. Data also helped outline pressing issues identified by stakeholders due to distance teaching and learning. I considered the issue's complexity; thus, the mixed-method quantitative-qualitative approach played a significant role. The quantitative and qualitative methods were implemented to identify the study's participants and later "develop questionnaires and conceptual models" (Palinkas et al. 2015). A qualitative approach generated a deeper insight into the phenomena and a contextual understanding of challenges faced by stakeholders. Such validation was achieved by cross-examining the data from two diverse yet complementary angles: cluster analysis and theme analysis. Moreover, the study's initial phase further validated data derived from the quantitative component (Vogl et al. 2018; Henry et al. 2015; Holland et al. 2006).

5.2   Data collection and initial analysis

5.2.1   Initial understanding of the stakeholders' settings and perceptions - surveys

The longitudinal study started by the survey's design, created on Google Forms[9], and was composed of three questionnaires (in appendix A, B and C) aimed at three stakeholder groups (N=215): teachers, students, and parents living in Portugal. In order to comply with the health authorities' safety measures, namely the social distancing, I chose to post the questionnaires on specific Facebook channels between the 1st and the 14th of April 2020. These Facebook groups, managed by and/or attended by teachers (87 249 members, collectively) or parents (12 390 members, collectively), provided several individuals that granted valuable insights on the methods and processes taken to mitigate the Covid-19 disruption on education. For the students, it was used the snowball technique where it was asked three pupils to fill the survey and refer it to their friends and colleagues, thus increasing the sample size (Taherdoost 2016). 79% of inquired subjects were teachers, 4.7% students, and 16.3% parents. The questionnaires first informed respondents about the study's goal to understand ICT's use as means to mitigate Covid-19's impact on the education system with the view of listing potential gaps.

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[9] https://www.google.com/forms/about/

Additionally, it assured the respondent's anonymity and the non-binding invitation to complete and submit their answers.

The first section consisted of demographic questions such as age, gender, and which school year the respondent is related to. The following sections differed on each of the three questionnaires according to each stakeholder's role within the education system. I probed on the respondents' attitudes, preparedness, and employment of ICTs during the transition from a regular school setting to an online one. Additionally, 40 questions, on average, designed by the author, consisted of multiple-choice and further specific open-ended questions to understand the respondent's distinct observations and experiences amid the pandemic that would be used to design the 5-week-long interviews with the same stakeholder group (Palinkas et al. 2015; Bryman 2012; Vogl et al. 2018).

5.2.2 An in-depth comprehension of stakeholders' settings and perceptions – Interviews

This study also contemplated an interview sample (N=6), see Table 4, to generate diversified insight into the teaching and learning constraints arising from the use of ICT's during the pandemic.

ID	Stakeholder	Age	Gender	Sector	Area's typology*	Socioeconomic background*
T1	Teacher	48	M	Public School	Urban	Low-poverty area
T2	Teacher	43	F	Public School	Rural	High-poverty area
S1	Student	14	M	Private School	Urban	Low-poverty area
S2	Student	15	M	Public School	Semi-urban	High-poverty area
P1	Parent	41	F	Private School	Urban	Low-poverty area
P2	Parent	42	F	Public School	Semi-urban	High-poverty area

Table 4. Interviews' participants general information.

The use of convenience, purposeful and extreme-user methods (Liikkanen 2009), used sequentially, determined the selection of two 8th grade teachers (T1, T2), two 8th grade students (S1, S2), and two parents with children enrolled in the 8th grade (P1, P2) (Bryman 2012). The sample tried to gather contrasting perspectives by including participants from the public and private school sectors, dispersed geographically throughout three cities (rural and urban areas), from the same region, with comparatively different household incomes and diverse academic and employment profiles. Despite the small sample, this diversified sampling allowed us to record and examine individual and collective

patterns on the participants' varied perspectives. The selection of deviant cases enabled the recording of ample insights that arose while adjusting to the school closing various issues (Michael Garrett Moore 2013; Vogl et al. 2018).

I adopted a semi-structured interview method due to its flexibility, enabling a balanced way to obtain information evoked by the interviewee. It also helped to create an iterative synergy between the interviewer and interviewee, an "attempt(s) to understand the world from the subjects" (Kvale and Brinkmann 2009) point of view and their experiences (Kallio et al. 2016; Palinkas et al. 2015; Marshall 1996; Mcleod 2003; Burns 1999). The longitudinal study was defined according to Morse and Niehaus (2009), in which the data "is gathered from the same subjects repeatedly over a period of time". So, the 6 participants were interviewed once a week, throughout five weeks, comprehending April and May of 2020, generating 30 interviews. This process occurred by Zoom or telephone, for an estimated period between 13 to 21 minutes, see appendix D.

The interviews started with a brief description of the study and a request to record the interviews. I designed the semi-structured interviews in response to data collated in the survey, which purposefully guided conversations, which process is presented in Figure 3. The more significant amount of teacher's responses in the surveys allowed a clearer direction in the interviews' design, whereas the students' and parents' initial interviews were more exploratory. The interviews consisted of a list of questions and follow-up ones to probe interviewees' pertinent remarks. Upon recording, transcribing and the responses' examination, a new set of questions arose, correlated to interviewees' previous comments and the quantitative data retrieved from the survey, thus clearing or reinforcing some issues and unfolding new ones (Kallio et al. 2016).
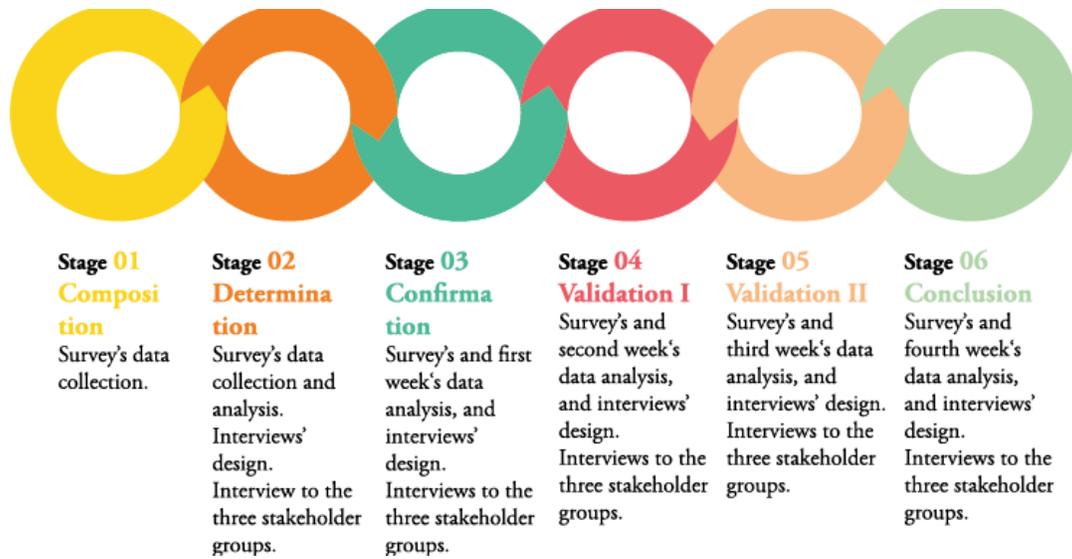
Figure 3. Mixed-methods longitudinal process followed in this study

One pivotal point on the longitudinal inquiry was the individual's interactions with interactive technological mediums adopted, either voluntarily or compulsory, to cope with the new remote learning methods. That is their use of interactive technology to perform specific tasks or connect or communicate with another individual or a group.

5.3 Data Analysis Method and Initial Understandings

5.3.1 Feature coding

The quantitative and qualitative data from the survey (presented in sub-chapter *5.2.1 Initial understanding of the stakeholders' settings and perceptions - surveys*) were examined to determine and guide the interviews (1590 questions). The 30 recorded interviews were later transcribed. Upon the interviews' analysis, 11 categories emerged, and each category was placed in one spreadsheet with a specific colour, found in Figure 4. Excerpts from interviews were added to each sheet and coded into 11 colour-coordinated categories: (i) feelings & perceptions; (ii) homework; (iii) student's assistance; (iv) group activities; (v) classes's structure; (vi) learning methods; (vii) technology; (viii) social media; (ix) communication; (x) institutional information and (xi) tele school. I added excerpts of transcribed interviews to each sheet, according to a respective category and relative to each stakeholder (teacher, student, or parent), week (1 to 5) and individual (1 or 2). Examples of transcripts from teachers (Ts), students (Ss) and parents (Ps) can be found in Table 10, appendix J.

Figure 4. Excerpt of the feature coding with the interviewees' responses (Google Spreadsheet's screenshot)

5.3.2 Cluster analysis

A subsequent cluster analysis was made by summarizing excerpts from transcripts, feature coding, and words that encapsulated their overall meaning or feeling. The resulting 33 words were later placed individually on digital sticky notes, using Miro[10], an online collaborative whiteboard visual platform. The notes are colour-coded to give an overview or relation between stakeholders and their statements. I placed codes relative to categories where most codes emerged. I also identified the three stakeholder groups on dark pink notes; the categories or feature coding's codes are green, the subcategories are light yellow, the 33 words are dark yellow, and the authors' main takeaways are white. This method helps assess data and reveal "the motives of participants for their actions and the reasons behind counterintuitive findings" (Henry et al. 2015). The visual data representation simplifies and grants a discernible overview of the material and the themes that emerge.

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[10] www.miro.com

Figure 5. Longitudinal interviews' cluster analysis

5.3.3 Theme analysis

A theme analysis (found in Appendix K) was also conducted to cross-examine the "individuals' perceptions, feelings, knowledge and behaviour" (Guest, MacQueen, and Namey 2012). Such research was performed using Lucid[11] and outlined the overall impressions of the codes found in the feature coding. The digital sticky notes with the general impressions were used as guidance to reach the three main themes that arose according to the data retrieved from the feature coding: "Education duties", "Technologies", and "Communication". Other themes emerged from the previous ones, thus forming a new sub-theme layer. The sticky notes refer to the three stakeholders: purple for teachers, orange for students and green for parents.

5.3.4 Summary

The data retrieved from this longitudinal mixed-method study indicates that education progressed, amid the pandemic, via interactive communication platforms and social media. The teaching and learning progression happened regardless of the school community's lack of readiness, ICT training and resources in the transition to DE, causing anxiety and unease among the school community. Additionally, some parents' inability to properly assist their children's learning needs leading to a series of issues that the school community tried to solve collaboratively within specific online social media groups. The issues found in this study, concealed in the pre-Covid-19 pandemic, were aggravated, revealing severe inequities in education and knowledge access.

6 Findings

6.1.1 Feature coding analysis

6.1.1.1 *Feelings & Perceptions*

Teachers – Initially, teachers had to manage their anxiety and stress due to the uncertain pandemic's effects and their students as well. The new methodologies and procedures were generally taken as challenges to fulfil in a hopeful manner. Nevertheless, despite being motivated and engaged, teachers felt overwhelmed and sometimes demotivated due to their student's lack of interest.

Students – Generally speaking, the students felt "constantly bored" (S1), anxious and trapped in a setting that is not conducive to proper learning due to the various distractions they have at home. The students perceived that the initial significant amount of homework made them realize that they were not on vacation despite being at home. The school chores gradually decreased, yet the amount of stress and tiredness remained the same.

Parents – Parents observed a lack of focus and fatigue in their children, but mostly boredom due to non-existent routines. Moreover, according to parents, children felt they were on a vacation period, making it difficult to focus on the school chores. Still, eventually, the new DE routines settled, and the students gradually became more autonomous. The stress and anxiety caused by the new environment are emphasized on the parents as well as the new responsibilities towards their children.

6.1.1.2 *Homework*

Teachers – After the school closure, teachers were asked to send school chores via email to the students. Shortly after, they decided to share teaching strategies with each other to unify criteria and implement new procedures to not overwhelm the students, like sending weekly worksheets that they would return in digital format or pictures of their notebook exercises. The initial high expectations were defrauded as the students were subpar, relatively to the face-to-face period, but "this is an extraordinary time in our lives, and we are doing our best" (T2). Regarding their scores, teachers are more benevolent under this situation, adding to their probable lack of resources or parental support (T1, T2).

Students – At first, students were sent 'vacations' tasks' with a 24h deadline, which, compared to a pre-pandemic setting, are "more, much more" (S1). However, some students observed a discrepancy among their friends from other classes or schools who got homework before or after them, or even absolutely none at that point. Usually, the assignment was considered a medium difficulty as it

consolidated previously taught lessons. Students received weekly worksheets by email in the third week with a due date, usually sent by the class director. The scheduled dates granted extra pressure, which was welcomed by some students, who saw their autonomy expand throughout this process.

Parents – Parents also noted a disparity among the homework or 'vacation's tasks' among their friends or coworkers' children. One parent stated the teachers should have sent assignments in a more structured manner from the beginning. This way, students would not feel like they are on vacation. Afterwards, the students received weekly worksheets with a standard number of tasks. Yet, according to the parents, the pupils' proactivity did not increase, as the progenitors must keep reminding them to check their online platforms or emails and do the homework.

6.1.1.3 **Student's Assistance**

Teachers – The class directors would have increased responsibilities, as they would serve as an intermediary between the school system or the other teachers and the students. Instructors had a clear perception that this pandemic "will emphasize the inequities, amongst us, as a society, and we have to face it" T2. However, teachers were uncertain on how to mitigate such issues, especially the students with special needs.

Students – Students would commonly resort to their class director via email to forward their doubts to the corresponding teacher. Some parents were unable to help due to their lack of knowledge. In this respect, the students would ask their siblings, friends or use search engines to aid them in their school tasks.

Parents – Before the pandemic, some parents would occasionally help their children during specific periods, such as before the exams. Nowadays, such assistance proves to be very demanding, especially with other children who also need to be assisted. For those parents who "do not understand" (P2) the student's homework, the assistive role relies on older siblings or extended family. Some progenitors observed an increased autonomy in their children, while others saw their offspring unable to complete their homework without help.

6.1.1.4 **Group Activities**

Teachers – (No relevant information provided on this matter).

Students – One student presented a group project remotely that transitioned from the previous school term. He believes it would not be possible, or he would not like to work on a similar project at a distance, even using ICT, while the other students emphasize the difficulty in working on such

conditions. The first student (S1) also states that he belongs to a study group that existed before the pandemic and now meets with his colleagues using ICT, most commonly social media (Instagram).

Parents – (No relevant information provided on this matter).

6.1.1.5   Classes' Structure

Teachers – Despite the teacher's autonomy, the schools created task force groups that implemented specific protocols with some differences from school to school. Usually, the classes lasted 30 minutes (a block), yet some teachers would join two blocks; if a class had two blocks in a row, these would have 60 minutes. Teachers varied on their evaluation methods regarding grades, from weekly tasks to questions made at the end of the class or Google Form's questions at the end of the period. Throughout this time, teachers claimed to be more benevolent towards the students and their grades, due to this uncertainty and the unexpected or untold issues students faced at home, regarding their resources.

Students – (No relevant information provided on this matter).

Parents – (No relevant information provided on this matter).

6.1.1.6   Learning Methods

Teachers – One teacher claimed to have a brief experience with DE despite no methodological or ICT training. Regardless, this teacher believes he and his colleagues were ready for the new distance teaching format. At the same time, the other pointed out the collaborative process, the initial lack of guidelines and emphasized the "learn by doing" (T2) aspect to deal with such difficulties. In this "extraordinary time" (T2), the new guidance gradually instructed teachers to reinforce previously taught concepts; nonetheless, some teachers preferred to continue the program. The methodologies changed over time, adjusting to local authorities' guidelines or even students' behaviour. DEs positive aspects are acknowledged, and this period served to update a 'stagnant' system allowing "an inclusive teaching" (T1), but the 'real school' and the human contact are preferable because school is not only for "learning what is in the books. It is the connections" (T1).

Students – The divide between private and public schools was displayed due to the apparent facility the private school's students handled the DE's activities submission using Moodle. On the other hand, the public school student never heard about such a system and would send his tasks via email (on digital mode or their notebook's pictures). Additionally, despite the first student finding 'cool' the remote 'Technology' class taken before the pandemic, he prefers a face-to-face setting because it is

more conducive to learning and less distracting. Both students stated they were not fully accompanied, and the weekly activities, although reduced afterwards, were still hard to balance.

Parents – Parents believe the schools' lack of a structured response to the school closing would damage their children's learning outcomes. The inquired parents had dissenting answers regarding their children's school procedures. The private school proved to have established a system (Moodle) before the pandemic that helped during the DE period. In comparison, the public school emphasized tele-school. Parents also tried to develop a routine for their children to provide a structured environment. Overall, the progenitors found the teachers helpful and praised their adaptation to the context, namely decreasing the amount of homework over time. Yet, there is an understanding of the teacher's shortcomings regarding the solve their children's doubts.

6.1.1.7   Technology

Teachers – Some teachers used this opportunity to change some of their teaching methods and incorporate more technological solutions in their teachings. The local authorities' guidelines established the various ICT solutions. However, the teachers took individual approaches to contact their students. The bulk of these interactions were on the shoulders of class directors who used email, Instagram, or Facebook, despite the last platform being associated with 'old people' (T1). Right after the school closures, class directors were asked to inquire their students about their resources. The objective was to know which students needed the tools to progress their learning. Thus, there was concern among these professionals about the scarce resources of some of their students and their parents' lack of knowledge to mitigate some technical issues.

It was emphasized that the student's expertise on ICT surpassed the teacher's skills, especially for the older ones. That could bring some difficulties regarding some type of student's foolishness that could impede the proper class continuity. T1 initially did not believe the students would adhere to Moodle, which was used solely by teachers to exchange meeting minutes or other documents; however, the students proved to be more than capable of interacting with such a system. The public school's principal recognizes this system's advantages by saying "Moodle is here to stay, and now is for good" (T1). Nonetheless, "there are several circumstances that make DE more exhausting" (T2), namely the content's transition for DE context. Additionally, dealing with technical issues or evaluating the students' homework through bad quality or dark pictures sent by them because students "do not have the resources or do not know how to work with it" (T2).

Students – Throughout the interviews, the technology divide became more apparent in both student's schools and households. The private school student used Moodle regularly before the pandemic, so the significant use after school closure was not of concern. Moodle proved to be very effective for the student's learning progress and interaction with teachers. Nonetheless, he finds the need to keep going to the platform, to check if new tasks were assigned, to be quite cumbersome. On the other hand, the public school student never heard about this system and was asked to create an email to receive instruction and send his homework, which could be done on his computer or notebook and later photographed. Students' different learning procedures are also mentioned by both. At the same time, there are synchronous and asynchronous classes in the private school; the public-school student was told to see tele-school classes and complete the weekly activities' plan. The interaction with their colleagues and friends is mainly done through Instagram or WhatsApp.

Parents – Parents refer to the increased use of the computer for learning purposes, yet the notebook is used as well, and the student will take a picture and send it to their teacher. One parent was particularly concerned about her younger daughter's school progression and the troubled initial use of Microsoft Teams. The synchronous video conference classes are seen in a better light because it is closer to what a 'real school' feels like (P1). The parent's social media groups, like WhatsApp, are perceived as necessary, especially for those "people who are a little bit lost and ask for help" (P1).

6.1.1.8 Social Media

Teachers – Some teachers would use specific Facebook pages to get suggestions or ideas in this transitional process, like "e-learning" pages. For others, social media groups with their colleagues would grant the needed support for such educational disturbance. Some of these groups existed before the pandemic as an informal means to pass information. Still, the pandemic period proved to be highly effective in giving knowledge about new methods and encouraging the group. Teachers would mostly use WhatsApp and Facebook groups to contact each other.

Students – Instagram is the preferred medium for students to interact with each other, either by text or voice messaging. The time spent on this social media and WhatsApp groups as well expanded throughout the studied period. These groups would be mainly used to talk with friends.

Parents – Parents' use of social media is scarce, and according to one progenitor, the groups are somewhat complicated and repleted with silliness (T1).

6.1.1.9 **Communication**

Teachers – One teacher with previous experience with DE stated the bonding is necessary; therefore, the face-to-face school setting is preferable. Nonetheless, this could be achieved by discussing some issues with the students after the content is taught. Regarding the communication among teachers, previous channels, like WhatsApp groups, proved to be fundamental to "find more information about all these issues" (T2) and support each other. The student support is emphasized frequently by T1, who is also a class director, who now believes that it must be "100% available for them (students), anytime" (T1). However, those students with lower grades, a poor work ethic and those with several difficulties" (T2) never contacted the teacher.

Students – Students' preferred medium to communicate with their colleagues is WhatsApp and Instagram. Furthermore, they do so to "remind someone who forgot some homework" (S1), to check which activity sheets are due next class or even to joke around, which might disengage some students. Teachers also resorted to social media groups, namely Facebook, to reach their pupils, check their academic progression, and support emotionally more anxious ones. Nevertheless, S2 says his class director sometimes talks to no one, as in, no student would respond or interact with her in the Facebook Messenger group, created specifically for this purpose. As T1 said, students believe Facebook is for 'old people'; therefore, this medium is not optimal to interact with youngsters.

Parents – Parents are aware of the student's communication needs, mostly with their friends, which happens regularly because "all of them have smartphones" (P1). On the other hand, parents do not interact much with each other despite knowing there are proper channels, namely parent's WhatsApp groups. This might happen due to the progenitors' increased responsibilities and some shyness, as one parent mentioned (P2).

6.1.1.10 **Institutional Information**

Teachers – Most of the school's interactions with students and their families are made by the class director, who is often the intermediary. However, the information is scarce and comes on very short notice, emphasising the stakeholders' uncertainty. Nonetheless, one teacher notices a certain detachment among the students, regarding these circumstances, possibly due to their lack of sense of responsibility. The school's insufficient preparedness led to T1 creating an Office Word file with all students' contacts, which he later shared with his colleagues to interact directly with their students. That is, the school did not have the students' contacts in their systems. Similarly, a file with the

teachers' contacts was created and shared with the students to clarify an eventual doubt with the specific tutor. Yet, T1 would intermediate all contacts between students and teachers.

Students – The uncertainty was pervasive among the students who believed their teachers did not fully enlighten them. The school closure's measures and tele-school or videoconference as a replacement for the face-to-face classes were taken with some surprise and apprehension. The pupils are also aware of their parents' lack of information; despite some of their class directors' availability to clarify their doubts, some progenitors never contacted the instructors.

Parents – Some parents were not informed about the added responsibilities on their children learning continuity. One parent was surprised by the overall lack of organization and the fact that "no one knows or gives direct information; it is just what we hear on the news" (P1). Additionally, the communication is poor and imprecise regarding the classes' continuity, grades, weekly homework plans or even tuition. The parents emphasized that the scarce instruction and information channels added anxiety to an already stressful environment.

6.1.1.11 Tele-school

Teachers – Overall, teachers did not consider tele-school as part of their teaching methodologies, yet they acknowledge its pertinence as a complement to their DE tutoring. Some teachers referred to not knowing much about it nor care if their students would see it or not. Others, however, said they would mention it to their students but not evaluate the content taught on that medium.

Students – Students found tele-school content to be tedious due to its simplicity for their age range. One student referred to tele-school as unnecessary, and only one of his teachers mentioned it. Students would rather spend their time studying and doing their homework instead.

Parents – Likewise, parents initially considered this medium, especially to the younger children, but afterwards, they gave up and would focus their efforts on their books, other teaching materials and their homework. In general, parents found tele-school childish and "an attack on children and adults' intelligence" (P1).

6.2 Stakeholders' readiness and learning continuity amid the pandemic

In response to the sudden disruption caused by the pandemic, the general unpreparedness to continue education remotely was manifested in a lack of DE methods and tools, as observed in the survey and interviews analysis. 64.7% of surveyed teachers and 34.3% of parents refer to insufficient resources in the context of DE, resulting in unequal access to education, also acknowledge by T2 and P2. The lack

of DE teacher and student training is also a pressing issue for 87.6% of the surveyed respondents. Nonetheless, we must interpret data in light of the information provided by Portuguese educational authorities, namely that public education services supported 78.6% of students learning online during the pandemic (Sarmento 2020). In addition to the fact that 80.9% of Portuguese families have a broadband internet connection, according to the Portuguese national statistical institute – Instituto Nacional de Estatística (INE) (Sarmento 2020; Ferreira and Gonçalves 2020). Yet, according to 70% of the surveyed students and 54.3% of parents, teachers' unawareness of DE methods and their implementation led to unclear or non-existent information instructions that would support pupils' online learning.

All stakeholder groups recognized the lack of DE preparedness as a significant gap. In response, many of those surveyed had to seek information online through social media groups, where many were already present. Reliance on social media groups for support was particularly prominent among more senior teachers who felt they were facing uncharted territory, especially regarding video conferencing tools, such as Microsoft Teams or Zoom (T1, T2, S1). Generally, the older teachers preferred Facebook Messenger and WhatsApp when seeking support amongst their peers, whilst students preferred WhatsApp and Instagram.

The surveyed data indicates that 80% of the parents who belonged to a WhatsApp group would visit the group more than five times a week to seek more information. 50% of these parents' interactions are about their children's homework, 16.7% about remote learning, 16.7% about their expanded role in their children's education, and 16.7% on how to submit tasks online. This information proved valuable for 80% of the students' parents, who claimed that teachers did not always answer their children's questions raised during DE classes. As demonstrated by the quantitative data, this issue is more pressing for 20% of students who claim a lack of support after class. On the other hand, those who felt supported stated that teachers had an essential role in ensuring learning continuity (66.7%), followed by their parents (55.6%), classmates (44.4%), or siblings (11.1%).

6.3   Student's learning variability

Once school closures resumed, still in remote context, teachers increased student workload to address educational needs and ensure learning continuity. Despite 78.2% of surveyed teachers believing that there was an appropriate number of tasks sent to the students at home, 70% of the surveyed students disagreed with this approach and often felt overwhelmed by the number of tasks to which their parents sympathised and agreed with. The number of tasks sent to students after the school closures were also

considered overwhelming by S1, P1, and S2. Later there was a reduction of homework as soon as teachers realized that students were not meeting the expectations set by a high volume of tasks. In fact, as a result, teachers observed a qualitative decrease in students' responses and a decline in-class participation.

Student participation in synchronous or asynchronous classes also decreased because "there's no comparison between expressing verbally, and clear a student's doubts using a chat, for students to see, when or if they see it" (T2). In addition to the deficient learning, teachers observed the importance of parent assistance, stating that some "will not support the student's needs, and many other needs" (T2, S2, P2), thus confirming the claim of 57,1% of the surveyed parents who said they could not assist their children's academic needs. This issue is especially alarming for students who lack a supportive network and often do not have someone who "can step in as tutors or monitor kids without strong self-learning skills" (Noonoo n.d.), therefore increasing previous inequalities and learning variability amongst the student population (Kuhfeld et al. 2020).

6.4 The weakest link

The retrieved data identified strong connections between clusters in the cluster analysis, as demonstrated in **Error! Reference source not found.**. The "students'" and "teachers'" clusters are connected through technologic tools such as "computer", "Zoom", "email", and social media platforms, for example, now incorporated in the new "learning methods" used in DE context. That is, such tools had a predominant role in the stakeholders' learning and teaching process. Upon inspection, the importance, use, and knowledge of DE's technical mediums are evident, as well as the collaborative dimension implied in their use. This dimension is acknowledged in the sticky note "Group", highlighting the importance of peers, friends, and acquaintances in clarifying doubts resulting from DE context. Additionally, from the students' and parents' perspectives, the technology's collaborative nature was fundamental for the student's comprehension of concepts taught on online platforms and considering the many limitations experienced by parents in their new teaching assistive role. Moreover, the parent's cluster is left detached and unresponsive to the other clusters, reflecting the parents' lack of engagement and understanding. Some parents embraced their new role in their children's education; however, many experienced frustrations due to DE setting (P1, P2, S2). Finally, the question mark visible in Figure 5 demonstrates the lack of contextual awareness and knowledge that inhibits parents' ability to participate and support their children during DE.

6.5   Theme's confluence

We also found three meaningful areas in which the thematic analysis is composed of. Such themes emerged from the feature coding's examination. The research provided valuable insights on the stakeholders' attitudes throughout the longitudinal study and reinforced the cluster analysis conclusions.

6.5.1   Education duties

All stakeholders are aware of the pandemic's constraints and how limited and overwhelming this disruptive event is for all education communities (T2, P1, S2), seen in Figure 88. Nevertheless, students do not feel appropriately guided by their teachers and often rely on other sources like the internet, colleagues, friends, or relatives. The overdependence on the parent's role in the students' support system proved ineffective to their other personal, familial, and professional demands. Additionally, the lack of academic knowledge was cited, by some parents and teachers, as an impediment to helping their children properly. Such an environment required a more dedicated and hard-working attitude from teachers, overwhelmed by the teaching transition and student requests. In order to mitigate some issues or doubts, teachers also looked for their colleagues or friends to support them amid the transitional period (T1, T2).

Some parents observed their children's proactivity increased through the study due to the systematic and organized weekly tasks. In comparison, other parents noticed the pupils' proactivity did not change, as the progenitors must keep reminding them to do their homework. Before the pandemic, some parents occasionally assisted their children during specific periods, such as before the exams. Nowadays, such help proved to be very demanding, especially with other children who also need to be assisted. For those parents who "do not understand" (P2) the student's homework, the assistive role relies on older siblings or extended family members.

6.5.2   Technologies

Some people recognized and praised the expanded use of ICTs to continue previous interactions with teachers and colleagues. However, the constraints regarding the skills needed were expressed, namely for some teachers who, before the pandemic, relied on their students to aid the interaction with technological devices (S1), as seen in Figure 89. The students' and teachers' enthusiasm for the social media groups was not matched by some parents who acknowledged the benefits of the groups' collaborative effort. Yet, the lack of objectivity is seen as unfavourable and time-consuming.

Some teachers would use specific Facebook pages about 'e-learning' to learn more about coping with this transitional process. For others, social media groups with their colleagues would grant the needed support for such educational disturbance. Some of these groups existed before the pandemic as an informal mean to pass information and for bonding. Still, the Covid-19 pandemic proved to be highly effective in exchanging knowledge about new DE methods and encouraging the group members whenever necessary. Teachers would use mostly WhatsApp and Facebook groups to contact each other, while Instagram was the student's preferred platform to interact with each other, either by text or voice messaging. The time spent on social media groups expanded throughout the studied period for educational or recreational purposes like talking with friends and colleagues.

Some teachers believe they were ready for the new DE format; however, the collaborative process and the "learn by doing" (T2) aspect to dealing with the unknown marked the entire process. DEs positive elements are acknowledged, and this period served to update a 'stagnant' system allowing "an inclusive teaching" (T1), but the 'real school' and the human contact are preferable because school is not only for "learning what is in the books. It is the connections" (T1) and the bonds that are created while learning and teaching. Also, the inequalities in the access to proper resources and an environment conducive to the student's learning are cited as essential issues to address; yet unfairness and injustices will exist regardless of the circumstances (T2).

6.5.3 Communication

Formal and informal communication constituted a necessary form for the stakeholders to interact. However, some issues arose initially but were gradually solved, which ultimately benefited the educational system. Most of the school's interactions with students and their families were made by the class director, who was often the students and faculty intermediary, as seen in Figure 90. Nevertheless, according to the interviewees, the information is scarce and comes on very short notice, emphasizing the stakeholders' unease.

Formally, in the school community and local authorities, "no one says anything" (P2), leading the individuals to rely on each other informally through social media groups. The formal communication was mainly made up between teachers and students who tried to progress education through educational activities present in weekly task's plans. This structured approach led some parents to notice beneficial effects on students who used the social media groups to complete their plans.

6.6 Summary

After the data examination, the initial uneasiness and anxiety regarding the pandemic context and the consequent sudden and seismic shift in people's lives are clear. Despite the initial dismay, an evolving attempt to progress the students' learning was executed. Such accomplishment was achieved using ICTs, which at first caused commotion due to the lack of preparedness, training, or resources from the school community. The teacher's and student's lack of ICT training, the student's and household's insufficient resources and the parent's inadequate response to their children's instructional needs led to an array of problems that the school community had to solve remotely while in mandatory confinement. The issues described above, latent in the pre-Covid-19 pandemic, were exacerbated amid the school closures revealing severe inequities in the access of knowledge and instruction.

7 Design Implications

Human-Computer Interaction (HCI) research is continuously studying how to connect people over distance using interactive digital technology, which in the Covid-19 pandemic has an added purpose. Not just in the light of the remoteness by itself but as the only means to connect, possibly for an unforeseeable time, the whole education system. It is fundamental to provide "a rich experience to all learners who are now without 'traditional' teachers standing beside them in classes" (Merrill 2020). Instead of relying solely on text, interactive technological devices may enable several resonant types of answers to a problem, thus fostering creative thinking. ICT tools can be aided with tangible materials, compelling pupils to diverge from their electronic devices.

From the previous results presented in *Findings*, I can conclude that the ICTs general acceptance does not necessarily mean that their implementation and use reassure the learning continuity's success. The need for a flexible response due to the pandemic's uncertainty and the education's stakeholders' extensive requirements should be recognized and further addressed. Moreover, the collaborative reflection expressed by the stakeholders indicated the need for a redesign of the existing solutions (T1, S1) and the expansion of more technological mediums to enable interactions among the stakeholders that were part of this study. They derived the creation of a set of design implications, developed after the longitudinal mixed-methods study analysis (Sas et al. 2014), divided into three groups: a) levelling the playfield with an assessment and equitable distribution of resources (5 design implications); b) managing the learning experience that emphasizes the academic and bureaucratic systematization to increase effectiveness and participation (8 design implications); c) communication and collaboration efforts to also extend and effective communication for varied purposes (8 design implications). These

solutions seek to answer student's pedagogical needs (T1, T2, S1, S2) and reduce the teachers and families' struggle to help their children with their assignments and homework (S2, P2).

7.1 Levelling the playing field

An important category that could be used to generate design implications consists mainly of technology-driven solutions (T1, T2, S1, S2, P1, P2). Implementing the set solutions might not be homogeneous throughout the schools or regions, and "there will always be injustices" (T2). Some families already possess a device (tablet, laptop, or pc), but it is essential to know if that device is shared, or not, among one or more siblings, for example.

Ensure technological equity - It is fundamental to understand the shortcomings of school communities to ensure resources' equity (T1, T2, S1, S2, P1, P2). This assessment could be executed using surveys (by any mean available) to teachers and families to know who will need devices and bandwidth.

Resources' evaluation - An estimation and promotion of all available digital resources are necessary as a means to be fully employed and optimized for mobile devices when a laptop is not available.

Increment of usability – Increase digital platforms' interactivity features in which the user would be timely notified in colour graded manner according to the type of material available like homework, grades, or information (T1, T2, S1, P1).

Technological instruction – Training must be provided to tutors and students, in the implemented technological solutions, and the future ones, continuously and in different formats such as tutorial videos or still images, for example.

Technological support – Educative institutions (schools or governments) could aid teachers, students, and parents with consistent and continual tech support to the tools that should already be limited to avoid the occurrence of confusion. Therefore, a tech support team could be created to assist the school community, providing help in several formats, such as telephone, videos, still images, step-by-step guide text, etc.

7.2 Managing the learning experience

The qualitative data analysis also concludes the need for a protocol in which a schedule is organised for classes, homework deliveries, discussions, and/or interactions.

Participatory management – The school community could be encouraged to make recommendations or suggestions in an open and participatory manner. The involvement of the community will serve to understand and consider everybody's points of view and set expectations.

Class management – A class protocol could include 45 minutes extended classes to promote student's participation in the last 15 minutes of class (T1, S1). As well as develop student's presentation content or homework to value their synthesis and public speaking (P1, P2, S1, P1). This extended time could serve students to comment on each other's work by giving and taking constructive feedback and insightful suggestions.

Class participation – Videoconference classes proved to be a matter of deep discussions about its pertinence and safety. According to one participant, synchronous videoconference classes facilitate "proximity to students, for one side, while on the other, some students will always be harmed because their familiar environment is not conducive to those types of classes" (T2). There is a need for a "certain type of isolation for them to focus on those types of classes" (T2), yet it seems to be the best approach because it "draws more of their attention than being there chatting" (P2).

Establishing homework – A protocol should be established for assigned tasks and homework where a work-sheet plan could be sent regularly (weekly or bi-weekly), so the school community can organise their schedule. This will allow the "parents to be able to support their children and to facilitate the student's organization" (T2) as well as imbue an extended sense of responsibility, autonomy, and proactivity.

Independent learning – Although student's autonomy can be nurtured and promoted, "sometimes it's good to be pushed to improve" (S1), and consistent deadlines seem to improve student's response (S1, S2, P1, P2). An organization tool could be established for students if they choose to follow.

Homework efficiency – Online learning should not overwhelm students, so the amount of homework should be divided into smaller parts with clear objectives. Teachers could take advantage of the interactive multimedia and support other activities like watching videos / movies / documentaries or explore cities and/or museums virtually to create a more engaging learning experience (T1).

Teacher's feedback – Teachers could provide feedback of the previous responded plans into the subsequent one, so students are aware of their learning process. Moreover, the feedback could be immediate through online collaborative documents, thus motivating the students to continue their learning.

7.3 Communication and Collaboration

A pertinent claim expressed by participants (T1, T2, P1, P2) was the timely and consistent access to information. Uncertainty could be alleviated quickly with clearer, concise, and consistent communication among the school community. To avoid confusion and mistrust, teachers, parents, and students could have access to various levels of procedures and frequently asked questions.

Data anytime, anywhere – It is preferable to digitized pertinent information, such as the school communities' contact, to facilitate the communication. Maintaining an up-to-date source of information is crucial to optimize time and resources, as well as "prevent confusion and miscommunication" (T1).

Group communication – It is essential to endorse students, parents and teachers' associations and creation of groups among them on a platform chosen by them. The set group might be used to "clear doubts, as well as to inform each other of new training" (T2). But a set of contact standards and conduct norms among stakeholders must be developed to avoid miscommunication and inappropriate remarks or interactions (S1, P1). And while teachers can seek their colleagues for emotional, psychological, or theoretical support, they can also promote closer interaction among students.

Teacher/Students' communication – A contact group could be created on a safe and more consensual platform, so trust can be built and establish an open line of communication. It is

important to understand students' most favourite options and forms to communicate, either text or voice message (T1).

Student's open, collaborative communication – Although students claim to resort to search engines like Google to understand some concepts to solve their homework, a crossed communication platform between students from different grades can also be created. The older students could help the younger ones, thus mitigating the deficient learning that 80% of inquired students, 84.1% of teachers and 51% of parents claim to exist. Moreover, according to the same surveys, 50% of the parents resorted to social media groups to understand how to clear their children's doubts. This tool could also be promoted to forge fellowship among students and promote a healthy and amicable school environment.

Open, collaborative teaching system – The remote and collaborative nature of interactive digital tools could also be deployed to a teaching community that can answer students' questions on an individual level. It also could mitigate the lack of support some students have at home, namely the 57,1% of parents who claim they are not able to fully clear their children's doubts (S2, P2). It is especially alarming to the students without a supportive network without someone who can adequately help them. The solution should be comprehensive, so students with learning impairments are also addressed in these precarious circumstances. Moreover, the instruction in a human-centered manner as praised by the UN would therefore lead to a humanized learning environment.

Student's closed collaborative communication – The collaborative element mentioned in *"Student's open, collaborative communication"* could also be lightened by creating group studies and enhancing the number of group projects assigned to students who will use collaborative digital tools to accomplish it (S1, S2).

Student's low-tech communication – A group study may be created to tackle technological accessibilities from one or more group members. A protocol should be developed in which a provided worksheet could be shared with the student with no technological resources by resorting to postal services. This peer-to-peer communication, via low-tech solution, "so that kids with no internet can feel like they belong" (Merrill, 2020).

PenPal Project – A PenPal might be assigned to one student or a group of students who would help each other through platforms designed for that purpose. The postal services might also be used for it by supporting a distinctive way to start new kinship, friendships - nationally or internationally. The students would achieve new academic and personal capabilities and skills, such as a new language, thus broadening their horizons and making new connections.

7.4   Summary

The collaborative reflection expressed by the stakeholders found in the previous section – Findings – indicated the need for a redesign of the existing solutions (T1, S1) and the expansion of more technological mediums to enable interactions among the stakeholders that were part of this study. These also derived the creation of a set of design implications divided into three groups: a) levelling the playfield with an assessment and equitable distribution of resources; b) managing the learning experience that emphasizes the academic and bureaucratic systematization to increase effectiveness and participation; c) communication and collaboration efforts in order to also extend and effective communication for varied purposes. These design implications seek to answer teachers' and students' pedagogical needs (T1, T2, S1, S2), as well as reduce the families' struggle to help their children with their learning progression, school assignments and homework (S2, P2).

8 OWL CLUB System

This chapter presents the OWL CLUB's ideation process and uses Design Thinking's problem-solving approach to create 'viable and novel' concepts for a particular user group. This "human-centered approach to problem-solving" (Kimbell 2011) core is grounded on a continuous 'work-in-progress' framework. The comprehension and characterization of the user's context, presented in the previous chapters, elicited the design directions for an interactive mobile system. Additionally, the *Design Implications* gave me relevant insights for creating the system that I will present in this chapter, namely those contained in the sub-chapter 7.*3 Communication and Collaboration*, mostly the *Open, collaborative teaching system*. The stakeholders' remarks regarding the communal interactions in various moments throughout the school closures led me to believe that this is a suitable solution to bring together the entire community in order to mitigate the problematic issues encountered by students.

   In the following chapter, I present the OWL CLUB system's design requirements – proposed solution - derived from the data presented in the previous chapters. Additionally, the system's architecture and the OWL CLUB app final iteration are introduced, divided into sections (sign in & registration, student's mode, and mentor's mode).

8.1   The Proposed solution

The longitudinal mixed-method study focuses on the DEs context amid the Covid-19 pandemic, brought light to the many new and previous barriers that arose and prevented the student's proper learning process. Once the problem is settled, I begin to create potential solutions by analyzing the literature gap and the users' remarks. As stated before, I concluded that creating a new mobile system to address the needs of the K-12 students is of extreme importance. An ideal system that would mitigate the above-mentioned educational inequities introduces the African's expression 'it takes a village to raise a child', which deviates from the pervasive concept that education is restricted to students and teachers in a formal school's physical setting. Additionally, according to Bourdieu's cultural capital's concept states that one's surrounding dictates one's interests "useful skills, ideas, and knowledge" (Silva, Mora, and Straubhaar 2018). This spontaneous and resourceful learning aided by multiple insights might be facilitated by "the surrounded cultures as a source" (Papert 1993).

   This system could also provide "a rich experience to all learners who are now without 'traditional' teachers standing beside them in classes" (Merrill 2020), thus addressing the students' learning variability aided by a community-centered approach. The community would support the students through "humanized learning by permitting more personal, less alienating relationships" (Papert 1993)

while creating bonds and partnerships in the learning process. The gathered data was insightful and helpful in the OWL CLUB app's creation, which requirements are summarized in Table 5. Proposed system e-mentoring Table 5.

Platform /Features	OWL Club
Subscription	No
Costs	Free
Profiles displayed	Yes
Type of dyad	Group / One-on-One
Randomly paired	-
Duration of dyad	Instantaneous
Discussion prompts	No
Synchronous or Asynchronous	Asynchronous
Type of interaction	On platform
Mobile or Web-based technology	Mobile app

Table 5. Proposed system e-mentoring nuclear features.

8.2   Design Direction

The system's development was a continuous iterative design process. I began by exploring several solutions in a simple, intuitive mobile system that incorporated the aforementioned features and assessed which option was the most pertinent. The need for two separate environments for each set of users with the student's questions element for both groups to interact was established. I explain in detail in the following sub-chapters.

8.3   OWL Club's Architecture and Usability Process

The mobile system seeks to intermediate two types of users – mentees or students and mentors; therefore, the mobile app has two separate environments in which both users interact in the students' question's segment. This app seeks to promote and nurture fruitful interactions in a positive learning

environment and avoiding a poor design that "could lead to participant disengagement and poor-quality" (Houghton et al. 2019) knowledge passing. The OWL CLUB app can be divided into three parts:

Sign in and/or Registration – the user enters the OWL CLUB app using their email and password, or they can register to create an account, as seen in Figure 91, in appendix L. The registration is divided into two parts, where the first part is general, and it asks the user's name. Next, an avatar might be chosen by a pre-determined set of drawings instead of using the user's photographs, thus reinforcing the safe nature of this learning environment. Afterwards, the user places their email and password twice for confirmation purposes. The registration's second part is differentiated between mentors and students and starts by choosing the "students" or "mentor" mode. In the student's mode, they select the school cycle they are enrolled in, followed by the school year, their favoured classes, next, the classes in which they have the most difficulties, and finally, some of their personal interests. In the mentoring mode, users initially choose the school cycle, school year, and subjects they want to assist, followed by their personal interests. Therefore, the mentor will only get access to student's questions according to the information provided to the system upon their setup account.

Student environment - The students would seek the mobile system to clarify their doubts in written form, which could be answered by more than one member of the teaching community (mentors). The questions are in the student's initial screen, both answered (yellow background) and not (white background). The user can change the questions' view mode: Tudo (all), Disciplina (subject), Respondido (answered) and Por responder (unanswered). On this screen, the students can go to the menu, notifications, search, see their profiles and pose a new question. When a student wants to publish a question, the subject must be chosen first, followed by the doubt, and the pupil may either publish or notified their favoured mentors' network first and then publish. The published but unanswered question will have a white background, while the answered ones have a yellow background. The student will be then notified when their questions were responded to and if one or more answers were liked. The students could then like one of the answers they were enlightened, thus raising this answer to the top positions and according to the number of people who voted in the same response. If a mentor's answers clarified the student, the pupil could add this mentor to their mentor cluster or network, divided per area, namely geography or math, and create a bond. This bond would translate into a preferred channel of communication between these two members of the community. Please see Figure 92, in appendix L, for more clarification.

Mentor environment – The mentor's environment is more straightforward than the mentee one. Yet, the mentor will also find a set of students' questions answered (yellow background) and not answered (white background). This user can also change the questions' view mode: Tudo (all), Disciplina (subject) and Por responder (unanswered). On the same screen, mentors can go to the menu, notifications, search, see their profiles. The mentor can answer the student's doubts by checking the forum or through the notifications sent by specific mentees. Next, the answer provided by one mentor would be validated by two randomly chosen mentors and later accessible to the students who wrote it in the first place. The chosen mentors will be notified, and they must accept the answer on their notification screen. The goal is the provide the most accurate knowledge to students who seek the app. If the mentor finds an appropriate and enlightening answer, they may like instead of answering, thus changing the answer-space from a white background to green and raising it to the top. Please see Figure 93, in appendix L, for more clarification.

Both types of users can also remove the bond between them, report a user (for not respecting the norms stipulated when the participants agreed to enter the community). Also, they can turn off the notifications and see each other's profiles for more insight into their likes and dislikes. Similarly, each question or answer has an option available to all users to report it for lack of compliance to the system's guidelines, disconnect notifications and disconnect from this particular content. Likewise, the menu's options are also available for both sets of users where they can go to their content, notifications, drafts (student's written questions and mentor's written responses that were not sent), definitions, language, help and logout.

8.4   OWL Club App

The system's development was a continuous iterative design process grounded in the revised literature and the analysed data, which derived into a series of design iterations. At the end of each iterative phase, I developed a prototype evaluated on a usability test. The iterative process was significantly advanced with the feedback gathered in the usability tests through the low-fidelity prototype and high-fidelity functional prototype. The human-centered design approach led to this system's concept and development based on the behavioural data collected. Iterative design methodology can identify and improve most usability issues, but "the designer must be able to separate actual usability problems from quirks due to individual differences" (Bailey 1993).

The information and most of the navigation smoothly ascends from the smartphone's bottom edge and uncovers more pertinent information and interactive elements. This approach enables the users

to interact with the required input solely, thus focusing on fewer elements at the time. To switch the previous option, the scrolls to that point and such change will unfold other information.

8.4.1 Final System – OWL CLUB Application

8.4.1.1 Launching Screen

The OWL CLUB system initiates with a launching micro-animation where the owl emerges from one side (sides or bottom) randomly and looks at the app's logo.

Figure 6. Launching screen

8.4.1.2 Sign in & registration

Both groups of users - students and mentors - must sign in or register to enter the OWL CLUB app. The users should fill in their information in the registration phase like name, choose avatar, email, and password. On the registration's second part, the app differentiates between students and mentors by filling in specific information relative to their mode. The students select which school year they attend and which subject(s) they need support, for, e.g., and the mentor selects which school year(s) and subject(s) they want to assist the students, for, e.g. Both users are also required to share their interests to ease interactions and doubts' clarifications and ultimately form genuine connections.
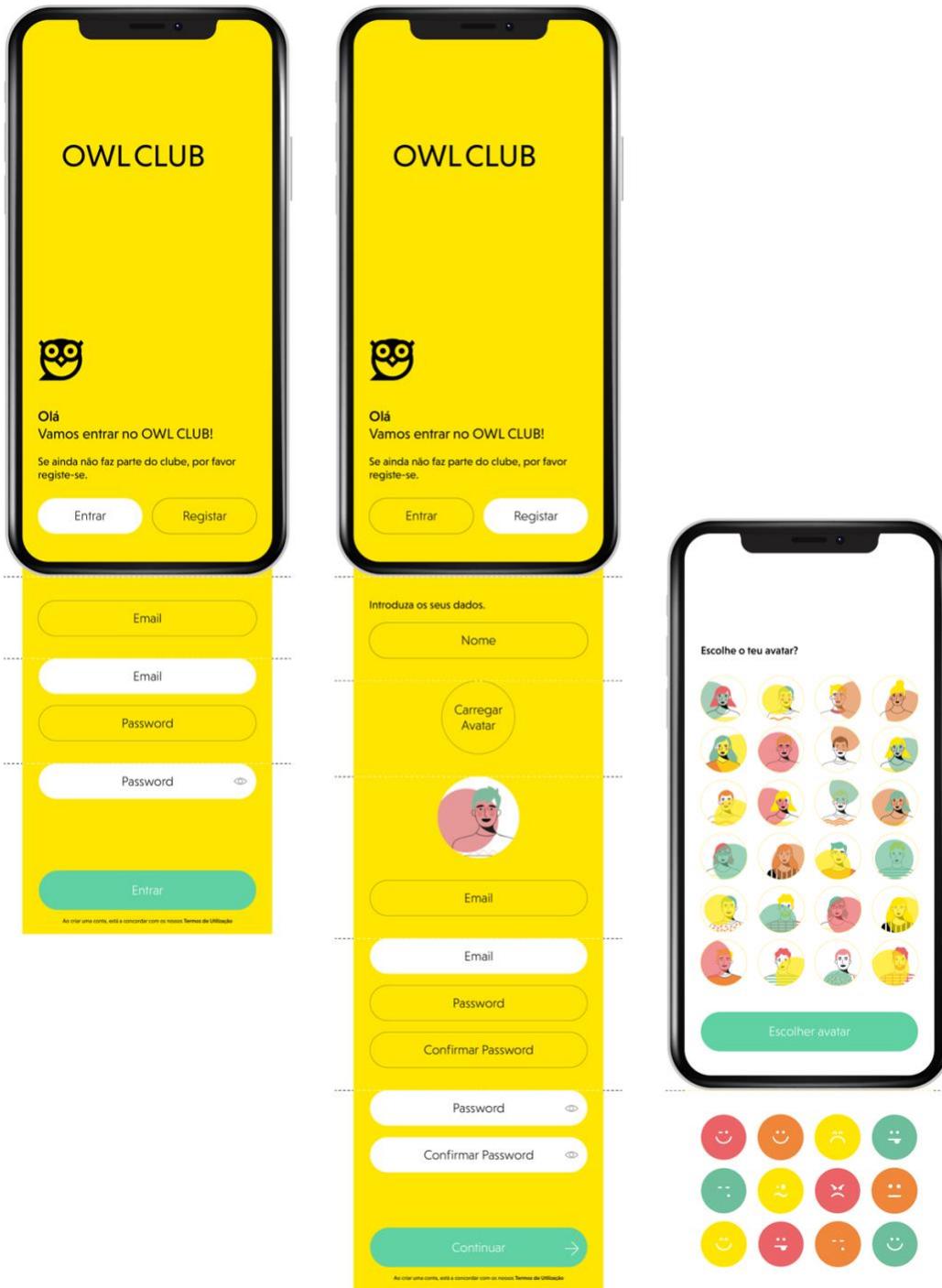
Figure 7. Sign in & Registration on the left. Registration (first part) on the middle. Registration (first part) - Avatar options, on the right.
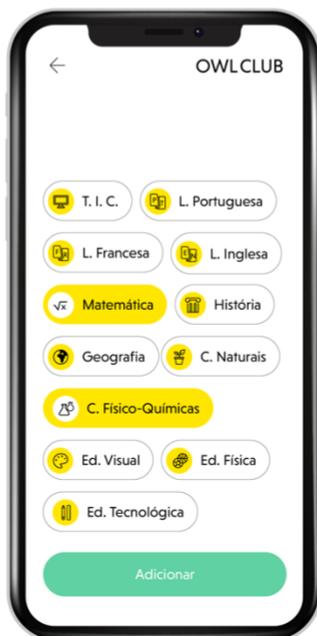
Figure 8. Registration (second part) - Student mode, on the left. Registration (second part) - Classes' options, on the middle. Registration (second part) - Interest's input, on the right.
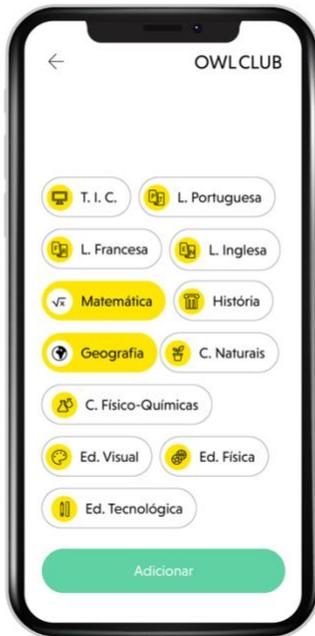
Figure 9. Registration (second part) - Mentor mode, on the left. Registration (second part) - Classes' options, on the middle. Registration (second part) - Interest's input, on the right.

8.4.1.3 Student's Mode

8.4.1.3.1 Home

After the initial greeting (Figure 10, left image), the student's home has their last interactions – recent question(s), the mentor's answer(s) or likes. The top and bottom's buttons are pervasive in most of the student's screens: on the top-left, the user find the menu, and on the right, the logo. On the bottom-left, the user can press the question button, which will lead to the last posed questions, now highlighted, followed by the notification button. On the bottom-center, the main button starts the posing question process. Next, the search button, the user can search a specific content by introducing some words included on the questions and/or answers, and finally, the user's profile button.

In the question's history (Figure 10, middle image), there are four fixed possible view modes: Tudo (all); Disciplina (subject); Respondido (answered); Por responder (unanswered). The question-space is yellow with the answer(s) behind it. This space has the student's image profile, name, and school year, on the top-left and a submenu on the top-right. The question is in the middle with the date below. On the bottom-left, the user can see the number of answers given and, on the right, the edition button. The student can see the question by pressing the yellow question-space. Most liked answers will be green and on top (Figure 10, right image), and the answer-space's design is similar to the question-space with the mentor's image profile, name, and profession, on the top-left, a submenu on the top-right. The answer is in the middle, with the date below, the like button is on the bottom-right, and those who liked the answer are on the left, which can be pressed to visit their profiles.
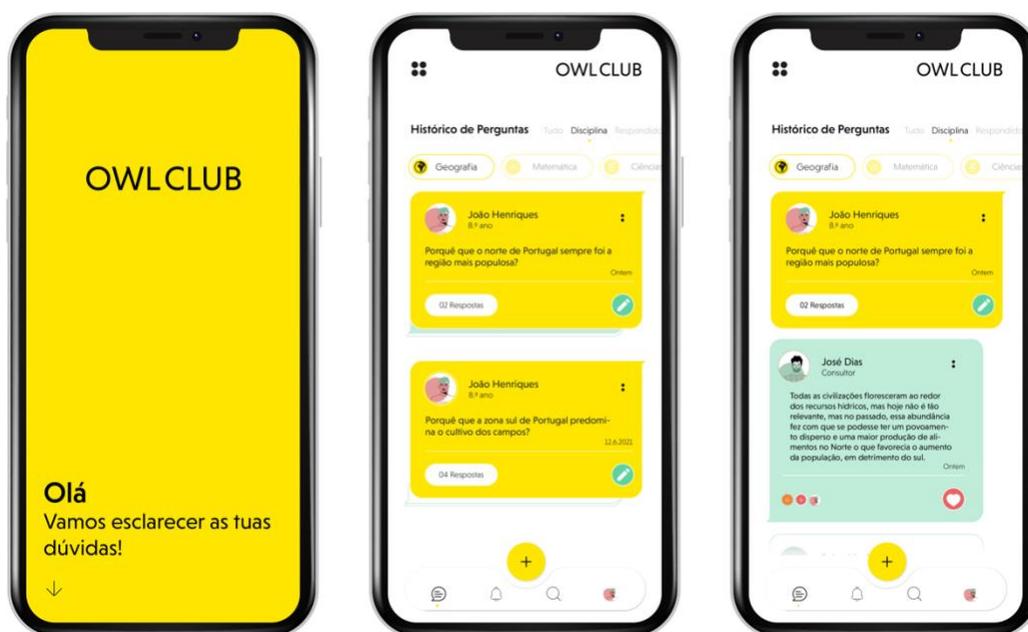
Figure 10. Introduction (students), on the left. Student's home, on the middle. Opened question and Like interaction, on the right

8.4.1.3.2   Posing a question

After pressing the bottom-central button, the student poses a question at any point or screen; next, the user chooses the subject (added on the bottom-right button) or remove (by pressing the subject button and dragging to the bottom). In the writing input space, emoji(s), document(s), or image(s) can be added. A specific mentor(s) can be notified, or not, before publishing the question.
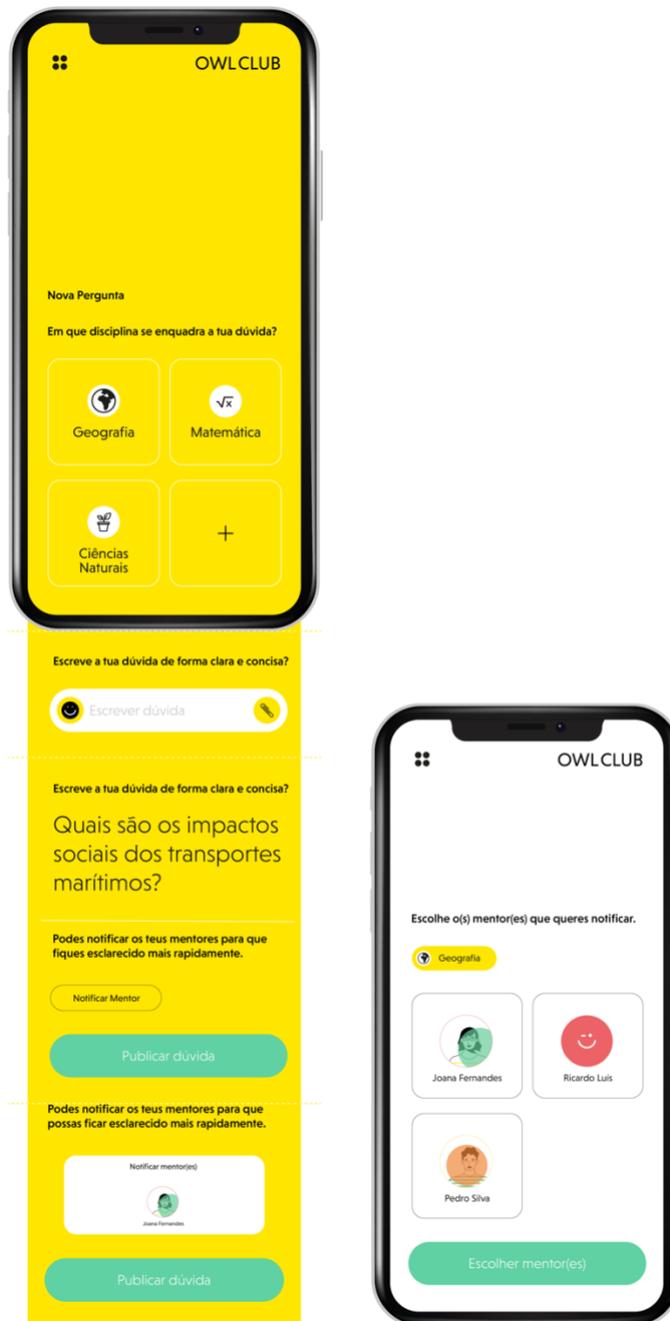
Figure 11. Posing a question, on the left. Notifying a mentor, on the right.

8.4.1.3.3   Mentor's profile and add to student's network

After pressing the mentor's profile image, the user can see their profile (Figure 12, left image) with name on the right and the left, a sub-menu 3 (Figure 20, fourth from the left), their answers, likes, and connections to students. Next, a profile statement (optional), field(s) of expertise, interests, and finally, a button to link or unlink with this user. To connect to a mentor, the student needs to press the link button and add the mentor to a particular mentor network (geography, e.g.) (Figure 12, middle image). A warning appears when this action is successful (Figure 12, right image). When scrolling down on the mentor's profile, the student can see this user's last answers or likes. It is possible to see the pervasive navigation buttons also.
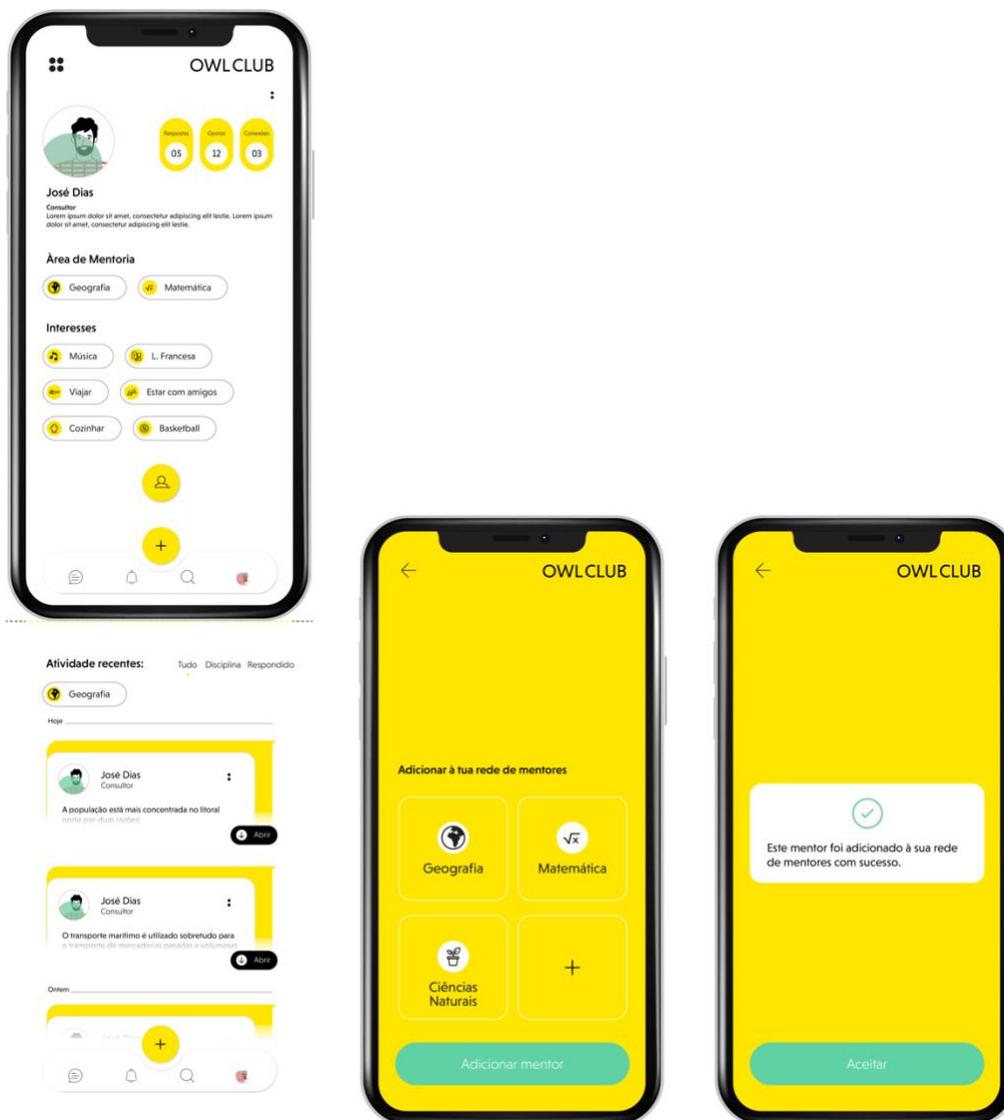
Figure 12. Mentor's profile seen by the student, on the left. Mentor's addition to student's network, on the middle. Mentor's addition to student's network completed, on the right.

8.4.1.3.4   Notifications

The notifications screen comes out after pressing the notification button on the bottom, now highlighted. Similarly to the Home screen, there are a few fixed possible view modes, three to be exact: Tudo (all); Disciplina (subject); Likes. Below, the user will be alerted of the answered questions, which will need to scroll down and open by pressing the "Abrir" (open) button.
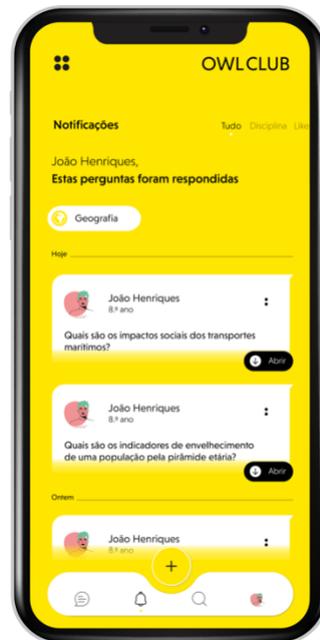
Figure 13. Student's notifications.

8.4.1.3.5   User's profile

The student's profile is very similar to the mentor's one; the pupil's profile picture is on the top-left, with their name and a profile statement (optional) below. On the right, the sub-menu can be pressed to edit the profile and change settings like the user's activity, mentor network and notification's settings. Below sub-menu 2 (Figure 14), there are several posed questions, likes and connections to mentors. In the next segment, we can find the user's favourite subjects, followed by the subjects needing support and their interests. Scrolling down, the student can see their last posed questions and answers provided by mentors (need to be opened).
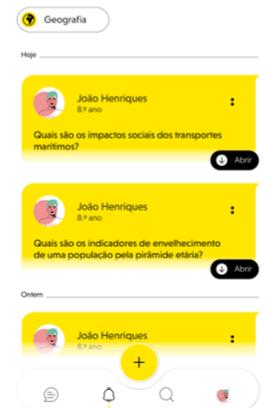
Figure 14. Student's profile.

8.4.1.4   Mentor's Mode

8.4.1.4.1   *Home*

The mentor is greeted initially, and in the mentor's home (Figure 15, right image), there are the last interactions – recent answers given to a student or likes. The top and bottom buttons are constant in most of the mentor's screens: on the top-left, there is the menu, and on the right, there is the apps' logo. On the bottom-left, the user can press the question button, which will lead to the last answers provided, now highlighted, followed by the notification button. Next, a search button to find content by introducing some words included on the questions and/or answers, and finally, the user's profile button. This screen shows the user the answer's historical; there are four fixed possible view modes: Tudo (all), Disciplina (subject), Respondido (answered) Por responder (unanswered). The questions

unanswered have a white question-space, so the mentor can quickly recognize a student's doubt. But its design is similar to the student's environment and provides identical information as the student's image profile, name, the question or the answering button (bottom-right).

Figure 15. Introduction (mentors), on the left. Mentor's home, on the right.

8.4.1.4.2 *Answering a student's question*

The answering process starts when the mentors press the answer button in the question-space. Next, a writing input screen appears with an emoji button on the left, and on the right, the user can add a document or image that help clarify the student's doubt. After pressing enter or the submit button (with a plane icon) that appear after the answer is initiated, the mentor's answer will be submitted, but before, it must be validated by two random mentors. After such validation, the student can see the answers in their question feed. This answer will have a white background which will turn green when it has more likes than the other ones.
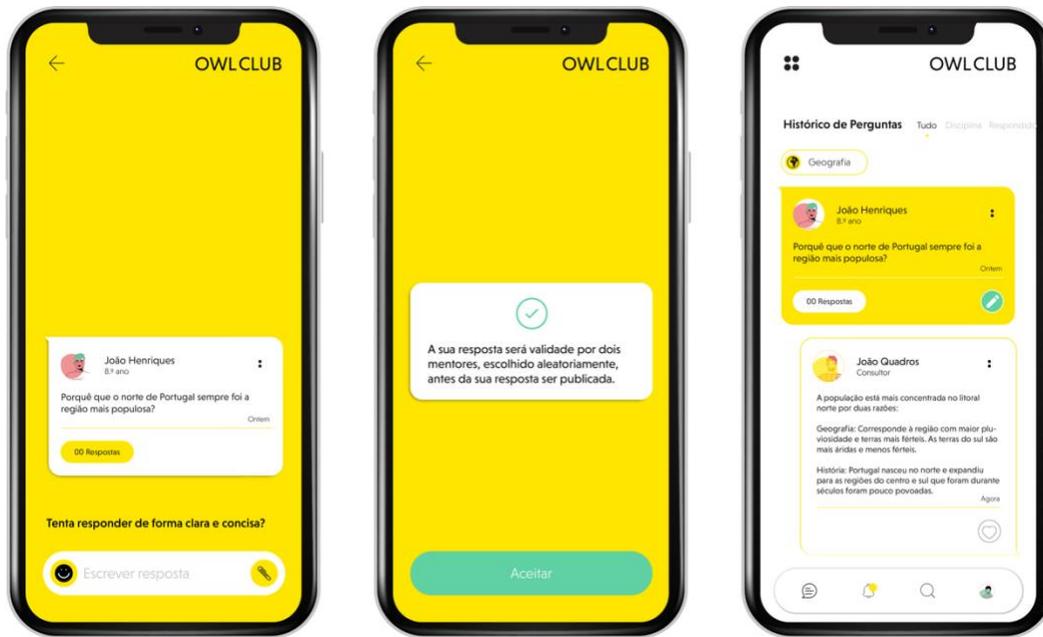
Figure 16. Writing answer for a student, on the left. Message: Need for submission's validation, on the middle. Answer submitted, on the right.

8.4.1.4.3 Student's profile

The student's profile can be accessed by pressing on the student's profile picture on the question-space. The mentor can see the student's profile picture, name, school year, and profile statement (optional) on the right. On the left, a sub-menu, the student's posed questions, likes, and links (connections to mentors). Below are the student's favourite subjects, the subjects in need of support, their interests, and a button to unlink with this user. Scrolling down, the mentor can see this user's last posed questions and answers, which this mentor needs to open.

Figure 17. Student's profile seen by mentor.

8.4.1.4.4   *Notifications*

Like in the student's mode, the mentor can check their notifications by pressing the notification button on the bottom, now highlighted. There are also three fixed data visualization modes: Tudo (all), Disciplina (subject), Likes. Below, the user will be alerted of students' questions and answers needing validation, which can be scroll down and open by pressing the "Abrir" (open) button.
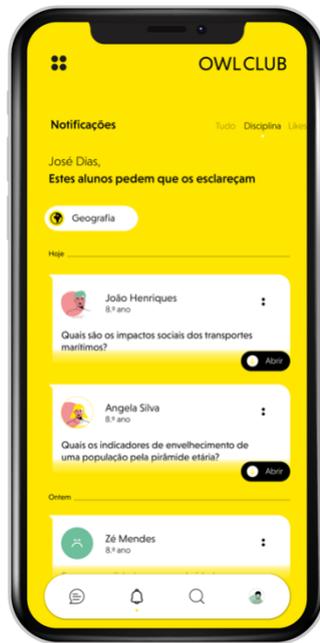
Figure 18. Mentor's notification.

8.4.1.4.5 *User's profile*

The mentor can see their profile headed on the left by their avatar, name, and a profile statement (optional). And on the right by a sub-menu (with similar features found in the student's profile), the number of answered questions, likes and connections to students. Afterwards, there are the user's mentoring subjects and their interests. The user's last interactions (answers and likes) can be seen by scrolling down in the following segment.

Figure 19. User's own profile (mentor).

8.4.1.5   Menus

There are four menus accessible two both user groups, divided into main menu and sub-menus. The main menu (Figure 20, main menu) is accessible; after pressing the menu button on top (four dots), the users have access to their content, notifications, drafts, overall settings, help and exit the app. While for the sub-menus, the users can interact by pressing on the two dots on the right side of the content. The first one (Figure 20, sub-menu 1) appears on the top-right of their content space (question or answer) and allows users to edit their own submission to edit it, change the date, move to drafts, or remove it. The other submenus (Figure 20, sub-menu 2 and sub-menu 3, respectively) sub-menus refer to the users' actions on other users or their content. So, on the sub-menu button, located on the top-right of the other user's submission, one user may switch off that submission's

notifications, hide or report, and disconnect from this user. In sub-menu 3, the actions taken refer to the other users specifically. This menu can be located on the other user's profile screen, below the logo, so their notification can be switched on or off, have restrictions (such as when answers will be given), and be blocked, reported, or disconnected.

Figure 20. From the left to the right: Main menu, Sub-menu 1, Sub-menu 2, Sub-menu 3.

8.5 Summary

I introduced the OWL CLUB app as the proposed solution to mitigate the issues mentioned in the previous chapters. I presented the design directions as well and described the system's implementation. Initially, the desired requirements for a system were established to address specific issues such as the students' learning variability. The system's architecture comprises three main parts (sign in & registration, student's mode, and mentor's mode). Afterwards, it is present the OWL CLUB final system with the usability descriptions, divided by features. A set of screens is gathered according to a specific feature's consecutive actions (pose a question, e.g.)

In the following chapter, I will present and explain the methodologies used to evaluate the prototypes that led to the solution presented in this chapter. The system's evaluations are characterized by two moments: low-fidelity prototype and high-fidelity functional prototype. I will describe the tools and devices used to build and test our prototypes, as well as and establish a usability performance comparison between both evaluation moments.

9 Evaluation

In order to determine this system's pertinence and its usability, I conducted two sets of tests. The user's understandings of the OWL CLUB app were assessed in two moments: low-fidelity prototype, using a paper printed version and high-fidelity prototype, using a smartphone.

This chapter presents the methodological approach I took for testing the prototypes with specific test subjects and tasks. The full awareness of the user's needs is paramount to facilitate "the bridge between ideation of the tool and the intended users' tasks and experiences" (Monteiro-Guerra et al. 2017). The prototype will "deepen the understanding of the user's needs, (...) and explore more solutions" (Pham, Fucci, and Maalej 2018) gained from the user's feedback from the usability tests. The user's interactions were measured and analysed. The results of the set examination are discussed, and the outcomes are presented below.

9.1 Prototypes

9.1.1 First usability test: Low-fidelity prototype

The prototyping phase followed the concept generation, where ideas were sketched on paper. Once the concept and the features were developed, a low-fidelity prototype was created on the Balsamiq[12] platform – a rapid prototyping tool. The execution of this prototype eases the forthcoming design changes, less focus on inopportune details, and "users feel less pressure, being more likely to express reliable reactions" (Monteiro-Guerra et al. 2017; Houde 1992). The prototype was downloaded from Balsamiq, printed on paper, cut on the smartphone's exact size, and divided by environments (Sign in & Registration, student, and mentor). The prototypes' figures are presented in appendix M and showcase some of the participants' suggestions and the author's iterations on the usability tests.

9.1.2 Second usability test: High-fidelity functional prototype

The insights gained with the low-prototype's usability test brought immense value to the following iterations that refined the app system and led to this prototype. As the design process advanced, a high-fidelity prototype (in appendix N) was created. The interactions and the app's overall look and feel were simulated on a real smartphone, an iPhone X[13] (Monteiro-Guerra et al. 2017). This prototype

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[12] https://balsamiq.com
[13] https://www.apple.com/newsroom/2017/09/the-future-is-here-iphone-x/

was developed using Adobe Illustrator[14] – a vector graphics software, and later Xcode[15] - integrated development environment (IDE) for Mac OS X, supporting Objective-C[16] and Swift[17] programming languages for IOS.

9.2   Data Collection

The data collection was performed in two moments, where the first was for the low-fidelity prototype usability test and the second for the high-fidelity functional prototype's usability test. For both tests, the participants were divided into two groups – five students and five mentors. According to Nielsen, five is the optimal amount of test users because it would be possible to "find almost as many usability problems as you'd find using many more test participants" (Nielsen 2012; 2000; Nielsen and Landauer 1993).

Early on, this study focused on the K-12 stage, more specifically the 8th grade, so the student's group were recruited according to the school year they were enrolled, namely the 8th grade. The mentors' recruitment had fewer constraints and I considered diverse academic backgrounds (teacher, project manager, designer, IT engineers, nurse, university students, e.g.). This study tried to gather information from an ample variety of participants, specifically the broad age range (13-51years old), gender (8 females and 12 males).

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[14] https://www.adobe.com/products/illustrator.html

[15] https://developer.apple.com/xcode/

[16]https://developer.apple.com/library/archive/documentation/Cocoa/Conceptual/ProgrammingWithObjectiveC/Introduction/Introduction.html

[17] https://developer.apple.com/swift/

	Participant	Participation Mode	Age	Gender
Low-fidelity prototype	U1	Mentor	51	Male
	U2	Mentor	34	Male
	U3	Mentor	35	Male
	U4	Mentor	29	Female
	U5	Mentor	22	Male
	U6	Student	13	Female
	U7	Student	13	Male
	U8	Student	14	Male
	U9	Student	13	Female
	U10	Student	14	Male
High-fidelity functional prototype	U11	Mentor	33	Female
	U12	Mentor	25	Female
	U13	Mentor	23	Female
	U14	Mentor	51	Male
	U15	Mentor	34	Other
	U16	Student	14	Male
	U17	Student	14	Male
	U18	Student	14	Female
	U19	Student	14	Female
	U20	Student	13	Female

Table 6. Low fidelity prototype participant's characterization.

The evaluation was thoroughly documented with informed consent, and all footage rights belong to the author. Yet, anonymity is assured to all participants either on the informed consent form or on the usability-test's introduction.

9.3 Usability test protocol

The usability testing methodology employment was similar on both sets of tests (low-fidelity and high-fidelity prototypes) and served to establish comparisons and identify users' perceptions in an everyday contextual environment. The first usability test's questionnaire was printed on paper and delivered to the users, while the second usability test's, was created on Google Forms and its link sent to the users'

smartphone, or they filled the questionnaire on the researcher's laptop. The protocol for the low-fidelity usability test can be seen on appendixes E, F and G. And the protocol for high-fidelity usability test can be seen on appendixes F and H.

	Phase	Time
1.	Informed consent	20 seconds
2.	Research introduction	2 minutes
3.	OWL CLUB app test	5 minutes
4.	Evaluation	8 minutes

Table 7. OWL CLUB usability test Schedule.

We can observe from Table 7 that the usability test took, on average, 15 minutes and was divided into four phases.

1. Informed consent

   The first phase consisted of verifying the signed informed consent, including the study's title, the researcher's name and contacts, the study's goal, procedures, inclusion criteria, cost, confidentiality, rights, etc.

2. Research introduction

   The researcher started the test by introducing himself and asked the participants to introduce themselves. Afterwards, it was explained the system's purpose and tasks to the participants, as well as the pertinence of their insights for the project's development. It was also presented the researcher's availability to answer any question throughout the usability test. It is assured that the participants' personal data will be shared, and they might withdraw from the study at any point.

3. OWL CLUB app test

   It was given four tasks to each participant group, that is, four tasks to students and four tasks to mentors and it was asked for them to perform it and think aloud.

4. Evaluation

The evaluation consisted of the data retrieved from the researcher's observation notes and a questionnaire given to participants. The questionnaire was the same for both groups of participants (students and mentors). Its goal was to get qualitative and quantitative feedback from the participants after the system's test on a) the user's see the value on this new system; b) users completed their goal quickly and easily and c) if the app was helpful, fun, and easy to interact with.

The questionnaires, for both usability tests, included the System Usability Scale (SUS)[18] as a means to "quickly and easily assess the usability of a given product or service" (Martins et al. 2015). I considered the variables involved, namely the language barrier that could impede the proper understanding of the questions original language, so I used a SUS Portuguese version, translated "in accordance with the internationally established guidelines" (Martins et al. 2015). Additionally, on the high-fidelity usability test questionnaire, I recognized the challenges of having children as user testers and collecting data that would lead to "reliable and valid findings" (Putnam et al. 2020). For this matter, it was created a visual representation of the Likert scale, using some of the app's avatar emojis. For the second usability test, the User Experience Questionnaire (UEQ) was added to the post-app usability experience's questionnaire to probe further the participants regarding this system's concept and the pertinence of its features (Laugwitz, Held, and Schrepp 2008).

The observation notes were taken while the participant performed the test and served as an added data source that emphasized the participants' answers.

9.4 Results

9.4.1 General Impressions

The users' initial reactions towards the OWL CLUB concept were very positive; they believe that it is very interesting (U6) and timely, especially to those in need of further clarification on several subjects with various people helping them; therefore, it is beneficial to the school community (U11, U14). For U13, this is an excellent idea because "sometimes you are afraid to ask something to your teacher and for him to think you were not paying attention or you are stupid. I saw my younger sister struggling,

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[18] https://www.usability.gov/how-to-and-tools/methods/system-usability-scale.html

and she often said that her teachers were not available." These participants' remarks emphasize the longitudinal mixed-method study and literature's findings and the pertinence for this system.

9.4.2 Low-fidelity prototype test

The low-fidelity usability tests were taken in Funchal between May 31st and June 1st of 2021.

9.4.2.1 *Participants' feedback*

9.4.2.1.1 *User Experience*

The usability test's participants were pretty receptive to the OWL CLUB app use as mentors and students alike, to which U6 said: "Ahhh, that is very interesting". The general reaction to the app was fantastic and stimulating to most users. The system's objectives are clear, straightforward, and beneficial to those students "who want to learn new things" (U9) and "clear their doubts" (U9, U1, U3, U10).
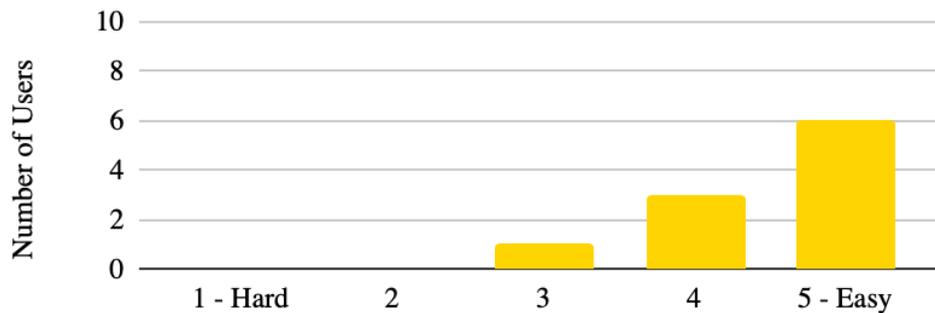
Figure 21. Low-fidelity usability results: Overall reaction to the System.
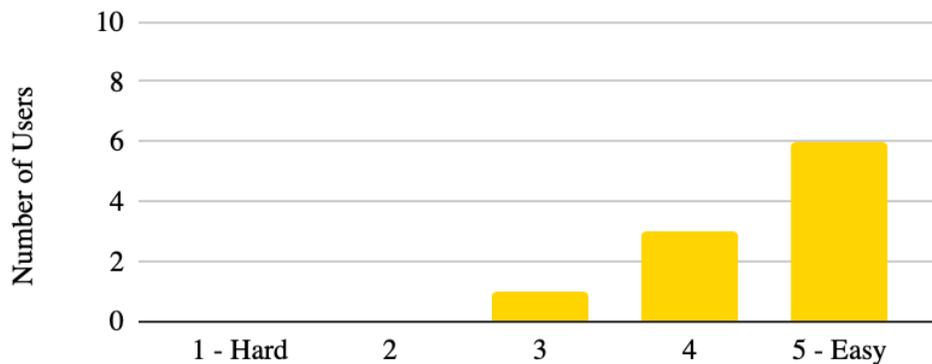
Figure 22. Low-fidelity usability results: Learning - The System's Objectives.

Some participants agree that the OWL CLUB app was also certainly well organized and straightforward (U2, U6, U7). The interaction between a teaching community and the students is also

praised and seen as this system's important core feature (U1, U5). Regarding the student's main feature, the pose of a question's button, at the bottom-center, is evident because "that button is bigger, and the others are smaller" (U7).
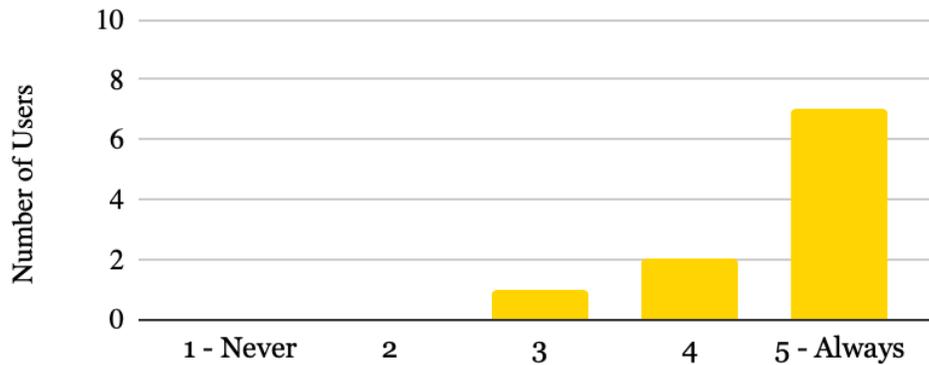
Figure 23. Low-fidelity usability results: Learning - The system is Straightforward.

Although its simplicity and downrightness are commended, the participants gave several pertinent insights for this system's improvement, like emphasizing some screens' titles, and the difference between the student and mentor modes' choices while in registration (U1). So, the registration process was divided into two moments: the first moment for both user groups to fill in their personal information like name, email, and password. The second moment is where the users choose the participation mode (student or mentor), and they fill in which settings they will participate, like the subject the students need help or the preferred subject to assist for the mentors, to name a few.

Also, some issues were addressed towards the answers' upvote and downvote, while U1 and U2 believe it is not necessary to emphasize the negative feeling associated with the "downvote" aspect, U3 and U4 agree the icons should change for an up and down arrow, instead of a plus and minus icon, but both agree to its importance. Moreover, U3 would like to stress this feature by having the arrows green (up) and red (down).

The student/mentor's interactions were also addressed, in which some users were concerned about the children's security (U1, U3, U4, U5) that was alleviated after knowing that in the app, the profile pictures would be drawings and not photos. Also, these concerns emphasized the need for the mentor's answer validation by other mentors (chosen randomly) before their answer was indeed submitted. This issue is especially beneficial for verifying the answer's accuracy and the possible files attached to the set answer.

The participants suggested emphasizing certain buttons or changing their icons, like the notification and connection buttons (U4, U6, U7, U8, U9). In the young participants, mild confusion was observed regarding the connection button, either for its size but primarily for its icon. U10 beliefs this icon should accentuate this system's human connection, so it "should have a person or a heart". This participant's remarks reinforce the human interaction facilitated by this app; the connection button changed into a human figure. Also, the answer's voting mechanism was reconsidered, and the downvote was eliminated, while the upvote was altered into a heart (like).

9.4.2.1.2 User Interface

Generally, the users found this app to be very helpful and intuitive. They seemed to be highly interested in the app and the features we tested. So, the participants were delighted with the system's overall effectiveness yet maintaining an alluring simplicity, despite the lack of complex visual elements (U2, U5, U8, U10). U7 states that he likes the app design and the ways the questions and answers are structured. Moreover, users were also pleased with buttons icons and how "cute" (U6, U9) the OWL CLUB mascot is. The users referred to this system would help the students if implemented.
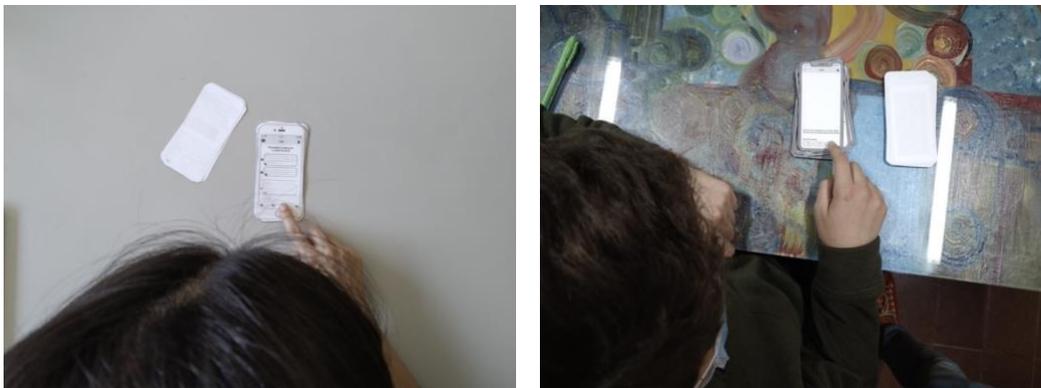
Figure 24. Low-fidelity usability tests' participants: mentor (left) and student (right).

9.4.2.2 Coded List of Transcriptions: Keyword group

User Experience: Easy (U2, U5, U6, U8, U10), intuitive, effective, and well organized (U1, U2, U3, U6, U8, U10).

User Interface: Simple (U2, U8, U10) and Interesting (U6, U7).

Easy and Difficult

+ Systems' objectives (U1, U9, U10); + Intuitive (U1, U2, U4, U5, U6, U7, U8, U10); + Student / Mentor interactions (U1, U5); + Notifications (U2).	- Answer's grade (upvote and downvote) (U1, U2); - Unclear connection icon (U7, U8, U10). - Small icons (U3, U7).

Table 8. Low-fidelity usability test participant's feedback.

Useful: Users said this app would facilitate the students learning (U10), providing an added source of knowledge (U3, U9), and promoting interaction within a learning community (U1, U5). Additionally, the "ease of answering and accessing other answers" (U2) is stressed as an essential aspect of this app.

9.4.2.3   System Usability Scale

System Usability Scale (SUS) was made to all participants in order to measure the OWL CLUB app low-fidelity prototype. It had a 78,9 average score, knowing that 68 is considered the minimum regarding the usability of a system, in this case, an app.

9.4.3   High-fidelity functional prototype test

The high-fidelity usability tests were taken in Funchal and Câmara de Lobos between July 29th and August 1st.

9.4.3.1   Participants' feedback

9.4.3.1.1   User Experience

This solution of addressing the students' learning variabilities in a community-centered manner while creating bonds and partnerships in the learning process was clearly understood by 80% of usability test's users. Also, they comprehended the app's goals and usefulness for the set community, which comparative data with the previous usability test showed growth. The retrieved data from the questionnaire also shows they had a generally positive experience regarding the OWL CLUB app's use on all analysed parameters like attractiveness, perspicuity or clarity, dependability, stimulation, and novelty. The attractiveness and the pragmatic perspicuity, efficiency, and dependability inform that the users had a clearly positive response to the performed tasks. Worth noticing is that the hedonic qualities (stimulation and originality), referring to the users' thoughts and feelings while using the app,

are positive and constructive. Below the mean of the three pragmatic and hedonic quality aspects is calculated.
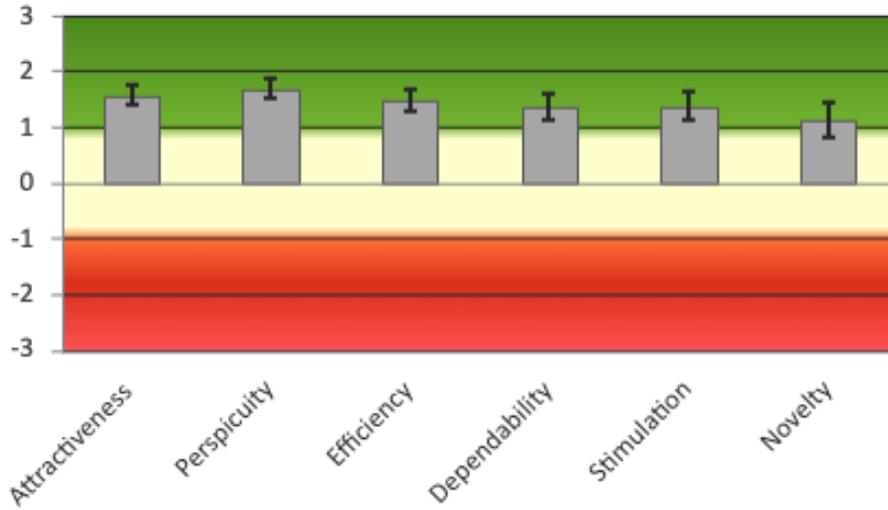
Figure 25. High-fidelity prototype usability results - Pragmatic and Hedonic app's qualities.

The responsiveness towards the app grew 20% on the second usability test, where most users agreed the OWL CLUB app was "easy" and "fantastic". Also, the awareness of the system's objectives increased as the users got a clearer perception of the app's purpose and demographics. Generally, the participants completed the task effortlessly and fast. U11, U13 and U14 believe this idea is essential for the students with more difficulties on a specific subject or content, so "it would be interesting to implement it (U14); moreover, it "has the potential to be applied on a larger scale" (U13).
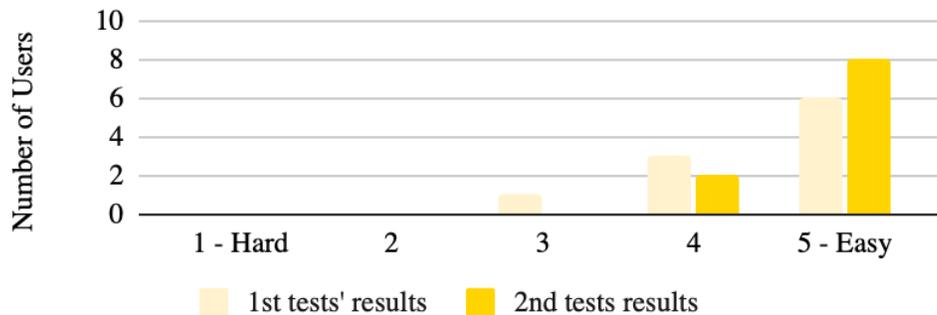
Figure 26. Usability test comparative results: Overall reaction to the System.
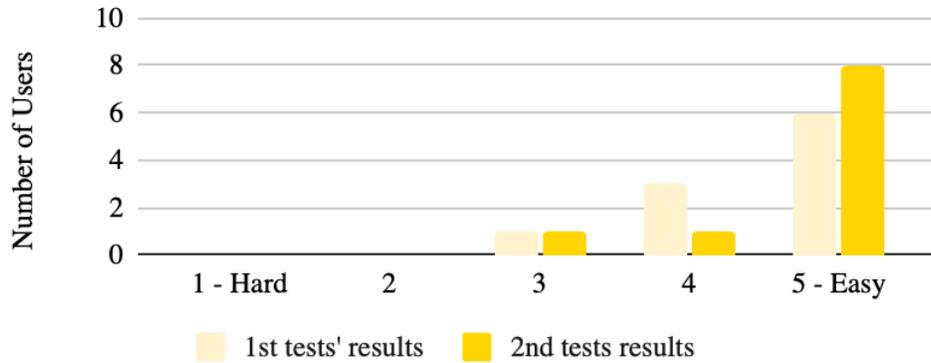
Figure 27. Usability test comparative results: Learning - The System's Objectives.

The positive feedback's growth, respect to the app's architecture and interaction, especially the "ease of finding correct answers, support and understanding the answers" (U18) is worth mentioning, as it is one of the core elements in this system. In addition, the clarity found by the users leads to intuitiveness and overall simplicity to which the users interact with the app (U11, U14, U15, U16, U17, U18). The interactions between students and mentors' intuitiveness are also exalted by most users, where this will necessarily lead to a "good communication" (U18) among the OWL CLUB app's users, which is one of this project's core purposes (U11, U12, U13, U14, U15, U19).
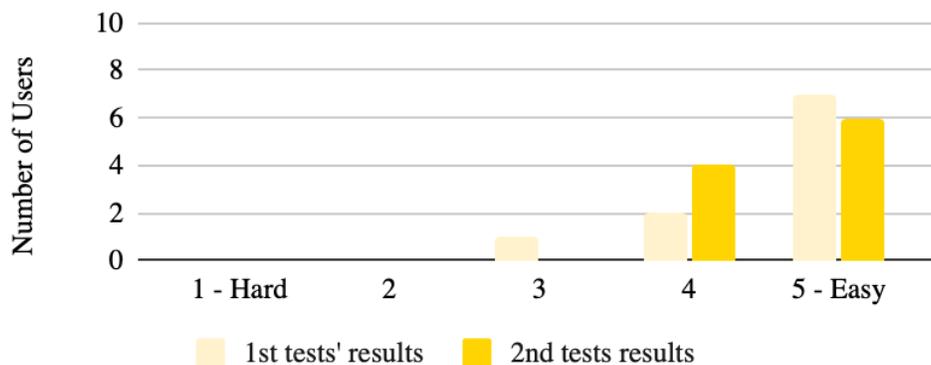
Figure 28. Usability test comparative results: Learning - The system is Straightforward.

The user's suggestions for improvements were scarcer on this usability test than on the previous one, which attests to the general improvement of the high-fidelity prototype. Their main concerns were essentially about the users' potential engagement, or not, on this system. That is, the "lack of mentor participation" (U15) in the OWL CLUB app or the lack of responsiveness towards the students' questions and doubts are of concern (U15, U20). Also, some concerns were initially addressed towards the app users' privacy, mainly regarding the students. Still, after seeing the app's

avatars and the fact that student/mentor interaction would be mediated by other people (mentors), such apprehensions were alleviated. The randomly chosen mentors to validate one mentor answer were praised by all participants who agreed that will also help avoid wrong or inaccurate answers provided to students.

U12 believes the system should provide more details on the answering feature, like if the other participant already opened it. Still, this claim is refuted by the remaining mentor users who believe the app should remain the simplicity on all aspects and less pressure or impositions on both group of users (students or mentors).

9.4.3.1.2   User Interface

It was observed a general appreciation for all interface elements like the colours, icons, or avatars. All users referred to the app's interface design, whether on the "very appealing colours, especially for the youngsters," (U11, U13, U14, U16, U17, U20) therefore, highly "appropriate to the app's demographics, without being too childish" (U11). The use of the avatars is also praised, and their design, which continues the app's simple design approach, but the use of vibrant colours make it more engaging and amiable. (U20) Moreover, the interface's design simplicity emphasizes the system's straightforward usability, leading to an intuitive use (U11, U12, U13, U14, U15, U16, U17).
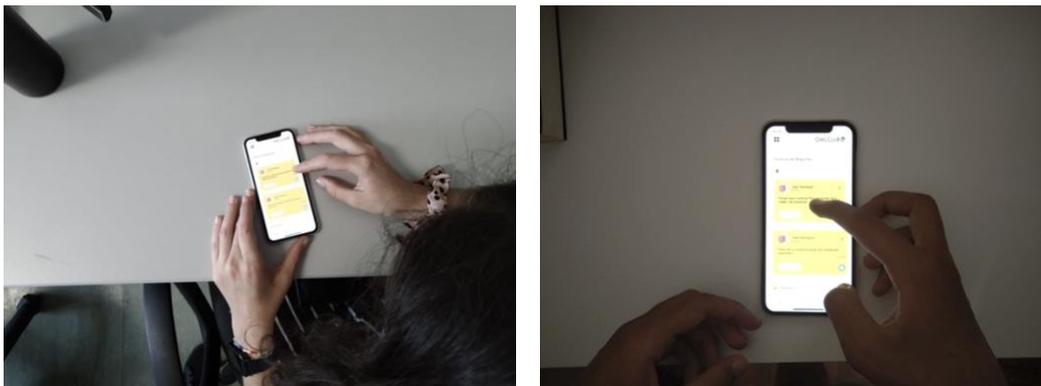
Figure 29. High-fidelity prototype usability tests' participants: mentor (left) and student (right).

However, it was observed that the colour palette's over-simplification and the use of yellow or white (and black highlight) for the buttons led to several misunderstandings among several users, who believed the "buttons should be of another colour" (U19). Therefore, the need to include a different colour for the action button was necessary, and in that sense, the colour green was introduced to

reinforce the action. The buttons' highlight colour would be black (when the background is white) or white (when the background is coloured).

In the student's mode, the "write or edit" a question's button, placed on the bottom-right answer-space, has a pencil icon, while in the mentor's mode, the "reply to" button, set in the same place, has a balloon message icon. It was also detected a minor confusion on users U13 and U14 (mentors) regarding the answer feature, namely the button that would trigger that action. These users took a few seconds to understand that the button with the "balloon message" icon was intended for the mentors' response. U13 mentioned that a different icon should be used, like a pencil, for example, used on the student answer-space. So, the "balloon message" icon was changed to a "pencil" one, thus standardizing and simplifying the icons used in the app.

9.4.3.2   Coded List of Transcriptions: Keyword group

User Experience: Intuitive (U11, U15), easy (U11, U14, U17, U18), and clear (U12).

User Interface: Appealing design (U11, U12, U14, U16, U20), simplicity (U13, U15, U19), and colours (U11, U17, U20).

Easy and Difficult

+ Concept (U11, U14, U20);	- More answer feedback information (12);
+ Intuitive (U11, U14, U15, U16, U17, U18);	- Action button's colors (10);
+ Compelling interface (U11, U12, U14, U17, U20);	- Lack of members (U15);
+ Straightforward and simplicity (U11, U12, U13, U14, U15, U19);	- Possible late replies (20);
+ Colours (U11, U17, 20);	- Privacy issues.
+ Profile images (U19).	

Table 9. High-fidelity functional prototype usability test participant's feedback.

Useful: This app is pertinent because the "students are able to answer questions in different subjects with different people helping" (U11). The education's communal assistance to students in need is also praised by U13, U14, U15 and U20.

9.4.3.3   System Usability Scale

SUS was made to all participants in order to measure the OWL CLUB app high-fidelity functional prototype and compare it with the previous prototype's results. The system's SUS scale evaluation is 80,7 of the average score, almost 2 points of improvement from the previous analysed iteration. According to the SUS, the OWL CLUB app is graded as "Good" and on the green zone's "B level".

9.5   Discussion and Limitations

Data examination made visible the unease and anxiety caused by the pandemic and the consequent sudden and seismic shifts in DE's teaching and learning modes, and the new challenges the school community faced. Despite the initial commotion, a continuous effort to progress students' learning happened through interactive communication platforms and social media regardless of the circumstances achieved. Nonetheless, the lack of ICT training on behalf of teachers and students, the insufficient means that characterize some households, like internet access or digital devices (T1, T2, P1), and some parents' inability to respond to their children's instructional needs led to an array of problems. The school community had to resolve those issues by seeking support online within specific social media groups, especially Facebook, WhatsApp, and Instagram.

As a result of a mixed-method longitudinal study, I created a technological design intervention to provide access to a resourceful and contributing community for learners who need personalised teaching assistance. The students who would resort to search engines and get decontextualized, wrong or partially incorrect information could now be assisted by their teaching community, who would monitor the knowledge passed to them. Regardless of the app's initial development, most users saw the pertinence of its use for the entire school community and applicability on a larger scale, especially on the second usability test, thus opening the students to broader mentor support and network (U14). In this sense, this system proved to have a simple yet engaging concept that could mediate an entire collective towards an appealing, open, and communal learning environment, reinforced in the high-fidelity prototype.

Notwithstanding, this study tried to extend the scope of research by looking for a wider variety of participants. Yet, the Covid-19 pandemic's constraints did not allow to accommodate more individuals in the longitudinal mixed-method study. The anecdotal sample's limitation is acknowledged, and some findings could be seen as tentative interpretations; however, the emerging data provide a broad view of the stakeholders' varied experiences amid the school transition to the DE setting contextualized by

relevant literature and prior studies. It is also recognized the absence of senior teachers from the sample due to the pervasive use of ICT tools as a primary source of interaction with the sample. According to the presented data, these teachers, who were more struggling than others, might lack the presence in this study's considerations; thus, it may have biased results. Additionally, I conducted this study according to a convergence of geographical and pandemic settings. Therefore, the insights I provide in this study might be directly correlated to a specific context not suitable to other contexts.

Despite the above-mentioned constraints, the preliminary results seem to be validated by teachers, parents, and students throughout the entire study. And although the OWL CLUB app has the potential to create a teaching community that could provide a specific learning experience to the students, a more profound and long-term evaluation must be conducted to assess and support my hypothesis' efficacy. Moreover, the system fully developed would be necessary and tested by a more significant number of participants to get further insights on the users' interactions with the app and how fruitful the exchanges among this community would be to the students' academic growth.

Another limitation is the medium itself and the possible over-reliance on technological devices often understood by people as distracting and having pernicious effects on youngsters. Despite the perception's shift regarding the interactive technological tools, some hesitation might be encountered by parents who believe in the youngsters' scare access to a mobile phone. Additionally, some households' scant resources could also mean that some students will potentially be left out of this learning community due to the lack of digital devices and/or the internet.

9.6 Summary

This chapter presented the OWL CLUB app validation's concept and usability through a series of tests on two different occasions using a low-fidelity prototype and later a high-fidelity prototype. The methodologies and test's specificities are presented, and the results and analysis of the user's feedback on both moments.

Conclusion and Future Work

The data retrieved from this longitudinal mixed-method study indicates the education progressed, amid the pandemic, via interactive communication platforms and social media. The teaching and learning progression happened regardless of the school community's lack of readiness, ICT training and resources in the transition to DE, causing apprehension and anxiety among the school community. Additionally, some parents' inability to properly assist their children's learning needs led to a series of issues that the school community tried to solve collaboratively within specific online social media groups. The issues found in this study, concealed in the pre-Covid-19 pandemic, were aggravated, revealing severe inequities in education and knowledge's access, as discussed in chapter 3.

It was observed in this study a deeper understanding and acceptance of the interactive digital mediums in education, especially in the DE context. In accordance with data retrieved from this analysis, I also conclude the awareness of the student's specific needs. It was also verified the pandemic's aggravation's repercussion on the educational system and its inability to respond accordingly.

After further analysis, the need for a flexible system that could tackle the student's distinct requirements was recognised. The most pertinent design implication reflects on a system that would answer the pupil's pedagogical needs and nurture the creation and maintenance of a learning enabling community via an interactive mobile app. This system's purpose is not to replace or subtract the school or the teacher figure from the student's learning process but to add another element to mitigate the students' learning loss and learning variability. So, I believe, and the data collected reinforces it, that our results reinstate the concept that it 'takes a village to educate or raise a child', an idea that impacts a shared conception of the education often bound to students and teachers and the classroom's physical space.

Despite the preliminary results, which mainly consisted of qualitative, quantitative interviews (with several of the education's stakeholders, namely teachers, students, and parents), and observations executed throughout this study, raise two major concerns to the OWL CLUB app's implementation:

> First and foremost, the ethical and privacy issues regarding the children and their interaction with adults. I believe the HCI experts should further discuss these concerns. In respect to the creation of interactive systems to respond to children's academic needs and maintaining, at the same time, the rigour, transparency, and security necessary to overcome the constraints that many students go through?

Second, despite this study's participants clear understating and interests in the OWL CLUB app, the users' participation continuity, as analysed in similar systems, tend to have a fruitful beginning and an enthusiastic early response that continuously fades into the system's oblivion. So, how can we maintain a constant, if not growing, excitement and interest among the learning community towards the assistance of students' academic needs?

In order to grant a more comprehensive and augmented understanding of this matter, future work may encompass more individuals and more extensive groups of stakeholders of diverse ages, educational, geographic and cultural backgrounds. Additionally, it would also be beneficial to analyse these subjects' perceptions and experiences on a fully developed system in the long term and how such examination relates to this study. The long-term analysis could examine the impact of the learning environment and the personalised teaching mediated by this system in the students' academic achievements, namely their evolution on the subject(s) they had more difficulties with.

Future work could also evaluate solutions that could grant the users' participation continuity, like implementing gamification components that reward the users' interactions and the accuracy of responses on the mentor's behalf.

References

1. Ammirato, Salvatore, Roberto Linzalone, and Alberto M. Felicetti. 2020. "Knowledge Management in Pandemics. A Critical Literature Review." *Knowledge Management Research & Practice*, August, 1–12. https://doi.org/10.1080/14778238.2020.1801364.

2. Bai, Hua. 2019. "Pedagogical Practices of Mobile Learning in K-12 and Higher Education Settings." *TechTrends* 63 (5): 611–20. https://doi.org/10.1007/s11528-019-00419-w.

3. Bailey, Gregg "Skip." 1993. "Iterative Methodology and Designer Training in Human-Computer Interface Design." In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI '93*, 198–205. Amsterdam, The Netherlands: ACM Press. https://doi.org/10.1145/169059.169163.

4. Bellinger, Robert. 1998. "EETimes - HP's Mentoring Project Grows International in Size." *EETimes* (blog). November 27, 1998. https://www.eetimes.com/hps-mentoring-project-grows-international-in-size/.

5. Bierema, Laura L., and Sharan B. Merriam. 2002. "E-Mentoring: Using Computer Mediated Communication to Enhance the Mentoring Process." *Innovative Higher Education* 26 (3): 211–27. https://doi.org/10.1023/A:1017921023103.

6. Bruckman, Amy Susan. 1997. "MOOSE Crossing : Construction, Community and Learning in a Networked Virtual World for Kids." Thesis, Massachusetts Institute of Technology. https://dspace.mit.edu/handle/1721.1/33821.

7. Bryman, Alan. 2012. *Social Research Methods*. 4th ed. Oxford ; New York: Oxford University Press.

8. Burns, Anne. 1999. *Collaborative Action Research for English Language Teachers*. Cambridge Language Teaching Library. Cambridge ; New York: Cambridge University Press.

9. Chen, Xinyue, Si Chen, Xu Wang, and Yun Huang. 2021. "'I Was Afraid, but Now I Enjoy Being a Streamer!': Understanding the Challenges and Prospects of Using Live Streaming for Online Education." *Proceedings of the ACM on Human-Computer Interaction* 4 (CSCW3): 1–32. https://doi.org/10.1145/3432936.

10. Cole, David A., Elizabeth A. Nick, Rachel L. Zelkowitz, Kathryn M. Roeder, and Tawny Spinelli. 2017. "Online Social Support for Young People: Does It Recapitulate in-Person Social Support; Can It Help?" *Computers in Human Behavior* 68 (March): 456–64. https://doi.org/10.1016/j.chb.2016.11.058.

11. Cuban, Larry. 2001. *Oversold and Underused: Computers in the Classroom*. 1st Harvard University Press paperback ed. Cambridge, Mass.: Harvard University Press.

12. DuBois, David L., Bruce E. Holloway, Jeffrey C. Valentine, and Harris Cooper. 2002. "Effectiveness of Mentoring Programs for Youth: A Meta-Analytic Review." *American Journal of Community Psychology* 30 (2): 157–97. https://doi.org/10.1023/A:1014628810714.

13. Ferreira, Ana Rita, and Daniela Gonçalves. 2020. "Políticas educativas em tempos de COVID em Portugal: que relação com a igualdade, equidade e inclusão em educação?" *REVISTA GALEGA DE EDUCACIÓN*, no. Special COVID-19 number (June): 49–52.

14. Guest, Greg, Kathleen MacQueen, and Emily Namey. 2012. *Applied Thematic Analysis*. 2455 Teller Road, Thousand Oaks California 91320 United States: SAGE Publications, Inc. https://doi.org/10.4135/9781483384436.

15. Hanushek, Eric A., and Ludger Woessmann. 2020. "The Economic Impact of Learning Losses." September 2020. https://www.oecd.org/education/The-economic-impacts-of-coronavirus-covid-19-learning-losses.pdf.

16. Henry, David, Allison B. Dymnicki, Nathaniel Mohatt, James Allen, and James G. Kelly. 2015. "Clustering Methods with Qualitative Data: A Mixed-Methods Approach for Prevention Research with Small Samples." *Prevention Science* 16 (7): 1007–16. https://doi.org/10.1007/s11121-015-0561-z.

17. Holland, Janet, Rachel Thomson, Sheila Henderson, London South Bank University, and Families & Social Capital ESRC Research Group. 2006. *Qualitative Longitudinal Research: A Discussion Paper*. London: London South Bank University.

18. Holmberg, Börje. 2003. *Distance Education in Essence: An Overview of Theory and Practice in the Early Twenty-First Century*. 2. ed. Studien Und Berichte Der Arbeitsstelle Fernstudienforschung Der Carl von Ossietzky Universität Oldenburg 4. Oldenburg: Bibliotheks- und Informationssystem der Univ. Oldenburg.

19. Homitz, Daniel James, and Zane L. Berge. 2008. "Using E‐mentoring to Sustain Distance Training and Education." *The Learning Organization* 15 (4): 326–35. https://doi.org/10.1108/09696470810879574.

20. Houde, Stephanie. 1992. "Iterative Design of an Interface for Easy 3-D Direct Manipulation." In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI '92*, 135–42. Monterey, California, United States: ACM Press. https://doi.org/10.1145/142750.142772.

21. Houghton, Robert, James Sprinks, Jessica Wardlaw, Steven Bamford, and Stuart Marsh. 2019.

"A Sociotechnical System Approach to Virtual Citizen Science: An Application of BS ISO 27500:2016." *Journal of Science Communication* 18 (01): A01. https://doi.org/10.22323/2.18010201.

22. Hrastinski, Stefan, Anneli Edman, Fredrik Andersson, Tanvir Kawnine, and Carol-Ann Soames. 2014. "Informal Math Coaching by Instant Messaging: Two Case Studies of How University Students Coach K-12 Students." *Interactive Learning Environments* 22 (1): 84–96. https://doi.org/10.1080/10494820.2011.641682.

23. Janasz, Suzanne C. de, and Veronica M. Godshalk. 2013. "The Role of E-Mentoring in Protégés' Learning and Satisfaction." *Group & Organization Management* 38 (6): 743–74. https://doi.org/10.1177/1059601113511296.

24. Kallio, Hanna, Anna-Maija Pietilä, Martin Johnson, and Mari Kangasniemi. 2016. "Systematic Methodological Review: Developing a Framework for a Qualitative Semi-Structured Interview Guide." *Journal of Advanced Nursing* 72 (12): 2954–65. https://doi.org/10.1111/jan.13031.

25. Kariri, Elham, and Carlos Rodríguez. 2019. "E-Mentoring Activities in Online Programming Communities: An Empirical Study on Stack Overflow." In *Service Research and Innovation*, edited by Ho-Pun Lam and Sajib Mistry, 367:123–38. Lecture Notes in Business Information Processing. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-32242-7_10.

26. Keegan, Desmond. 2002. "The Future of Learning: From ELearning to MLearning." *Technical Report FernUniversität*, 2002. https://eric.ed.gov/?id=ED472435.

27. Kelsey, Sigrid, and Kirk St. Amant, eds. 2008. *Handbook of Research on Computer Mediated Communication*. Hershey, PA: Information Science Reference.

28. Kimbell, Lucy. 2011. "Rethinking Design Thinking: Part I." *Design and Culture* 3 (3): 285–306. https://doi.org/10.2752/175470811X13071166525216.

29. Kuhfeld, Megan, James Soland, Beth Tarasawa, Angela Johnson, Erik Ruzek, and Jing Liu. 2020. "Projecting the Potential Impact of COVID-19 School Closures on Academic Achievement." *Educational Researcher* 49 (8): 549–65. https://doi.org/10.3102/0013189X20965918.

30. Kvale, Steinar, and Svend Brinkmann. 2009. *InterViews: Learning the Craft of Qualitative Research Interviewing*. 2nd ed. Los Angeles: Sage Publications.

31. Laugwitz, Bettina, Theo Held, and Martin Schrepp. 2008. "Construction and Evaluation of a User Experience Questionnaire." In *HCI and Usability for Education and Work*, edited by

Andreas Holzinger, 5298:63–76. Lecture Notes in Computer Science. Berlin, Heidelberg: Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-540-89350-9_6.

32. Ligadu, Christina, and Patricia Anthony. 2015. "E-Mentoring 'MentorTokou': Support For Mentors and Mentees During The Practicum." *Procedia - Social and Behavioral Sciences* 186 (May): 410–15. https://doi.org/10.1016/j.sbspro.2015.04.144.

33. Liikkanen, Lassi A. 2009. "Extreme-User Approach and the Design Energy Feedback Systems." 2009. http://l.kryptoniitti.com/lassial/files/publications/090903-energy_efficiency_xtreme_user.pdf.

34. Lima, Licínio Carlos Viana da Silva, Ivany Rodrigues Pino, Theresa Adrião, Luana Costa Almeida, Celso João Ferretti, Antonio Álvaro Soares Zuin, Sandra Maria Zákia Lian Souza, et al. 2020. "CONFINAR A EXPERIÊNCIA ESCOLAR NUM ECRÃ?" *Educação & Sociedade* 41: e240846. https://doi.org/10.1590/es.240846.

35. Liu, Haiming, Ronald Macintyre, and Rebecca Ferguson. 2012. "Exploring Qualitative Analytics for E-Mentoring Relationships Building in an Online Social Learning Environment." In *Proceedings of the 2nd International Conference on Learning Analytics and Knowledge - LAK '12*, 179. Vancouver, British Columbia, Canada: ACM Press. https://doi.org/10.1145/2330601.2330646.

36. Marshall, Martin N. 1996. "Sampling for Qualitative Research." *Family Practice* 13 (6): 522–26. https://doi.org/10.1093/fampra/13.6.522.

37. Martins, Ana Isabel, Ana Filipa Rosa, Alexandra Queirós, Anabela Silva, and Nelson Pacheco Rocha. 2015. "European Portuguese Validation of the System Usability Scale (SUS)." *Procedia Computer Science* 67: 293–300. https://doi.org/10.1016/j.procs.2015.09.273.

38. Mcleod, Julie. 2003. "Why We Interview Now--Reflexivity and Perspective in a Longitudinal Study." *International Journal of Social Research Methodology* 6 (3): 201–11. https://doi.org/10.1080/1364557032000091806.

39. McLuckie, J., and K.J. Topping. 2004. "Transferable Skills for Online Peer Learning." *Assessment & Evaluation in Higher Education* 29 (5): 563–84. https://doi.org/10.1080/02602930410001689144.

40. Mehrotra, Chandra, C. David Hollister, and Lawrence McGahey. 2001. *Distance Learning: Principles for Effective Design, Delivery, and Evaluation*. Thousand Oaks, Calif: Sage Publications.

41. Merrill, Stephen. 2020. "Teaching Through a Pandemic: A Mindset for This Moment." Edutopia. 2020. https://www.edutopia.org/article/teaching-through-pandemic-mindset-

moment.

42. Miller, Sara M., and Brien K. Ashdown. 2020. "When COVID Affects the Community: The Response of a Needs-Based Private School in Guatemala." *Local Development & Society* 1 (1): 34–42. https://doi.org/10.1080/26883597.2020.1794758.

43. Monteiro-Guerra, Francisco, Octavio Rivera-Romero, Vasiliki Mylonopoulou, Gabriel R. Signorelli, Francisco Zambrana, and Luis Fernandez-Luque. 2017. "The Design of a Mobile App for Promotion of Physical Activity and Self-Management in Prostate Cancer Survivors: Personas, Feature Ideation and Low-Fidelity Prototyping." In *2017 IEEE 30th International Symposium on Computer-Based Medical Systems (CBMS)*, 761–66. Thessaloniki: IEEE. https://doi.org/10.1109/CBMS.2017.75.

44. Moore, Michael G., ed. 2019. *Handbook of Distance Education*. Fourth edition. New York: Routledge.

45. Moore, Michael G., and Greg Kearsley. 2012. *Distance Education: A Systems View of Online Learning*. 3rd ed. Belmont, CA: Wadsworth Cengage Learning.

46. Moore, Michael Garrett, ed. 2013. *Handbook of Distance Education*. 3. ed. New York, NY: Routledge.

47. Morse, Janice M, and Linda Niehaus. 2009. "Principles and Procedures of Mixed Methods Design." *Walnut Creek, CA: Left.*

48. Neureiter, Katja, Johannes Vollmer, Rebecca L. Gerwert Vaz de Carvalho, and Manfred Tscheligi. 2017. "Starting up an E-Mentoring Relationship: A User Study." In *Proceedings of the 8th International Conference on Communities and Technologies*, 232–35. Troyes France: ACM. https://doi.org/10.1145/3083671.3083692.

49. Nielsen, Jakob. 2000. "Why You Only Need to Test with 5 Users." *NN/g Nielsen Norman Group* (blog). April 18, 2000. https://www.nngroup.com/articles/why-you-only-need-to-test-with-5-users/.

50. ———. 2012. "How Many Test Users in a Usability Study?" *NN/g Nielsen Norman Group* (blog). June 3, 2012. https://www.nngroup.com/articles/how-many-test-users/.

51. Nielsen, Jakob, and Thomas K. Landauer. 1993. "A Mathematical Model of the Finding of Usability Problems." In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI '93*, 206–13. Amsterdam, The Netherlands: ACM Press. https://doi.org/10.1145/169059.169166.

52. Noonoo, Stephen. n.d. "'Students Are Lonely:' What Happens When Coronavirus Forces

Schools Online | EdSurge News." Accessed April 3, 2021. https://www.edsurge.com/news/2020-03-02-students-are-lonely-what-happens-when-coronavirus-forces-schools-online.

53. OECD. n.d. "Education and COVID-19: Focusing on the Long-Term Impact of School Closures." OECD. Accessed November 12, 2020a. https://www.oecd.org/coronavirus/policy-responses/education-and-covid-19-focusing-on-the-long-term-impact-of-school-closures-2cea926e/.

54. ———. n.d. "School Education during COVID-19: Were Teachers and Students Ready? - OECD." Accessed April 3, 2021b. http://www.oecd.org/education/coronavirus-education-country-notes.htm.

55. Palinkas, Lawrence A., Sarah M. Horwitz, Carla A. Green, Jennifer P. Wisdom, Naihua Duan, and Kimberly Hoagwood. 2015. "Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research." *Administration and Policy in Mental Health and Mental Health Services Research* 42 (5): 533–44. https://doi.org/10.1007/s10488-013-0528-y.

56. Papert, Seymour. 1993. *Mindstorms: Children, Computers, and Powerful Ideas*. 2nd edition. New York, NY: Basic Books.

57. Pham, Yen Dieu, Davide Fucci, and Walid Maalej. 2018. "A First Implementation of a Design Thinking Workshop during a Mobile App Development Course Project." In *Proceedings of the 2nd International Workshop on Software Engineering Education for Millennials*, 56–63. Gothenburg Sweden: ACM. https://doi.org/10.1145/3194779.3194785.

58. Premkumar, Kalyani, and Angie Wong. 2010. "Mentoring Principles, Processes, and Strategies for Facilitating Mentoring Relationships at a Distance." *MedEdPORTAL* 6 (1): mep_2374-8265.3148. https://doi.org/10.15766/mep_2374-8265.3148.

59. Putnam, Cynthia, Melisa Puthenmadom, Marjorie Ann Cuerdo, Wanshu Wang, and Nathaniel Paul. 2020. "Adaptation of the System Usability Scale for User Testing with Children." In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–7. Honolulu HI USA: ACM. https://doi.org/10.1145/3334480.3382840.

60. Rowland, Kimberly Nicole. 2012. "E-Mentoring: An Innovative Twist to Traditional Mentoring." *Journal of Technology Management & Innovation* 7 (1): 228–37. https://doi.org/10.4067/S0718-27242012000100015.

61. Samuel, Pedro, Joao Barroso, and Vitor Santos. 2017. "E-Mentoring: Mentoring Evolution

with New Technologies." In *2017 12th Iberian Conference on Information Systems and Technologies (CISTI)*, 1–6. Lisbon, Portugal: IEEE. https://doi.org/10.23919/CISTI.2017.7975902.

62. Sangster, Alan, Greg Stoner, and Barbara Flood. 2020. "Insights into Accounting Education in a COVID-19 World." *Accounting Education* 29 (5): 431–562. https://doi.org/10.1080/09639284.2020.1808487.

63. Sarmento, Manuel Jacinto. 2020. "A6. As crianças e os efeitos da crise pandémica." *O Público*, June 3, 2020. http://repositorium.sdum.uminho.pt/handle/1822/66518.

64. Sas, Corina, Steve Whittaker, Steven Dow, Jodi Forlizzi, and John Zimmerman. 2014. "Generating Implications for Design through Design Research." In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 1971–80. Toronto Ontario Canada: ACM. https://doi.org/10.1145/2556288.2557357.

65. Schlager, Mark S., and Judith Fusco. 2003. "Teacher Professional Development, Technology, and Communities of Practice: Are We Putting the Cart Before the Horse?" *The Information Society* 19 (3): 203–20. https://doi.org/10.1080/01972240309464.

66. Schwartz, Sarah E. O., Sarah R. Lowe, and Jean E. Rhodes. 2012. "Mentoring Relationships and Adolescent Self-Esteem." *The Prevention Researcher* 19 (2): 17–20.

67. Shrestha, C., S. May, P. Edirisingha, Linda Burke, and Tim Linsey. 2009. "From Face-to-Face to e-Mentoring: Does the 'e' Add Any Value for Mentors?" *The International Journal of Teaching and Learning in Higher Education* 20: 116–24.

68. Silva, Cláudia, Adolfo R. Mora, and Joseph D. Straubhaar. 2018. "Critical Importance of Emphasising Working-Class Parents in Digital Inclusion: A US Latino/a Case Study." *The Journal of Community Informatics*.

69. Simonson, Michael, and Charles Schlosser. 2014. "We Need a Plan - An Instructional Design Approach for Distance Education Courses," January.

70. Simonson, Sharon Smaldino, and Susan Zvacek. 2015. *Teaching and Learning at a Distance: Foundations of Distance Education*. Charlotte, North Carolina: Information Age Publishing.

71. Single, Peg Boyle, and Richard M. Single. 2005. "E-mentoring for Social Equity: Review of Research to Inform Program Development." *Mentoring & Tutoring: Partnership in Learning* 13 (2): 301–20. https://doi.org/10.1080/13611260500107481.

72. Snelson, Chareen. 2015. "Vlogging about School on YouTube: An Exploratory Study." *New Media & Society* 17 (3): 321–39. https://doi.org/10.1177/1461444813504271.

73. Spencer, Renée. 2006. "Understanding the Mentoring Process between Adolescents and

Adults." *Youth & Society* 37 (3): 287–315. https://doi.org/10.1177/0743558405278263.

74. Stoeger, Heidrun, Xiaoju Duan, Sigrun Schirner, Teresa Greindl, and Albert Ziegler. 2013. "The Effectiveness of a One-Year Online Mentoring Program for Girls in STEM." *Computers & Education* 69 (November): 408–18. https://doi.org/10.1016/j.compedu.2013.07.032.

75. Taherdoost, Hamed. 2016. "Sampling Methods in Research Methodology; How to Choose a Sampling Technique for Research." *SSRN Electronic Journal.* https://doi.org/10.2139/ssrn.3205035.

76. Tinoco-Giraldo, Harold, Eva María Torrecilla Sánchez, and Francisco José García Peñalvo. 2020. "Developing a Design Phase for a Mentoring Mobile App." In *Eighth International Conference on Technological Ecosystems for Enhancing Multiculturality*, 273–82. Salamanca Spain: ACM. https://doi.org/10.1145/3434780.3436543.

77. Tominaga, Atsuko, and Chiharu Kogo. 2018. "Attributes of Good E-Learning Mentors According to Learners." *Universal Journal of Educational Research* 6 (8): 1777–83. https://doi.org/10.13189/ujer.2018.060822.

78. Van Lancker, Wim, and Zachary Parolin. 2020. "COVID-19, School Closures, and Child Poverty: A Social Crisis in the Making." *The Lancet Public Health* 5 (5): e243–44. https://doi.org/10.1016/S2468-2667(20)30084-0.

79. Verikios, George, James M. McCaw, Jodie McVernon, and Anthony H. Harris. 2012. "H1N1 Influenza and the Australian Macroeconomy." *Journal of the Asia Pacific Economy* 17 (1): 22–51. https://doi.org/10.1080/13547860.2012.639999.

80. Vogl, Susanne, Ulrike Zartler, Eva-Maria Schmidt, and Irene Rieder. 2018. "Developing an Analytical Framework for Multiple Perspective, Qualitative Longitudinal Interviews (MPQLI)." *International Journal of Social Research Methodology* 21 (2): 177–90. https://doi.org/10.1080/13645579.2017.1345149.

81. Williams, Sandra, Judith Sunderman, and Justin Kim. 2012. "E-Mentoring in an Online Course: Benefits and Challenges to E-Mentors." *International Journal of Evidence Based Coaching and Mentoring*, 2012. https://radar.brookes.ac.uk/radar/file/5a23e628-e881-48df-8eb3-7d0397934c0e/1/vol10issue1-paper-08.pdf.

82. Willis, Barry Donald, ed. 1994. *Distance Education: Strategies and Tools*. Englewood Cliffs, N.J: Educational Technology Publications.

10 Appendix
10.1 Appendix A

Transição para o ensino à distância durante a epidemia de COVID-19 – Professores.

Este questionário é destinado a professores e tem como objetivo estudar o impacto da COVID-19 no sistema de ensino e a utilização de novas metodologias para o mesmo, nomeadamente o ensino à distância.

A sua participação é livre. Pode desistir a qualquer momento. Não são solicitados dados pessoais que permitam identificar os inquiridos. As informações recolhidas são confidenciais e serão objeto de análise para o projeto de mestrado e para futuras publicações científicas.

A sua participação é muito importante e poderá ser feita repetidamente, em diferentes momentos. Seria uma mais valia para o estudo se respondesse a este questionário semanalmente até receber informação contrária.

* Required

1.   1. Indique a sua idade *

_____

2.   2. Indique o seu género *

   Mark only one oval.

   ◯ Masculino
   ◯ Feminino
   ◯ Outro

3.   3. Qual é o ciclo de ensino que leciona no presente ano letivo: *

   Check all that apply.

   ☐ Pré-escolar
   ☐ 1.º Ciclo
   ☐ 2.º Ciclo
   ☐ 3.º Ciclo
   ☐ Secundário

Figure 30. Teachers' assessment survey (1/9)

4. 4. É professor(a) / educador(a) no ensino: *

Mark only one oval.

◯ Público

◯ Privado / Cooperativo

5. 5. Leciona no distrito de: *

Mark only one oval.

◯ Viana do Castelo

◯ Castelo Branco

◯ Braga

◯ Porto

◯ Aveiro

◯ Coimbra

◯ Vila Real

◯ Bragança

◯ Guarda

◯ Leiria

◯ Lisboa

◯ Santarém

◯ Portalegre

◯ Évora

◯ Setúbal

◯ Viseu

◯ Beja

◯ Faro

◯ Açores

◯ Madeira

Figure 31. Teachers' assessment survey (2/9)

6. 6. Qual ou quais os métodos que prefere para leccionar à distância neste período de encerramento dos estabelecimentos de ensino? *

Check all that apply.

- [ ] Aulas em direto (real-time ou síncronos)
- [ ] Disponibilização de vídeos gravados (assíncronos)
- [ ] Envio de atividades para os alunos realizarem (assíncronos)
- [ ] Não se aplica atualmente

Other: [ ] _____

7. 7. Se respondeu "Aulas em direto", por favor indique que software utiliza.

Check all that apply.

- [ ] Skype
- [ ] Zoom
- [ ] Microsoft Teams
- [ ] Não se aplica atualmente

Other: [ ] _____

8. 8. Qual ou quais os métodos que efectivamente está a usar para leccionar à distância neste período de encerramento dos estabelecimentos de ensino? *

Check all that apply.

- [ ] Aulas em direto (real-time ou síncronos)
- [ ] Disponibilização de vídeos gravados (assíncronos)
- [ ] Envio de atividades para os alunos realizarem (assíncronos)
- [ ] Não se aplica atualmente

Other: [ ] _____

Figure 32. Teachers' assessment survey (3/9)

9. 9. Qual ou quais os métodos que o seu estabelecimento de ensino recomenda para leccionar à distância neste período de encerramento dos estabelecimentos de ensino? *

Check all that apply.

- ☐ Aulas em direto (real-time ou síncronos)
- ☐ Disponibilização de vídeos gravados (assíncronos)
- ☐ Envio de atividades para os alunos realizarem (assíncronos)
- ☐ Não se aplica atualmente
- Other: ☐ _____

10. 10. Recebeu alguma recomendação do seu estabelecimento de ensino *

Mark only one oval.

- ⬭ Sim
- ⬭ Não

11. 11. Se respondeu "Sim" por favor indique qual ou quais.

Check all that apply.

- ☐ Skype
- ☐ Zoom
- ☐ Microsoft Teams
- ☐ Moodle
- ☐ Facebook
- Other: ☐ _____

12. 12. Acredita que tem todos os recursos técnicos necessários para leccionar à distância? *

Mark only one oval.

- ⬭ Sim
- ⬭ Não

Figure 33. Teachers' assessment survey (4/9)

13.   13. Considera que é necessária formação específica para ensinar à distância? *

Mark only one oval.

⬭ Sim

⬭ Não

14.   14. Teve formação específica para ensinar à distância? *

Mark only one oval.

⬭ Sim

⬭ Não

15.   15. Tem usado as redes sociais para obter mais informação sobre a temática do ensino à distância? *

Mark only one oval.

⬭ Sim

⬭ Não

16.   16. Se respondeu sim, por favor indique qual ou quais.

_____

17.   17. Faz parte de algum grupo, criado nos social media, com os seus colegas para trocar impressões sobre o ensino à distância? *

Mark only one oval.

⬭ Sim

⬭ Não

Figure 34. Teachers' assessment survey (5/9)

18. 18. Se respondeu "Sim" indique qual ou quais

Check all that apply.

☐ Facebook
☐ Whatsapp
Other: ☐ _____

19. 19. Qual é a percentagem dos seus alunos que não tem acesso ao ensino à distância via internet? *

Mark only one oval.

◯ 0% a 9%
◯ 10% a 19%
◯ 20% a 29%
◯ 30% a 39%
◯ 40% a 49%
◯ 50% a 59%
◯ 60% a 69%
◯ 70% a 79%
◯ 80% a 89%
◯ 90% a 100%
◯ Não sei

20. 20. Acredita que os alunos estão a aprender tanto no ensino à distância como no ensino presencial? *

Mark only one oval.

◯ Sim
◯ Não
◯ Não se aplica atualmente

Figure 35. Teachers' assessment survey (6/9)

21. 21. Enviou tarefas aos seus alunos para serem realizadas à distância no âmbito do encerramento dos estabelecimentos de ensino no dia 16 de março? *

Mark only one oval.

◯ Sim

◯ Não

22. 22. Se respondeu "Sim" à questão anterior, por favor indique a percentagem dos alunos que realizaram as respetivas tarefas?

Mark only one oval.

◯ 0% a 9%

◯ 10% a 19%

◯ 20% a 29%

◯ 30% a 39%

◯ 40% a 49%

◯ 50% a 59%

◯ 60% a 69%

◯ 70% a 79%

◯ 80% a 89%

◯ 90% a 100%

◯ Não sei

23. 23. Considera que está a enviar mais trabalhos de casa aos seus alunos do que nos períodos anteriores a esta epidemia? *

Mark only one oval.

◯ Sim

◯ Não

Figure 36. Teachers' assessment survey (7/9)

24. 24. Qual é a percentagem de alunos que realizaram os respectivos trabalhos de casa? *

Mark only one oval.

- ( ) 0% a 9%
- ( ) 10% a 19%
- ( ) 20% a 29%
- ( ) 30% a 39%
- ( ) 40% a 49%
- ( ) 50% a 59%
- ( ) 60% a 69%
- ( ) 70% a 79%
- ( ) 80% a 89%
- ( ) 90% a 100%
- ( ) Não sei

25. 25. Houve uma melhoria na classificação dos trabalhos de casa relativamente ao ensino presencial? *

Mark only one oval.

- ( ) Sim
- ( ) Não

26. 26. Como interage com os seus alunos? *

Check all that apply.

- [ ] Durante a aula à distância
- [ ] E-mail
- [ ] Telefone
- Other: [ ] _____

Figure 37. Teachers' assessment survey (8/9)

27. 27. Tem havido maior participação dos encarregados de educação no processo formativo dos seus alunos? *

Mark only one oval.

◯ Sim

◯ Não

28. 28. Se respondeu "Sim" à pergunta anterior, por favor indique de que forma?

_____

Figure 38. Teachers' assessment survey (9/9)

10.2 Appendix B

Transição para o ensino à distância durante a epidemia de COVID-19 - Estudantes.

Este questionário é destinado a estudantes e tem como objetivo estudar o impacto da COVID-19 no sistema de ensino e a utilização de novos recurso interactivos, nomeadamente no ensino à distância.

A sua participação é livre. Pode desistir a qualquer momento. Não são solicitados dados pessoais que permitam identificar os inquiridos. As informações recolhidas são confidenciais e serão objeto de análise para o projecto de mestrado e para futuras publicações científicas.

A sua participação é muito importante e poderá ser feita repetidamente, em diferentes momentos. Seria uma mais valia para o estudo se respondesse a este questionário semanalmente até receber informação contrária.

* Required

1. Declaro que a minha participação neste estudo é voluntária, que tomei conhecimento da liberdade de desistir a qualquer momento e que não serão pedidos dados que levem à minha identificação. *

Check all that apply.

☐ Sim, tomei conhecimento

Figure 39. Students' assessment survey (1/13)

2. 1. Indique a sua idade. *

Mark only one oval.

◯ 6 anos

◯ 7 anos

◯ 8 anos

◯ 9 anos

◯ 10 anos

◯ 11 anos

◯ 12 anos

◯ 13 anos

◯ 14 anos

◯ 15 anos

◯ 16 anos

◯ 17 anos

◯ 18 anos

◯ 19 anos

◯ 20 anos

◯ 21 anos

3. 2. Indique o seu género. *

Mark only one oval.

◯ Masculino

◯ Feminino

◯ Outro

Figure 40. Students' assessment survey (2/13)

4. 3. Indique o ano em que está actualmente matriculado. *

Mark only one oval.

◯ 1.º ano

◯ 2.º ano

◯ 3.º ano

◯ 4.º ano

◯ 5.º ano

◯ 6.º ano

◯ 8.º ano

◯ 9.º ano

◯ 10.º ano

◯ 11.º ano

◯ 12.º ano

◯ Ensino superior

5. 4. Está matriculado no ensino: *

Mark only one oval.

◯ Público

◯ Privado / Cooperativo

Figure 41. Students' assessment survey (3/13)

6.　5. Em que distrito vive *

Mark only one oval.

- ◯ Viana do Castelo
- ◯ Castelo Branco
- ◯ Braga
- ◯ Porto
- ◯ Aveiro
- ◯ Coimbra
- ◯ Vila Real
- ◯ Bragança
- ◯ Guarda
- ◯ Leiria
- ◯ Lisboa
- ◯ Santarém
- ◯ Portalegre
- ◯ Évora
- ◯ Setúbal
- ◯ Viseu
- ◯ Beja
- ◯ Faro
- ◯ Açores
- ◯ Madeira

7.　6. Recebeu alguma informação do seu professor ou estabelecimento de ensino sobre o método de ensino à distância? *

Mark only one oval.

- ◯ Sim
- ◯ Não

Figure 42. Students' assessment survey (4/13)

8. 7. Acha que está esclarecido sobre o ensino à distância? *

Mark only one oval.

⬭ Sim

⬭ Não

9. 8. Acredita que o seu estabelecimento de ensino providenciou os recursos necessários para o ensino à distância? *

Mark only one oval.

⬭ Sim

⬭ Não

10. 9. Se respondeu "Sim", por favor indique qual ou quais

Check all that apply.

☐ Software

☐ Hardware

☐ Fichas de trabalho

Other: ☐ _____

11. 10. Acredita que tem todos os recursos técnicos necessários para o ensino à distância (ligação à internet, computador ou tablet)? *

Mark only one oval.

⬭ Sim

⬭ Não

Figure 43. Students' assessment survey (5/13)

12. 11. Tem usado as redes sociais para obter mais informação sobre o ensino à distância? *

Mark only one oval.

◯ Sim

◯ Não

13. 12. Se respondeu "Sim" à pergunta anterior, por favor indique qual ou quais. *

Check all that apply.

☐ Facebook

☐ Twitter

☐ Instagram

Other: ☐ _____

14. 13. Com que frequência tem visitado essa(s) rede(s) social(sociais)?

Mark only one oval.

◯ Menos de 3 vezes por dia

◯ Entre 3 e 5 vezes por dia

◯ Mais do que 5 vezes por dia

15. 14. Quanto tempo por dia, em média, tem visitado à mais as redes sociais, comparativamente ao período antes da pandemia? *

Mark only one oval.

◯ Menos de 30 minutos por dia

◯ Entre 30 a 60 minutos por dia

◯ Entre 60 a 90 minutos por dia

◯ Mais do que 90 minutos por dia

Figure 44. Students' assessment survey (6/13)

16.   15. Com que frequência tem publicado conteúdos nessa(s) rede(s)
      social(sociais)?

      Mark only one oval.

      ◯ Não publico

      ◯ Menos de 3 vezes por semana

      ◯ Entre 3 e 5 vezes por semana

      ◯ Mais do que 5 vezes por semana

17.   16. Qual é a natureza dessas publicações

      _____

18.   17. Qual ou quais os métodos que prefere para o ensino à distância neste
      período de encerramento dos estabelecimentos de ensino? *

      Check all that apply.

      ☐ Aulas em direto (tempo-real ou síncronos)
      ☐ Disponibilização de vídeos gravados (assíncronos)
      ☐ Envio de atividades para os alunos realizarem (assíncronos)
      ☐ Não se aplica atualmente
      Other: ☐ _____

19.   18. Se respondeu "Aulas em direto", por favor indique que software utiliza.

      Check all that apply.

      ☐ Skype
      ☐ Zoom
      ☐ Microsoft Teams
      ☐ Não se aplica atualmente
      Other: ☐ _____

Figure 45. Students' assessment survey (7/13)

20. 19. Acredita que está a aprender tanto no ensino à distância como no ensino presencial? *

Mark only one oval.

◯ Sim

◯ Não

◯ Não se aplica atualmente

21. 20. As aulas ficaram mais difíceis de acompanhar no ensino à distância? *

Mark only one oval.

◯ Sim

◯ Não

22. 21. Acredita que participa tanto no ensino à distância como no presencial. *

Mark only one oval.

◯ Sim

◯ Não

23. 22. Acredita que os seus colegas participam tanto no ensino à distância como no presencial. *

Mark only one oval.

◯ Sim

◯ Não

Figure 46. Students' assessment survey (8/13)

24.   23. Considera que as suas dúvidas sobre os conteúdos leccionados são tão esclarecidas no ensino à distância como no presencial. *

Mark only one oval.

( ) Sim
( ) Não

25.   24. Acredita que, de modo geral, os alunos aprendem melhor com o ensino à distância do que com o ensino presencial. *

Mark only one oval.

( ) Sim
( ) Não

26.   25. Acreditas que tens recebido muitos trabalhos de casa? *

Mark only one oval.

( ) Sim
( ) Não
( ) Não Aplicável

27.   26. Tenho todo o apoio necessário nas aulas e fora delas. *

Mark only one oval.

( ) Sim
( ) Não

Figure 47. Students' assessment survey (9/13)

28.   27. Se respondeu "Sim" por favor indique qual ou quais.

Check all that apply.

☐ Professor
☐ Encarregado de Educação
☐ Colegas
Other: ☐ _____

29.   28. Acredita que o seu encarregado de educação é inteiramente capaz de esclarecer as tuas dúvidas? *

Check all that apply.

☐ Sim
☐ Não

30.   29. Recebeu tarefas dos seus professores para serem realizadas à distância no âmbito do encerramento dos estabelecimentos de ensino no dia 16 de março? *

Mark only one oval.

◯ Sim
◯ Não

31.   30. Se respondeu "Sim" à questão anterior, por favor indique a quantidade de tarefas que conseguiu completar sozinho?

Mark only one oval.

◯ Todas
◯ Quase todas
◯ Cerca de metade
◯ Poucas
◯ Nenhuma

Figure 48. Students' assessment survey (10/13)

32. 31. Acredita que está a receber mais trabalhos de casa do que nos períodos anteriores a esta epidemia? *

Mark only one oval.

⬭ Sim

⬭ Não

33. 32. Os seus colegas têm acesso ao ensino à distância? *

Mark only one oval.

⬭ Todos

⬭ Quase todos

⬭ Cerca de metade

⬭ Poucos

⬭ Nenhum

34. 33. Tem mantido contacto com os seus colegas? *

Mark only one oval.

⬭ Sim

⬭ Não

35. 34. Se respondeu "Sim" por favor indique como

Check all that apply.

☐ Whatsapp

☐ Instagram

☐ Facebook

Other: ☐ _____

Figure 49. Students' assessment survey (11/13)

36. 35. Com que frequência tem mantido contacto com os seus colegas?

Mark only one oval.

⬭ Menos de 3 vezes por semana

⬭ 3 vezes por semana

⬭ Todos os dias

37. 36. Como interage com os seus professores? *

Mark only one oval.

⬭ E-mail

⬭ Telefone

⬭ Rede sociais

38. 37. Se respondeu "Redes sociais" na pergunta anterior, por favor indique qual ou quais.

Check all that apply.

☐ Facebook
☐ Twitter
☐ Instagram
Other: ☐ _____

39. 38. Tem havido maior participação do seu encarregado de educação no seu processo formativo? *

Mark only one oval.

⬭ Sim

⬭ Não

40. 39. Se respondeu "Sim" indique de que forma

_____

Figure 50. Students' assessment survey (12/13)

41. 40. Gosta mais do ensino à distância do que o presencial. *

Mark only one oval.

◯ Sim

◯ Não

42. 41. Se respondeu "Sim" por favor indique porquê.

_____

Figure 51. Students' assessment survey (13/13)

10.3 Appendix C

Transição para o ensino à distância durante a epidemia de COVID-19 - Pais.

Este questionário é destinado aos pais/encarregados de educação e tem como objetivo estudar o impacto da COVID-19 no sistema de ensino e a utilização de novos recurso interactivos, nomeadamente no ensino à distância.

A sua participação é livre. Pode desistir a qualquer momento. Não são solicitados dados pessoais que permitam identificar os inquiridos. As informações recolhidas são confidenciais e serão objeto de análise para o projecto de mestrado e para futuras publicações científicas.

A sua participação é muito importante e poderá ser feita repetidamente, em diferentes momentos. Seria uma mais valia para o estudo se respondesse a este questionário semanalmente até receber informação contrária.

* Required

1. Declaro que a minha participação neste estudo é voluntária, que tomei conhecimento da liberdade de desistir a qualquer momento e que não serão pedidos dados que levem à minha identificação. *

    Check all that apply.

    ☐ Sim, tomei conhecimento

Figure 52. Parents' assessment survey (1/16)

2. 1.Indique a sua idade. *

Mark only one oval.

- ( ) 18
- ( ) 19
- ( ) 20
- ( ) 21
- ( ) 22
- ( ) 23
- ( ) 24
- ( ) 25
- ( ) 26
- ( ) 27
- ( ) 28
- ( ) 29
- ( ) 30
- ( ) 31
- ( ) 32
- ( ) 33
- ( ) 34
- ( ) 35
- ( ) 36
- ( ) 37
- ( ) 38
- ( ) 39
- ( ) 40
- ( ) 41
- ( ) 42
- ( ) 43
- ( ) 44
- ( ) 45
- ( ) 46
- ( ) 47
- ( ) 48
- ( ) 49

Figure 53. Parents' assessment survey (2/16)

○ 50

○ 51

○ 52

○ 53

○ 54

○ 55 ou mais

3. 2.Indique o seu género. *

Mark only one oval.

○ Masculino

○ Feminino

○ Outro

4. 3.Indique as suas habilitações literárias. *

Mark only one oval.

○ 4.º ano de escolaridade (1.º ciclo do ensino básico completo)

○ 6.º ano de escolaridade (2.º ciclo do ensino básico completo)

○ 9.º ano de escolaridade (3.º ciclo do ensino básico completo)

○ 12.º ano ou equivalente (ensino secundário completo)

○ Licenciatura (completo)

○ Mestrado (completo)

○ Doutoramento (completo)

Figure 54. Parents' assessment survey (3/16)

5. 4.Neste momento, desenvolve a sua atividade profissional: *

Mark only one oval.

○ Totalmente em teletrabalho, a partir de casa

○ Parcialmente em teletrabalho, predominantemente a partir de casa

○ No local de trabalho habitual

○ Deixou de exercer a sua atividade profissional

○ Não exercia atividade profissional antes da pandemia.

6. 5.Essa forma de trabalhar era a que habitualmente usava antes de serem tomadas medidas em relação à pandemia?

Mark only one oval.

○ Sim

○ Não

7. 6.Indique o ano em que o(a) seu(sua) filho(a) está actualmente matriculado. *

Mark only one oval.

○ 1.º ano

○ 2.º ano

○ 3.º ano

○ 4.º ano

○ 5.º ano

○ 6.º ano

○ 7.º ano

○ 8.º ano

○ 9.º ano

○ 10.º ano

○ 11.º ano

○ 12.º ano

○ Ensino Superior

Figure 55. Parents' assessment survey (4/16)

8. 7.Qual é a idade do seu/sua filho(a)/educando(a) *

Mark only one oval.

○ 6
○ 7
○ 8
○ 9
○ 10
○ 11
○ 12
○ 13
○ 14
○ 15
○ 16
○ 17
○ 18 ou mais

9. 8.Está matriculado no ensino: *

Mark only one oval.

○ Público
○ Privado / Cooperativo

10. 9.Recebeu alguma informação dos professores ou estabelecimento de ensino do seu/sua filho(a)/educando(a) sobre como se decorrerá o restante ano letivo ? *

Mark only one oval.

○ Sim
○ Não

Figure 56. Parents' assessment survey (5/16)

11. 10.A escola da(o) sua/seu filha(o)/educanda(o) desenvolveu atividades de ensino não presencial depois de encerradas as escolas? *

Mark only one oval.

( ) Sim

( ) Não

( ) Não sei

12. 11.Se respondeu "Sim" à pergunta anterior, está satisfeita(o) com essa solução?

Mark only one oval.

( ) Sim, completamente satisfeito(a)

( ) Sim, moderadamente satisfeito(a)

( ) Estou ligeiramente insatisfeita(o)

( ) Estou completamente insatisfeita(o)

( ) Não sei responder

13. 12.Acha que está esclarecido sobre o ensino à distância? *

Mark only one oval.

( ) Sim

( ) Não

14. 13.Considera que é necessário que os professores tenham formação específica para ensinar à distância? *

Mark only one oval.

( ) Sim

( ) Não

Figure 57. Parents' assessment survey (6/16)

15. 14.Considera que os professores do(a) sua/seu filha(o)/educanda(o) têm formação específica para ensinar à distância? *

Mark only one oval.

◯ Sim

◯ Não

16. 15.Tem usado as redes sociais para obter mais informação sobre a temática do ensino à distância? *

Mark only one oval.

◯ Sim

◯ Não

17. 16.Se respondeu "Sim" por favor indique qual ou quais

Check all that apply.

☐ Facebook

☐ Twitter

☐ Instagram

☐ Whatsapp

Other: ☐ _____

18. 17.Com que frequência tem visitado essa(s) rede(s) social(sociais)?

Mark only one oval.

◯ Menos de 3 vezes por semana

◯ 3 vezes por semana

◯ Entre 3 e 5 vezes por semana

◯ Mais do que 5 vezes por semana

Figure 58. Parents' assessment survey (7/16)

19. 18.Com que frequência tem publicado nessa(s) rede(s) social(sociais)?

Mark only one oval.

○ Não publico

○ Menos de 3 vezes por semana

○ Entre 3 e 5 vezes por semana

○ Mais do que 5 vezes por semana

○ Other: _____

20. 19.Se tem publicado, indique por favor a natureza das suas publicações

Check all that apply.

☐ Notícias dos media

☐ Publicação da sua opinião

Other: ☐ _____

21. 20.Acredita que o(a) sua/seu filha(o)/educanda(o) tem todos os recursos técnicos necessários para o ensino à distância? *

Mark only one oval.

○ Sim

○ Não

22. 21.Teve que adquirir equipamento ou material específico para este período? *

Mark only one oval.

○ Sim

○ Não

Figure 59. Parents' assessment survey (8/16)

23. 22.Se respondeu "Sim", por favor indique qual.

Check all that apply.

- [ ] Computador
- [ ] Tablet
- [ ] Smartphone

Other: [ ] _____

24. 23.Conhece situações de famílias de colegas do(s) seu(s) filho(s) que não têm acesso em casa a equipamentos informáticos ou Internet? *

Check all that apply.

- [ ] Sim, conheço pelo menos 1 família
- [ ] Sim, conheço 2 famílias
- [ ] Sim, conheço mais de 5 famílias
- [ ] Não conheço

25. 24.Qual ou quais os métodos que o seu estabelecimento de ensino recomenda para leccionar à distância neste período de encerramento dos estabelecimentos de ensino? *

Check all that apply.

- [ ] Aulas em direto (tempo-real ou síncronos)
- [ ] Disponibilização de vídeos gravados (assíncronos)
- [ ] Envio de atividades para os alunos realizarem (assíncronos)
- [ ] Não se aplica atualmente

Other: [ ] _____

26. 25.Se respondeu "Aulas em direto", por favor indique que software utiliza.

Check all that apply.

- [ ] Skype
- [ ] Zoom
- [ ] Microsoft Teams
- [ ] Não se aplica atualmente

Other: [ ] _____

Figure 60. Parents' assessment survey (9/16)

27.   26.Tem usado as redes sociais para obter mais informação sobre o ensino à distância? *

Mark only one oval.

◯ Sim

◯ Não

28.   27.Se respondeu "Sim", por favor indique qual ou quais.

Check all that apply.

☐ Facebook

☐ Twitter

☐ Instagram

Other: ☐ _____

29.   28.Acredita que o(a) seu/sua filho(a)/educando(a) está a aprender tanto no ensino à distância como no ensino presencial? *

Mark only one oval.

◯ Sim

◯ Não

◯ Não se aplica atualmente

30.   29.Acredita que, de modo geral, os alunos aprendem melhor com o ensino à distância do que com o ensino presencial. *

Mark only one oval.

◯ Sim

◯ Não

Figure 61. Parents' assessment survey (10/16)

31. 30.Acredita que, em geral, a alteração de hábitos está a permitir aos alunos fazer uma aprendizagem de vida que complementa a escolaridade? *

Mark only one oval.

◯ Sim, muito

◯ Sim, mas pouco

◯ Não, a não ser pontualmente

◯ Não, pelo contrário

32. 31.Considera que a solução de ensino encontrada pode manter-se até ao final do ano letivo, se a situação de pandemia não melhorar? *

Mark only one oval.

◯ Sim, a solução funciona e não precisa ser alterada

◯ Sim, a solução funciona, mas tem que ser melhorada

◯ Não. Tem que ser encontrada outra solução para o ensino não presencial

◯ Não sei

33. 31.Acredita que foi disponibilizado o(a) do seu/sua filho(a)/educando(a) todo o apoio pedagógico necessário para o ensino à distância? *

Mark only one oval.

◯ Sim

◯ Não

34. 33.Se respondeu "Sim" por favor indique qual ou quais.

Check all that apply.

☐ Fichas de trabalho

☐ Vídeos

☐ Filmes

Other: ☐ _____

Figure 62. Parents' assessment survey (11/16)

35. 34.Acredita que as dúvidas sobre os conteúdos leccionados são tão esclarecidas no ensino à distância como no presencial. *

Mark only one oval.

◯ Sim

◯ Não

36. 35.O seu grau de envolvimento com a realização de tarefas escolares do(a) seu/sua educando(a) alterou-se desde que as escolas encerraram? *

Mark only one oval.

◯ Sim, passei a envolver-me substancialmente mais

◯ Sim, passei a envolver-me ligeiramente mais

◯ Não. Mantive o grau de envolvimento que tinha antes

37. 36.Se respondeu "Sim", quanto tempo a mais, em média, passou a apoiar o(a) seu/sua filho(a)/educando(a) nas suas tarefas diárias.

Mark only one oval.

◯ Menos de 30 minutos

◯ Entre 30 e 60 minutos

◯ Entre 60 e 90 minutos

◯ Mais de 90 minutos

38. 37.Acredita que enquanto encarregado de educação foi sobrecarregado com muitas tarefas? *

Check all that apply.

☐ Sim

☐ Não

Figure 63. Parents' assessment survey (12/16)

39. 38.Recebe indicações do professor para a realização de tarefas do(a) do seu/sua filho(a)/educando(a)? *

Mark only one oval.

◯ Sim
◯ Não

40. 39.Se respondeu "Sim" indique qual ou quais.

_____

41. 40.Acredita que é inteiramente capaz de esclarecer as dúvidas do(a) do seu/sua filho(a)/educando(a)? *

Mark only one oval.

◯ Sim
◯ Não

42. 41.Acredita que o(a) seu/sua filho(a)/educando(a) está a receber mais trabalhos de casa do que nos períodos anteriores a esta pandemia? *

Mark only one oval.

◯ Sim
◯ Não

43. 42.Como interage com os seus professores? *

Mark only one oval.

◯ Não interajo com o professor
◯ Interajo por e-mail
◯ Interajo por telefone
◯ Interajo através de rede sociais
◯ Other: _____

Figure 64. Parents' assessment survey (13/16)

44.   43.Se respondeu "Através de redes sociais" na pergunta anterior, por favor indique qual ou quais.

Check all that apply.

☐ Facebook
☐ Twitter
☐ Instagram
Other: ☐ _____

45.   44.Faz parte de algum grupo nas redes sociais criado propositadamente para este período? *

Mark only one oval.

◯ Sim
◯ Não

46.   45.Se respondeu "Sim" por favor indique qual ou quais.

Check all that apply.

☐ Whatsapp
☐ Facebook
Other: ☐ _____

47.   46.Com que frequência visita o grupo?

Mark only one oval.

◯ Menos de 3 vezes por semana
◯ 3 vezes por semana
◯ Entre 3 e 5 vezes por semana
◯ Mais do que 5 vezes por semana

Figure 65. Parents' assessment survey (14/16)

48.   47.Qual é a natureza dessa interação

Mark only one oval.

◯ Dúvidas sobre o ensino à distância

◯ Dúvidas sobre recursos técnicos

◯ Dúvidas sobre os trabalhos de casa o(a) seu/sua filho(a)/educando(a)

◯ Other: _____

49.   48.Na sua opinião, considera que o final do ano letivo está comprometido? *

Mark only one oval.

◯ Sim, acredito que os alunos não voltarão à escola este ano letivo

◯ Sim, mesmo que os alunos voltem à escola, não haverá condições para lecionar e avaliar

◯ Não, acredito que mais tarde ou mais cedo, os alunos voltarão à escola e que será possível terminar o ano letivo

◯ Não, mesmo que os alunos não voltem à escola será possível lecionar e avaliar

50.   49.O/a seu/sua filho(a)/educando(a) já manifestou expressamente desejo de voltar à escola? *

Mark only one oval.

◯ Sim

◯ Não

51.   50.Se respondeu "Sim", indique a que se deve a manifestação desse desejo?

_____

Figure 66. Parents' assessment survey (15/16)

52. 51.Globalmente, o isolamento em casa tem tido impacto no bem-estar do seu/sua filho(a)/educando(a)? *

Mark only one oval.

- ( ) Não. Não tenho notado alterações de comportamento
- ( ) Sim gerou um estado de maior apatia
- ( ) Sim, noto maiores níveis de ansiedade
- ( ) Sim, anda mais agitado(a)

Figure 67. Parents' assessment survey (16/16)

10.4 Appendix D

Longitudinal interview's example

Transcription by: Duarte Sousa

03.04.2020
Teacher's interview
Zoom
With Teacher1 (T1)

Present:
T1
Duarte Sousa

The meeting starts, via Zoom, and it is explained the study's nature: longitudinal study of education's system during the COVID-19 pandemic and how three specific stakeholders are handling it. Afterwards, Duarte asks for permission to record the meeting and T1 accepts.

A que anos ensinas?
(interviewees' responses deleted for anonymity purposes)

1. Quantas turmas tens?

2. Qual foi a última aula presencial que deste?

3. Como era a rotina das tuas aulas antes desse dia? E em relação à preparação da aula.

4. Como estás a adaptar as aulas já estabelecidas para o ensino online.

    4.1. Mas como planeias fazer isso?

    4.2. E foi por tua iniciativa própria? Ou seja, não tinhas nenhum dos dados ou emails deles?

    4.3. És diretor de turma?

    4.4. Mas porque criaste um grupo no Facebook inicialmente?

    4.5. Os alunos preferem o Instagram?

5. Os alunos estão de férias, não é?

    5.1. Que tipo de tarefas?

    5.2. Essas eram apenas as tuas tarefas. Mas tu, enquanto diretor de turma, tinha outras responsabilidades, como a ligação entre os alunos e os outros professores?

    5.3. Então os alunos vão enviar todos os trabalhos de casa no dia 13 de abril, no início do 3.º período?

    5.4. Por que você vai criar um grupo no Zoom?

6. A tua escola estabeleceu um protocolo sobre como darias as tuas aulas?

6.1. E qual escolheste?

6.2. Antes da pandemia?

7. Já estruturaste as tuas aulas online? Como irás alterar as aulas atuais para um ambiente de ensino a distância?

7.1. Mas quem te disse para usar essas ferramentas específicas? A tua escola criou um toolkit com os materiais necessários ou és tu que procuras?

7.2. Para confirmar, a tua escola não deu nenhuma indicação, conjunto de ferramentas para usares. Tu é que estás a procurar, certo?

8. Acreditas que tens competências para o ensino a distância?

8.1. Porquê?

8.2. Quantos alunos tinhas?

8.3. E essa foi a tua primeira experiência

8.4. com ensino a distância?

8.5. E tiveste formação específica para isso?

8.6. Tiveste formação via ensino?

8.7. E tiveste formação no ensino a distância ou virtual na tua formação académica?

9. Acreditas que tens todas as condições para ensinar a distância?

9.1. Porquê? O que achas que falta?

9.2. E os meios técnicos ou tecnológicos?

10. Achas que os teus alunos têm todas as condições para o ensino a distância?

10.1.   E o que fazes nesses casos?

11. Achas que és entendido em tecnologia, pelo menos o suficiente para lidar com o aspeto técnico do ensino a distância?

12. Acreditas que os teus colegas também têm um conhecimento mínimo?

12.1.   Em que faixa etária, os professores não possuem o conhecimento mínimo?

13. Disseste-me antes que a escola sugeriu três opções para suas aulas online - Skype, Zoom e Microsoft Teams. Pesquisaste por outras ferramentas para usar?

13.1.   Um formulário?

13.2.   Mas por que escolheste o Zoom, independentemente de todas as informações sobre o Microsoft Teams, porque escolheste um com o qual não estavas familiarizado?

14. Já visitaste as páginas de grupo de professores no Facebook para encontrar mais informações sobre todos esses problemas?

15. Em relação às fichas do final do 2º período, os teus alunos (Direção da turma) quiseram mais esclarecimentos sobre isso?

15.1. A que conteúdos essas fichas se referem? Referem-se a conteúdos ensinados anteriormente ou novos conteúdos?

15.2. Então, ele provavelmente não aprendeu sobre essa parte porque eles estão apenas a começar o segundo semestre, não é?

15.3. E como é que isso está a ser tratado?

16. Voltando aos alunos, a única maneira de interagir com eles é por email?

16.1. E os outros professores, tens conhecimento disso?

17. Telefonaste aos pais dos teus alunos antes do encerramento da escola, antes do término do 2º período? Dizendo, por exemplo, a escola iria fechar ...

17.1. Porquê que ligaste aos pais dos teus alunos?

17.2. Vais ligar para os pais de novo?

17.3. Todos os diretores de turma estão a

17.4. fazer o mesmo?

17.5. Informado por quem?

18. Os alunos falam sobre esses métodos de ensino distância e qual é o feedback deles?

19. Já tens experiência com ensino a distância desde o ano passado.

19.1. Ok, quais são os aspetos positivos do ensino a distância?

19.2. Por que és a favor da "escola real"?

19.3. Quais são os aspetos negativos do ensino a distância?

19.4. Mas então, como fazias os exames?

19.5. Mas ele tinha o contato dela?

20. Achas que o ensino a distância faz parte do futuro da educação?

20.1. Porquê?

21. Mas não podes fazer isso remotamente? Não fizeste isso com a turma do ano passado?

21.1. Como fizeste isso - isso da conexão?

22. Acreditas que estás preparado para o ensino a distância de 4 turmas, do próximo período?

22.1. Mas isso significa que não estás preparado, porque não sabes se os alunos têm os recursos que mencionaste, não é?

22.2. Pretende fazer dos pais os teus aliados, dizendo para controlarem se os alunos estão a fazer os trabalhos de casa e a enviá-los no devido tempo ou mesmo controlá-los durante os exames?

23. Comparando as tuas aulas do último ano, o ensino a distância versus o presencial. Acreditas que uma de tuas turmas aprendeu mais e / ou mais rápido?

23.1. Se considerares os exames, por exemplo, a turma virtual teve notas melhores ou piores que a presencial?

24. Há alguma pergunta que eu deveria ter feito e não fiz?

10.5 Appendix E

Informação ao Participante de Investigação e Consentimento Informado

Título do Estudo: Teste de sistema de assistência aos problemas académicos de estudantes

Investigador Principal: Duarte Sousa, Aluno de Mestrado de Design de Medias Interativos. Universidade da Madeira
+351 964 402 487, 2024604@student.uma.pt

_____

Objetivo do Estudo
O objetivo principal desta investigação é avaliar como os jovens interagem com um sistema que tem por objetivo intermediar a sua assistência no seu progresso académico, de uma forma específica e personalizada, por uma comunidade de ensino.

Procedimento
Será explicado ao jovem o objetivo do teste e do sistema a ser testado. A seguir será dada uma lista de tarefas (4) para que possa executar no protótipo. Finalmente o estudante irá preencher um formulário com perguntas sobre a sua interação com o sistema.

Critérios de Inclusão
Será considerado elegível para participar neste estudo se for estudante e possuir entre os 12 e os 16 anos de idade.

Custos
A participação nesta investigação não tem qualquer custo para o participante.

Confidencialidade
A confidencialidade dos dados será mantida das seguintes formas: os dados dos participantes serão guardados separadamente; esta declaração de consentimento estará mantida com o investigador principal e não será divulgada a terceiros. Ao aceitar participar neste estudo, o participante também aceita que a sua informação recolhida durante a experiência seja objeto de análise e de futuras publicações científicas. Para proteger a sua privacidade, ser-lhe-á atribuído um código e toda a informação recolhida sobre si será gravada através deste código, não contendo nunca o seu nome.

Direitos
A participação do estudante é voluntária. O estudante é livre de interromper a sua participação em qualquer momento. A recusa em participar ou interrupção da participação não resultará em qualquer penalização, ou perda de eventuais benefícios ou direitos. O investigador principal poderá decidir, de forma fundamentada, interromper algumas participações neste estudo. Caso se verifique esta situação, esta não resultará em qualquer penalização, ou perda de eventuais benefícios ou direitos.

Figure 68. Informed consent used on both usability tests (1/2).

Autorização

Assinale com um **X** qual das afirmações autoriza:

Entendo que os investigadores possam querer usar <u>fotografias</u> e <u>áudio</u> por razões ilustrativas nas apresentações e publicações deste trabalho, para fins científicos ou educativos.

[ ] *Eu dou autorização para fazê-lo, desde que o **rosto do meu educando <u>não</u>** apareça.*

[ ] *Eu dou autorização para fazê-lo, desde que o **rosto do meu educando <u>apareça</u>.***

Esclarecimento de Dúvidas & Contactos

Se você tem dúvidas sobre este estudo, desejar obter mais informações, ou desejar interromper a sua participação no estudo, entre em contacto com o Investigador Principal em pessoa, por telefone ou e-mail. A informação de contacto está disponível no início da primeira página deste documento.

Menores

Os menores (indivíduos com idade inferior a 18 anos) não podem legalmente dar o consentimento para participar em estudos de investigação. O consentimento deve ser dado pelo(a) diretor(a) da escola.

Ao assinar este documento, você confirma que leu a informação acima descrita sobre este estudo, e que todas as suas perguntas foram respondidas. Você poderá também fazer perguntas adicionais a qualquer momento durante o estudo, e mesmo após este ter terminado.

Ao assinar este documento, concorda que os estudantes participem neste estudo de investigação.

_____

ASSINATURA DO(A) DIRETOR(A) DA ESCOLA   DATA
OU ENCARREGADO DE EDUCAÇÃO

_____   _____

Investigador que obtém o consentimento

Como membro da equipa de investigação, confirmo que expliquei ao participante acima referido a natureza e finalidade deste estudo de investigação. Estou disponível para esclarecer quaisquer dúvidas que possam surgir ao longo do estudo.

_____

ASSINATURA DO INVESTIGADOR   DATA

_____   _____

Figure 69. Informed consent used on both usability tests (2/2).

10.6 Appendix F

Descrição do sistema

Olá, sou o Duarte Sousa, Aluno de Mestrado de Design de Medias Interativos, da Universidade da Madeira e vamos testar um projecto feito no âmbito da minha dissertação de mestrado. O projecto baseia-se numa aplicação - OWL CLUB - que tem por objectivo criar uma comunidade de ensino (uma rede de explicadores informais) que irá procurar ajudar os estudantes nas suas dúvidas académicas, de uma forma específica e personalizada. Irá, portanto, testar a aplicação OWL CLUB, por forma a perceber a sua usabilidade, ou seja, se existem pontos favoráveis ou desfavoráveis na interação com a aplicação e quais são esses pontos. Assim sendo, agradecemos a sua contribuição na melhoria deste projecto que vai testar. Quero salientar que não estamos a testá-lo(a), mas sim somente a sua interação com a aplicação. Este estudo terá 20 minutos de duração e responderei a quaisquer questões que tenha ao longo do mesmo.

Por favor, pense em voz alta à medida que completas as 3 tarefas que te serão pedidas. Isto ajudar-nos-á a perceber melhor o processo pelo qual está a passar.

A confidencialidade dos seus dados será mantida das seguintes formas: os dados dos participantes serão guardados separadamente; b) a declaração de consentimento estará mantida com o investigador principal e não será divulgada a terceiros. Ao aceitar participar neste estudo, o participante também aceita que a sua informação recolhida durante a experiência seja objeto de análise e de futuras publicações científicas. Para proteger a sua privacidade, iremos atribuir um código e toda a informação recolhida sobre si será gravada através deste código, não contendo nunca o seu nome.

Se tiver dúvidas sobre este estudo, desejar obter mais informações, ou desejar interromper a sua participação no estudo, por favor entre em contacto comigo, o Investigador Principal

Comecemos então.

Figure 70. Usability tests' introduction used on both tests.

Mentor user-test

App test

- Tarefa:

  1 (T1) - Responde à uma dúvida de um aluno.

  2 (T2) - Vota numa resposta dada por outro mentor.

  3 (T3) - Vê o perfil de um aluno através da sua pergunta.

  4 (T4) - Vê as tuas notificações.

- Formulário:

  Por favor, preencha o formulário.

Obrigado pela sua colaboração!

Estudante user-test

App test

- Tarefa:

  1 (T1) - Cria uma pergunta.

  2 (T2) - Vota numa resposta dada por um mentor.

  3 (T3) - Vê o perfil de um mentor através da sua resposta.

  4 (T4) - Link a um novo mentor.

- Formulário:

  Por favor, preencha o formulário.

Obrigado pela sua colaboração!

Figure 71. Low-fidelity usability test's evaluated tasks.

10.7 Appendix G

Questionário: Low-definition prototype

User _____

Idade _____

Género _____

Data _____

Reação ao sistema, no geral	1 2 3 4 5 Terrível Fantástico
	1 2 3 4 5 Difícil Fácil
	1 2 3 4 5 Frustrante Satisfatório
	1 2 3 4 5 Aborrecido Estimulante
	1 2 3 4 5 Rígido Estimulante
Aprendizagem	Aprendizagem do objetivo do sistema 1 2 3 4 5 Difícil Fácil
	Aprendizagem dos mecanismos do sistema 1 2 3 4 5 Difícil Fácil
	O sistema é direto ao ponto 1 2 3 4 5 Nunca Sempre

Aspectos positivos	Aspetos negativos

Figure 72. Low-fidelity usability test's questionnaire (1/2).

System Usability Scale (SUS)

Perguntas	Respostas				
	Concordo Completamente **1**	**2**	**3**	**4**	Discordo Completamente **5**
1. Eu acho que gostaria de usar este sistema com frequência.					
2. Eu acho o sistema desnecessariamente complexo.					
3. Eu achei o sistema fácil de usar.					
4. Eu acho que eu precisaria de ajuda de uma pessoa com conhecimentos técnicos para usar o sistema.					
5. Eu acho que as várias funções do sistema estão muito bem integradas.					
6. Eu acho que o sistema apresenta muitas inconsistências.					
7. Eu imagino que as pessoas aprenderão a usar esse sistema rapidamente.					
8. Eu achei o sistema confuso de usar.					
9. Eu senti-me confiante ao usar o sistema.					
10. Eu precisei aprender várias coisas novas antes de conseguir usar o sistema.					

Figure 73. Low-fidelity usability test's questionnaire (2/2).

10.8 Appendix H

USABILITY TEST

    - Tasks

a) Students' tasks

    1 (T1) - Cria uma pergunta nova: "Qual é o maior rio de Portugal Continental e onde deságua?"

    2 (T2) - Vota numa resposta dada por um mentor.

    3 (T3) - Vê o perfil do mentor e conecta-te com ele

    4 (T4) - Vê as tuas notificações

b) Mentors' tasks

    1 (T1) - Abre uma pergunta e depois responde à dúvida do aluno cuja pergunta abriste.

    2 (T2) - Faz like numa resposta.

    3 (T3) - Vê o perfil do estudante

    4 (T4) - Vê as tuas notificações.

- Post-test questionnaire :

    Por favor, preencha o formulário.

Obrigado pela sua colaboração!

Figure 74. High-fidelity functional prototype usability test's evaluated tasks.

10.9 Appendix I

Figure 75. High-fidelity functional prototype usability test's questionnaire (online version).

INQUÉRITO SOBRE A USABILIDADE DA APLICAÇÃO "OWL CLUB"

Este projecto baseia-se numa aplicação - OWL Club - que tem por objectivo criar uma comunidade de ensino que poderá ajudar os estudantes nas suas dúvidas académicas, de uma forma específica e personalizada.

Neste questionário, reflicta na forma como interagiu com a aplicação nas tarefas que lhe foram pedidas, ou seja, indique-nos se se existem pontos favoráveis ou desfavoráveis na interação com a aplicação e quais são esses pontos. Assim sendo, agradecemos a sua contribuição na melhoria deste projecto que vai testar.

Os dados obtidos serão tratados com a máxima confidencialidade e anonimato. Relembramos, porém, que a sua participação, totalmente voluntária, só será válida se responderes a todas as questões (i.e., daquelas de carácter obrigatório) apresentadas, embora possa desistir a qualquer momento.

Quero salientar que não estamos a testá-lo(a) a si, mas apenas a sua interação com a aplicação.

1. Percebeste claramente o objetivo deste estudo? *

   Mark only one oval.

   ◯ Sim

   ◯ Não

1. Teste de experiência de utilização	Esta secção visa a avaliar sua experiência na utilização da aplicação "OWL Club." Com base na sua experiência de utilização da aplicação "OWL Club", dê a sua opinião relativamente aos aspectos que poderá encontrar em abaixo. Devo salientar que não existem respostas certas ou erradas.

2. 1.1 Quais são os 3 principais aspectos positivos que encontrou na aplicação? *

   _____

   _____

   _____

   _____

   _____

3. 1.2 Quais são os 3 principais aspectos negativos que encontrou na aplicação? *

   _____

   _____

   _____

   _____

   _____

Figure 76. High-fidelity functional prototype usability test's questionnaire (1/12).

4. 1.3 Em cada afirmação assinale a opção que mais se aproxima da sua opinião, utilizando a seguinte escala: 1. Discordo totalmente; 2. Discordo; 3. Indiferente/Neutro; 4. Concordo; 5. Concordo totalmente. *

1 = Discordo totalmente 5 = Concordo totalmente

	Discordo Totalmente	Discordo	Indiferente / Neutro	Concordo	Concordo Totalmente

Mark only one oval per row.

	1	2	3	4	5
Acho que gostaria de utilizar esta aplicação com frequência.	◯	◯	◯	◯	◯
Considerei a aplicação mais complexo do que necessário.	◯	◯	◯	◯	◯
Achei a aplicação fácil de utilizar.	◯	◯	◯	◯	◯
Acho que necessitaria de ajuda de um técnico para conseguir utilizar esta aplicação.	◯	◯	◯	◯	◯
Considerei que as várias funcionalidades desta aplicação estavam bem integradas.	◯	◯	◯	◯	◯
Achei que esta aplicação tinha muitas inconsistências.	◯	◯	◯	◯	◯
Suponho que a maioria das pessoas aprenderia a utilizar rapidamente esta aplicação.	◯	◯	◯	◯	◯
Considerei a aplicação muito complicada de utilizar.	◯	◯	◯	◯	◯
Senti-me muito confiante a utilizar esta aplicação.	◯	◯	◯	◯	◯
Tive que aprender muito antes de conseguir lidar com esta aplicação.	◯	◯	◯	◯	◯

Figure 77. High-fidelity functional prototype usability test's questionnaire (2/12).

2. Reação ao Sistema (aplicação)

Nesta secção procuramos perceber as suas reações gerais da aplicação. Esta é composta por pares de respostas representando e em cada afirmação assinale a opção que mais se aproxima da sua opinião, utilizando a seguinte escala gradual de 1 a 5.

5. **2.1 Reação ao Sistema, no geral: ***

Mark only one oval.

	1	2	3	4	5	
Terrível	◯	◯	◯	◯	◯	Fantástico

6. **2.2 Reação ao Sistema, no geral (continuação): ***

Mark only one oval.

	1	2	3	4	5	
Difícil	◯	◯	◯	◯	◯	Fácil

7. **2.3 Reação ao Sistema, no geral (continuação): ***

Mark only one oval.

	1	2	3	4	5	
Frustrante	◯	◯	◯	◯	◯	Satisfatório

8. **2.4 Reação ao Sistema, no geral (continuação): ***

Mark only one oval.

	1	2	3	4	5	
Aborrecido	◯	◯	◯	◯	◯	Estimulante

Figure 78. High-fidelity functional prototype usability test's questionnaire (3/12).

9. **2.5 Reação ao Sistema, no geral (continuação):** *

Mark only one oval.

	1	2	3	4	5	
Rígido	◯	◯	◯	◯	◯	Flexível

10. **2.6 Aprendizagem do objectivo da aplicação** *

Mark only one oval.

	1	2	3	4	5	
Difícil	◯	◯	◯	◯	◯	Fácil

11. **2.7 Aprendizagem dos mecanismos da aplicação** *

Mark only one oval.

	1	2	3	4	5	
Difícil	◯	◯	◯	◯	◯	Fácil

12. **2.8 A aplicação é directa ao ponto** *

Mark only one oval.

	1	2	3	4	5	
Nunca	◯	◯	◯	◯	◯	Sempre

3. Teste de experiência de utilização (final)	Esta última fase do questionário é relativa às propriedades que a aplicação pode ter. É composta por pares de respostas representando as graduação (de 1 a 5) entre os mesmos. Marque um circulo que melhor expressa a sua opinião sobre o conceito em questão.

Figure 79. High-fidelity functional prototype usability test's questionnaire (4/12).

13. 3.1 Experiência de utilização: propriedades da aplicação *

Mark only one oval.

	1	2	3	4	5	
Desagradável	◯	◯	◯	◯	◯	Agradável

14. 3.2 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Incompreensível	◯	◯	◯	◯	◯	Compreensível

15. 3.3 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Criativo	◯	◯	◯	◯	◯	Sem criatividade

16. 3.4 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
De fácil aprendizagem	◯	◯	◯	◯	◯	De difícil aprendizagem

Figure 80. High-fidelity functional prototype usability test's questionnaire (5/12).

17. 3.5 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Valioso	◯	◯	◯	◯	◯	Sem valor

18. 3.6 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Aborrecido	◯	◯	◯	◯	◯	Excitante

19. 3.7 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Desinteressante	◯	◯	◯	◯	◯	Interessante

20. 3.8 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Imprevisível	◯	◯	◯	◯	◯	Previsível

Figure 81. High-fidelity functional prototype usability test's questionnaire (6/12).

21. 3.9 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Rápido	◯	◯	◯	◯	◯	Lento

22. 3.10 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Original	◯	◯	◯	◯	◯	Convencional

23. 3.11 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Obstructivo	◯	◯	◯	◯	◯	Condutor

24. 3.12 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Bom	◯	◯	◯	◯	◯	Mau

Figure 82. High-fidelity functional prototype usability test's questionnaire (7/12).

25. 3.13 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Complicado	◯	◯	◯	◯	◯	Fácil

26. 3.14 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Desinteressante	◯	◯	◯	◯	◯	Atrativo

27. 3.15 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Comum	◯	◯	◯	◯	◯	Vanguardista

28. 3.16 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Incómodo	◯	◯	◯	◯	◯	Cómodo

Figure 83. High-fidelity functional prototype usability test's questionnaire (8/12).

29. 3.17 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Seguro	◯	◯	◯	◯	◯	Inseguro

30. 3.18 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Motivante	◯	◯	◯	◯	◯	Desmotivante

31. 3.19 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Atende às expectativas	◯	◯	◯	◯	◯	Não atende às expectativas

32. 3.20 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Ineficiente	◯	◯	◯	◯	◯	Eficiente

Figure 84. High-fidelity functional prototype usability test's questionnaire (9/12).

33. **3.21 Experiência de utilização: propriedades da aplicação (continuação)** *

Mark only one oval.

	1	2	3	4	5	
Evidente	◯	◯	◯	◯	◯	Confuso

34. **3.22 Experiência de utilização: propriedades da aplicação (continuação)** *

Mark only one oval.

	1	2	3	4	5	
Impraticável	◯	◯	◯	◯	◯	Prático

35. **3.23 Experiência de utilização: propriedades da aplicação (continuação)** *

Mark only one oval.

	1	2	3	4	5	
Organizado	◯	◯	◯	◯	◯	Desorganizado

36. **3.24 Experiência de utilização: propriedades da aplicação (continuação)** *

Mark only one oval.

	1	2	3	4	5	
Atraente	◯	◯	◯	◯	◯	Feio

Figure 85. High-fidelity functional prototype usability test's questionnaire (10/12).

37. 3.25 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Simpático	◯	◯	◯	◯	◯	Antipático

38. 3.26 Experiência de utilização: propriedades da aplicação (continuação) *

Mark only one oval.

	1	2	3	4	5	
Conservador	◯	◯	◯	◯	◯	Inovador

4. Informação de participante

39. 1.1 Género *

Mark only one oval.

◯ Feminino

◯ Masculino

◯ Outro

40. 1.2 Idade *

_____

41. 1.3 Escolaridade (ano escolar que frequenta ou o último ano concluído com sucesso). *

_____

Figure 86. High-fidelity functional prototype usability test's questionnaire (11/12).

42. **1.4 Atividade profissional** *

Mark only one oval.

◯ Estudante

◯ Trabalhador

◯ Outro

43. **1.5 Se respondeu "trabalhador" na pergunta anterior, por favor diga qual é a sua atividade profissional?**

_____

Figure 87. High-fidelity functional prototype usability test's questionnaire (12/12).

10.10 Appendix J

i Feelings & Perceptions	"I've been working harder. My partner constantly says that I'm always working" (T1).
ii Homework	"Lots and lots of homework" (S2) when compared with before the pandemic
iii Student's Assistance	"(…) my mother, for example, does not know anything of my classes' content" (S2).
iv Group Activities	"(…) my colleagues and I are relying on each other" (S1) for clearing each other's doubts.
v Classes' Structure	"At the beginning of the class, I launched the challenge. I stay there if they need further information or to clear any doubts" (T2).
vi Learning Methods	"At the moment, I'm guiding, I'm deepening concepts, as it is required from us" (T1).
vii Technology	"(…) friends whose internet is always going down. And there is a girl whose computer audio was broken. Also, many of them (colleagues) have brothers who also need the computer for their classes" (S1).
viii Social Media	"I've been visiting e-learning (Facebook groups), and they have suggestions, ideas, and other platforms" (T1).
ix Communication	"(…) we always ask the Class Director first and then she decides whether she talks to the other teachers or tells us to send an email to them" (S2) regarding the students' specific doubts about classes' content or homework, e.g.
x Institutional Information	"The information arrives, but at the last minute" (T2).
xi Tele-school	"I already gave up on that; I prefer for them to focus on their books and other materials" (P1).

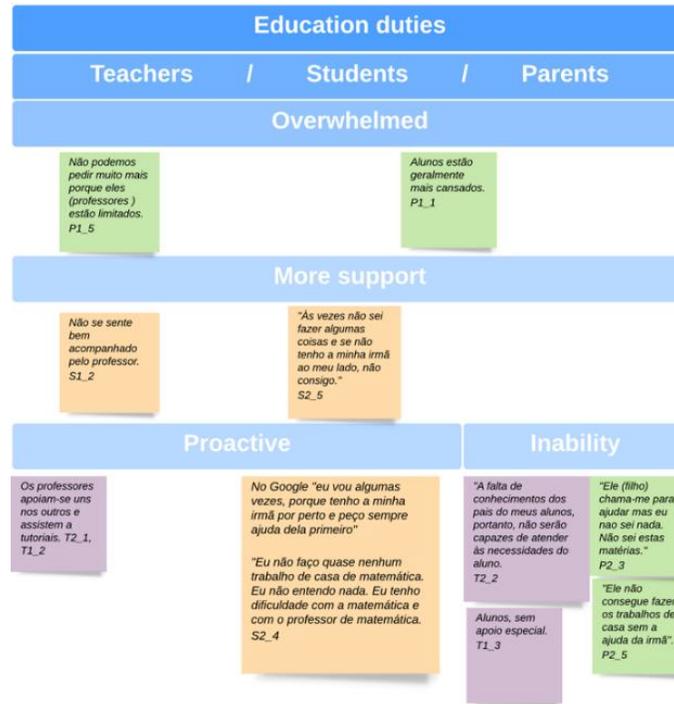*Table 10. Feature coding's excerpt.*

10.11 Appendix K

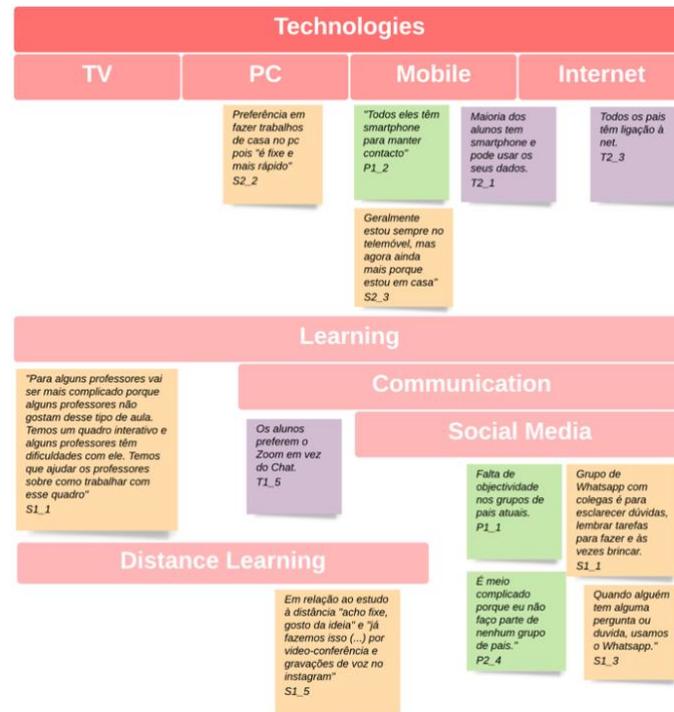*Figure 88. Longitudinal interviews' thematic analysis – Education duties.*

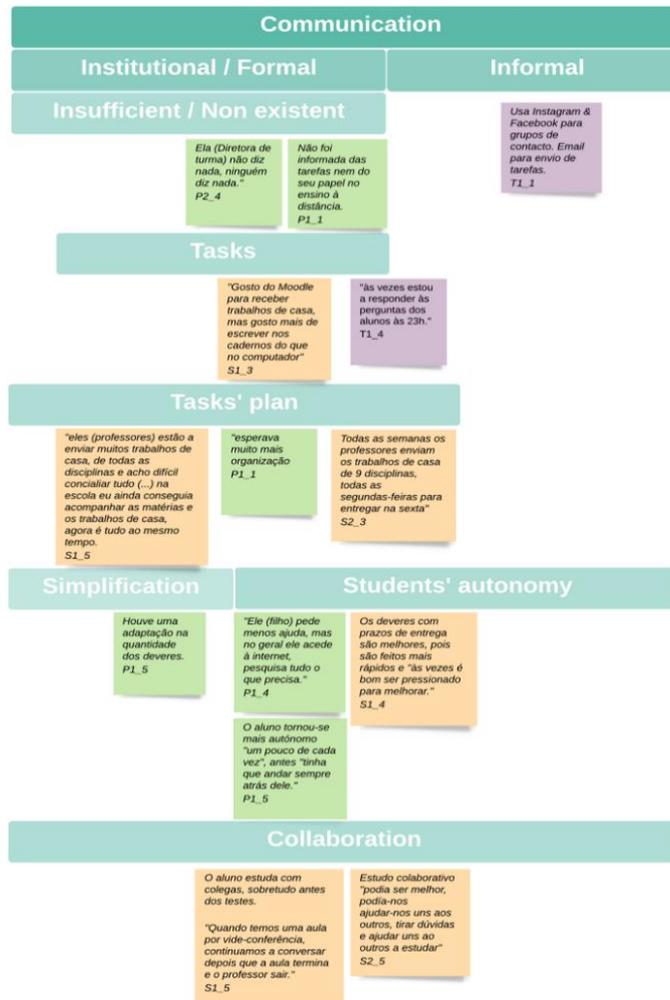*Figure 89. Longitudinal interviews' thematic analysis – Technologies.*

Communication

Institutional / Formal	Informal

Insufficient / Non existent

Ela (Diretora de turma) não diz nada, ninguém diz nada."
P2_4

Não foi informada das tarefas nem do seu papel no ensino à distância.
P1_1

Usa Instagram & Facebook para grupos de contacto. Email para envio de tarefas.
T1_1

Tasks

"Gosto do Moodle para receber trabalhos de casa, mas gosto mais de escrever nos cadernos do que no computador"
S1_3

"às vezes estou a responder às perguntas dos alunos às 23h."
T1_4

Tasks' plan

"eles (professores) estão a enviar muitos trabalhos de casa, de todas as disciplinas e acho difícil concilizar tudo (...) na escola eu ainda conseguia acompanhar as matérias e os trabalhos de casa, agora é tudo ao mesmo tempo.
S1_5

"esperava muito mais organização
P1_1

Todas as semanas os professores enviam os trabalhos de casa de 9 disciplinas, todas as segundas-feiras para entregar na sexta"
S2_3

Simplification	Students' autonomy

Houve uma adaptação na quantidade dos deveres.
P1_5

"Ele (filho) pede menos ajuda, mas no geral ele acede à internet, pesquisa tudo o que precisa."
P1_4

Os deveres com prazos de entrega são melhores, pois são feitos mais rápidos e "às vezes é bom ser pressionado para melhorar."
S1_4

O aluno tornou-se mais autónomo "um pouco de cada vez", antes "tinha que andar sempre atrás dele."
P1_5

Collaboration

O aluno estuda com colegas, sobretudo antes dos testes.

"Quando temos uma aula por vide-conferência, continuamos a conversar depois que a aula termina e o professor sair."
S1_5

Estudo colaborativo "podia ser melhor, podia-nos ajudar-nos uns aos outros, tirar dúvidas e ajudar uns ao outros a estudar"
S2_5

Figure 90. Longitudinal interviews' thematic analysis – Communication.

10.12 Appendix L
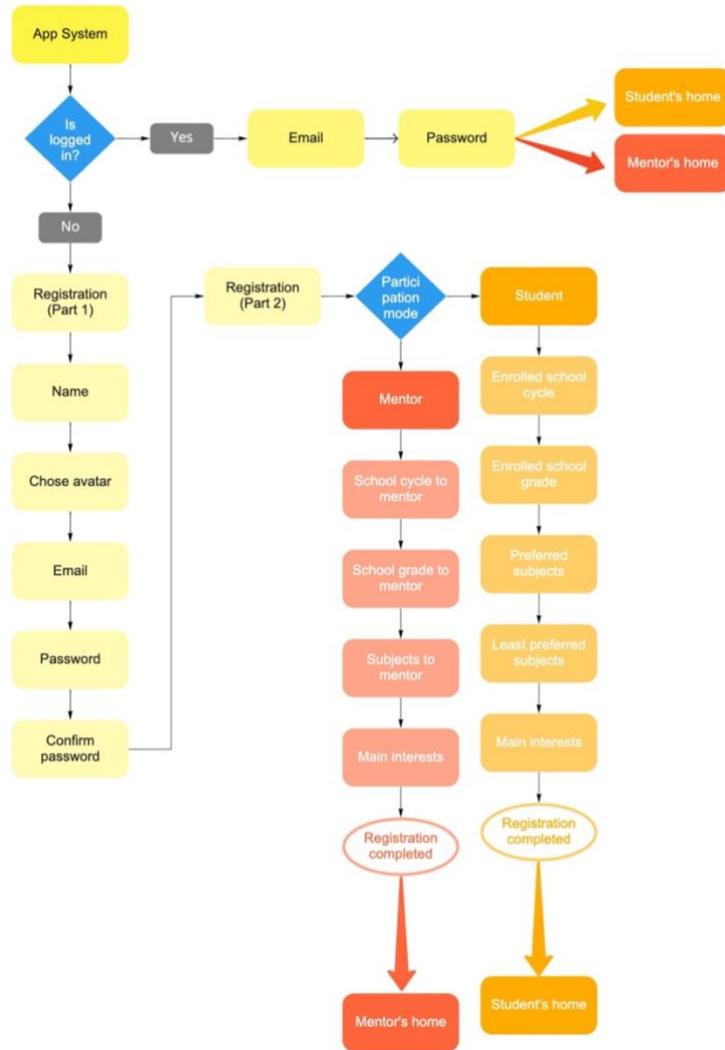
Figure 91. OWL CLUB App flow diagram: Sign in and registration steps.

Figure 92. OWL CLUB App flow diagram: Student's accessible features.

Figure 93. OWL CLUB App flow diagram: Mentor's accessible features.

10.13 Appendix M

Low-fidelity prototype

10.13.1.1 Sign in or registration

Figure description: **Screen A1** – Initial screen with the Logo; **Screen B1** – Sign in; **Screen C1** – Registration (part 1) – user's system information; **Screen D1** – Avatar choices for registration (part 1); **Screen E1** – Registration (part 2) – user's participation mode; **Screen F1** – Registration (part 2) – user's participation information.
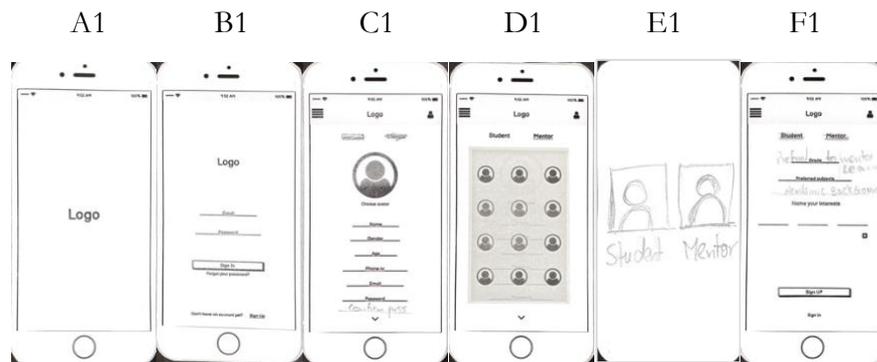

Figure 94. Low-fidelity prototype (Sign in and Registration).

10.13.1.2 Student's mode

Figure description: **Screen A2** – App's Introduction; **Screen B2** –. Student mode's home; **Screen C2** – Question (first) opened; **Screen D2** – Answer opened; **Screen E2** – Answer's upvoters (mentors); **Screen F2** – Upvoter (mentor) profile; **Screen G2** – Mentor network choices (comes after pressing the link button); **Screen H2** – Questions' subjects choices (comes after pressing the bottom-central button); **Screen I2** – Writing question screen; **Screen J2** – Notify mentor or Publish screen; **Screen L2** – Student mentor's network (comes after pressing notify mentor button); **Screen M2** – Publish question (with mentor notification); **Screen N2** – User's own profile (student); **Screen O2** – Student's notification(s).
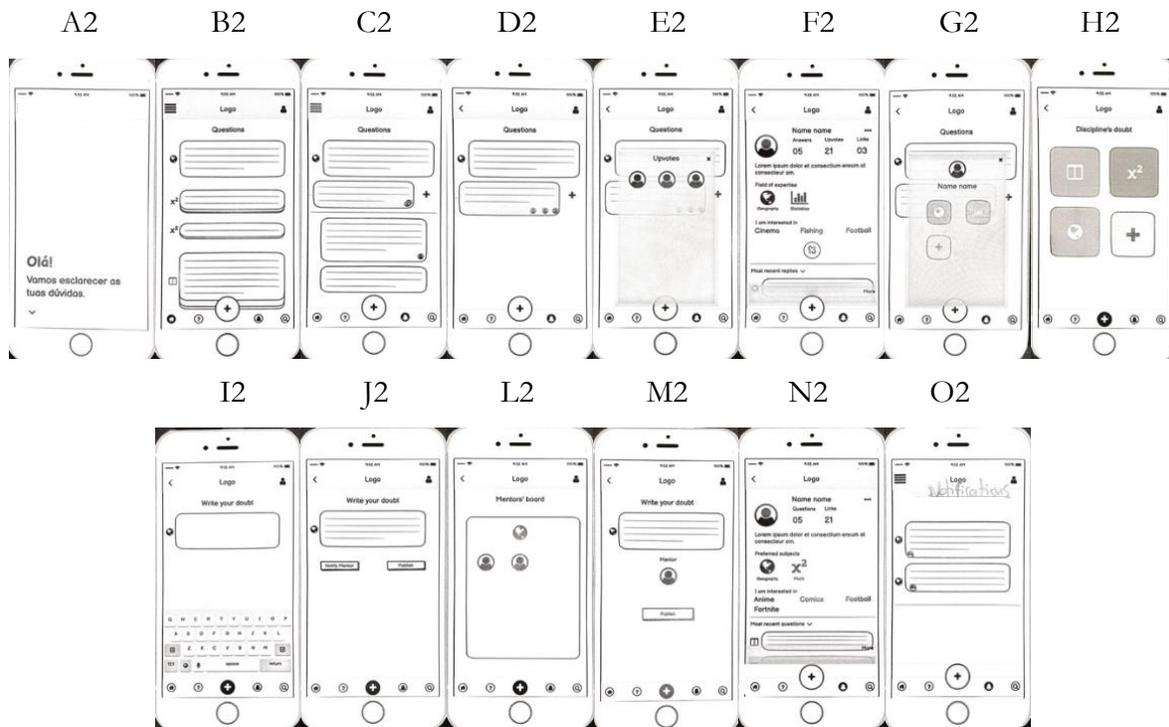
A2	B2	C2	D2	E2	F2	G2	H2

I2	J2	L2	M2	N2	O2

Figure 95. Low-fidelity prototype (Student mode).

10.13.1.3 Mentor's mode

Figure description: **Screen A3** – App's introduction; **Screen B3** – Mentor mode's home; **Screen C3** – Question (first) opened; **Screen D3** – Writing an answer to a student; **Screen E3** – Publish answer; **Screen F3** – Need for validation message; **Screen G3** – Answer submitted; **Screen H3** – Upvote feature; **Screen I3** – User's own profile (mentor); **Screen J3** – Mentor's notification(s); **Screen K3** – student's profile.
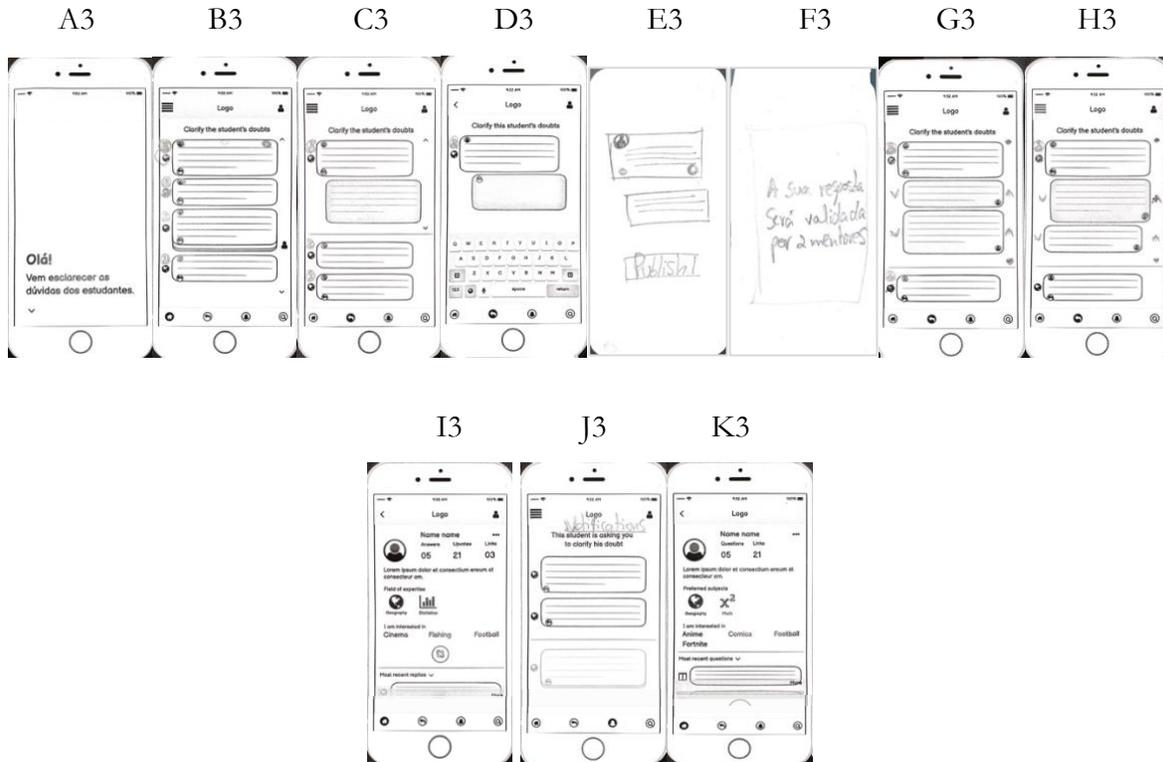
A3　　　B3　　　C3　　　D3　　　E3　　　F3　　　G3　　　H3

I3　　　J3　　　K3

Figure 96. Low-fidelity prototype (Student mode).

10.13.1.4 Menus

Figure description: **Screen A4** – Menu; **Screen B4** – Sub-menu (profiles and interaction).

A4　　　B4

*Figure 97. Low-fidelity prototype (accessible to all users***).**

10.14 Appendix N

High-fidelity functional prototype

10.14.1.1 Sign in

Figure description: **Screen A5** – Launching screen; **Screen B5** – Sign in or register; **Screen B5** – Enter email; **Screen C5** – Enter password & sign in.

A5   A5   B5   A5

Figure 98. High-fidelity functional prototype (Sign in).

10.14.1.2 Registration (part 1)

Figure description: **Screen A6** – Registration (part 1) - name; **B5** – Registration (part 1) - choose avatar; **C5** – Avatar options; **D5** – Registration (part 1) – email; **E5** – Registration (part 1) – final step; **E5** – Registration (part 2) – user's participation mode.

A6   B6   C6   D6   E6   F6   H6

Figure 99. High-fidelity functional prototype (Registration part 1).

10.14.1.3 Registration (part 2)

Figure description: **Screen A7** – Registration (part 2) – student participation mode. **Screen B7** – Registration (part 2) – Choose cycle; **Screen C7** – Registration (part 2) – Choose school year; **Screen D7** – Registration (part 2) – Choose favorite subject(s); **Screen E7** – Registration (part 2) – Subject options; **Screen F7** – Registration (part 2) – Choose subject(s) in need of help; **Screen F7** – Registration (part 2) – Choose interests; **Screen F7** – Registration (part 2) – add interests. **Screen I7**

– Registration (part 2) – mentor participation mode. **Screen I7** – Registration (part 2) – Choose cycle(s); **Screen K7** – Registration (part 2) – Choose school year(s); **Screen L7** – Registration (part 2) – Choose subject(s); **Screen M7** – Registration (part 2) – Subject options; **Screen O7** – Registration (part 2) – Choose interests; **Screen P7** – Registration (part 2) – add interests (and go back to the previous screen).
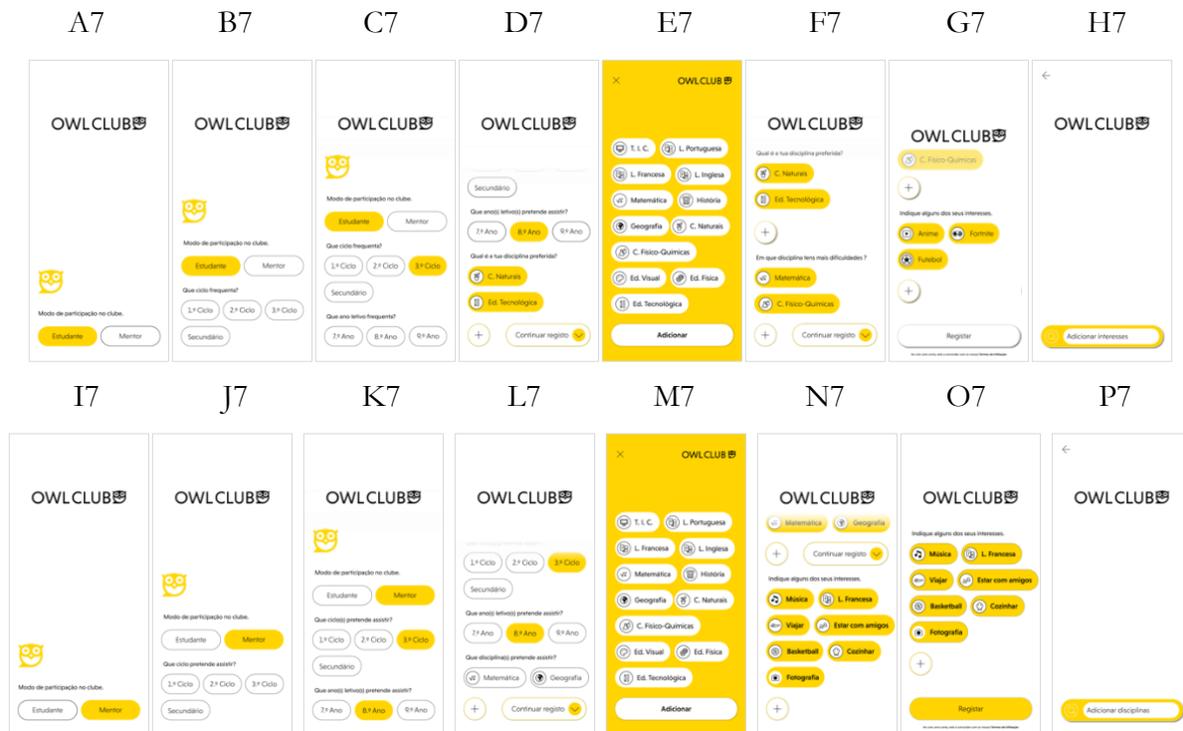

Figure 100. High-fidelity functional prototype (Registration part 2).

10.14.1.4 Student's mode

Figure description: **Screen A8** – Student mode's home; **Screen B8** – Questions' subjects choices (comes after pressing the bottom-central button); **Screen C8** – Writing question screen; **Screen D8** – Notify mentor or Publish screen; **Screen E8** – Student mentor's network (comes after pressing notify mentor button); **Screen F2** – Publish question (with mentor notification; **Screen G8** – Published question; **Screen G8** – Student's notification(s); **ScreenIG8** – Opened question with answers; **Screen J8** – Liked answer; **Screen K8** – Mentors that liked the answer; **Screen L8** – Mentor profile; **Screen M8** – Mentor profile (scroll down); **Screen N8** – Adding mentor to the student's network(comes after pressing the link button); **Screen O8** – Student's network subject choices; **Screen P8** – Action completed.
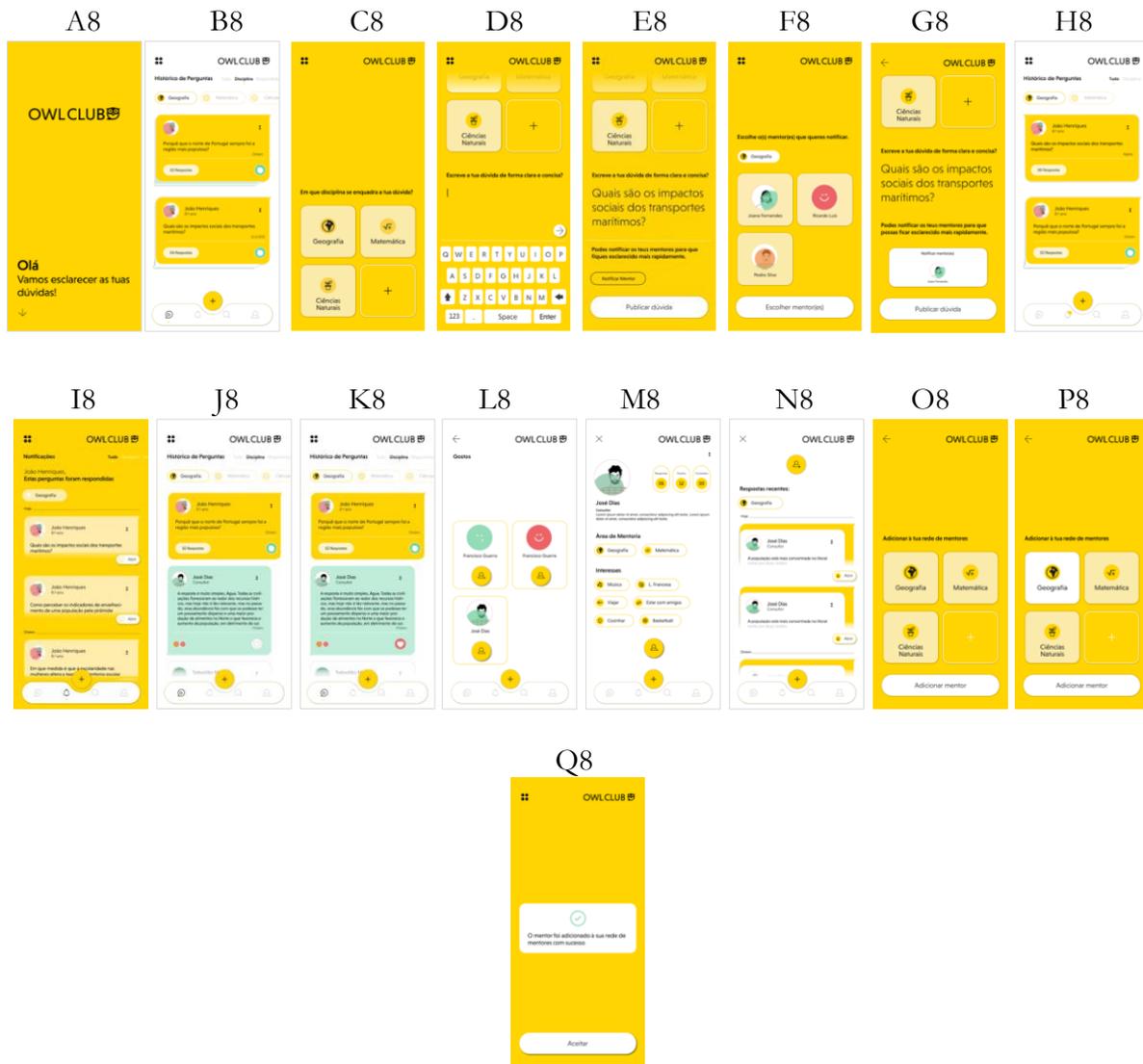
A8 B8 C8 D8 E8 F8 G8 H8

I8 J8 K8 L8 M8 N8 O8 P8

Q8

Figure 101. High-fidelity functional prototype (student mode).

10.14.1.5 Mentor's mode

Figure description: **Screen A9** – App's introduction; **Screen B9** – Mentor mode's home; **Screen B9** –Question (first) opened where the student's question floats while the answers scroll below; **Screen D9** – Writing answer for student; **Screen E9** – Need for validation message; **Screen F9** – Answer submitted; **Screen G9** – Mentor's notification(s); **Screen H9** – First notification opened; **Screen H9** – Liked answer; **Screen J9** – Student's profile; **Screen J9** – Student's profile (scroll down); **Screen I3** – User's own profile (mentor).
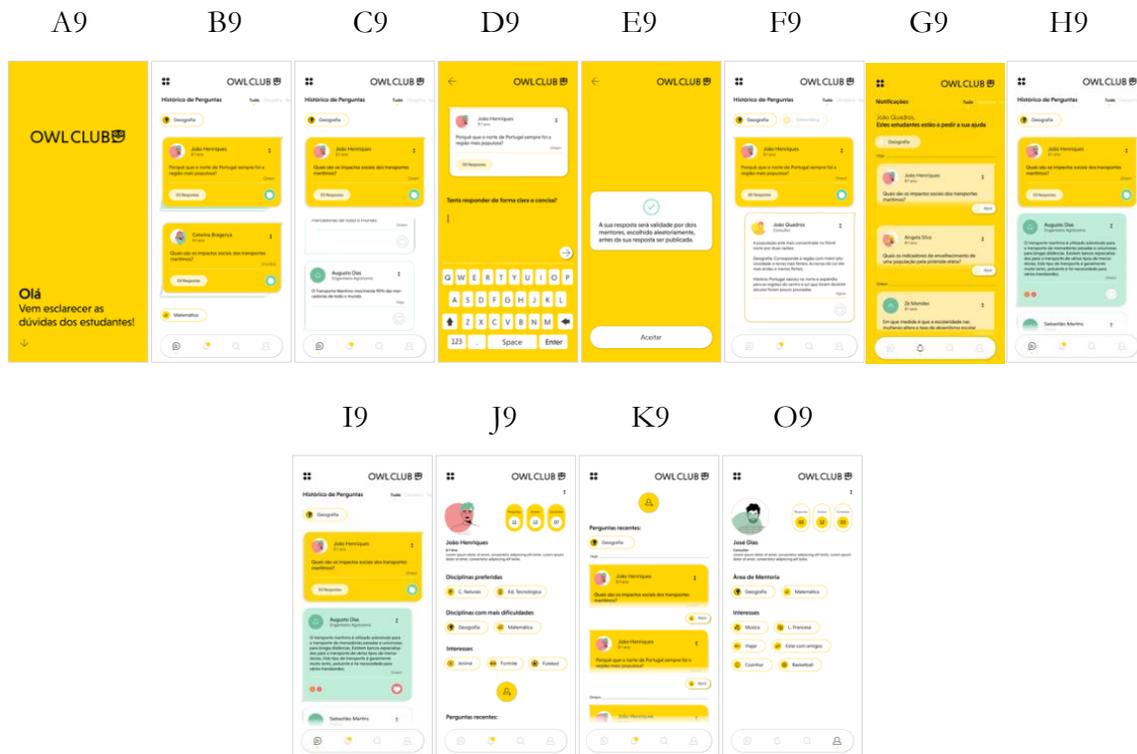
A9　　　B9　　　C9　　　D9　　　E9　　　F9　　　G9　　　H9

I9　　　J9　　　K9　　　O9

Figure 102. High-fidelity functional prototype (Mentor mode).

10.14.1.6 Menus

Figure description: **Screen A10** – The main menu is accessible after pressing the four-dots button (on top; **Screen B10** – after pressing on the two dots on the right side of the content, the users can report someone's conduct, disconnect notification, or disconnect from this use.
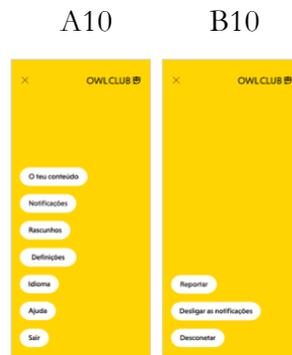
A10　　　B10

Figure 103. High-fidelity functional prototype (Menu & Sub-menu).