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MEASURING STUDENTS' E-LEARNING SATISFACTION AND FLEXIBILITY IMPACTS IN INDIVIDUAL PERFORMANCE DURING COVID-19 IN HIGHER EDUCATION INSTITUTIONS

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Master Thesis presented as partial requirement for obtaining the Master's degree in Information Management

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ABSTRACT

Rapid digital transformation has never been so important as during the Covid-19 pandemic for Higher Education Institutions. Institutions for Higher Education had to experience a prompt digital transformation; they also had to transform their business models in innovative ways, or they could not offer further services to students once a face-to-face lecture was suddenly forbidden due to a worldwide pandemic. After two years of a worldwide pandemic, it is possible to analyse how Higher Education Institutions have adapted themselves and how their customers, namely students, view and experience e-learning in the emergency remote teaching context. Furthermore, this thesis aims to analyse which factors statistically influence students' satisfaction, perceived flexibility, and individual impacts in Higher Education Institutions during the Covid-19 pandemic.

KEYWORDS

INDEX

LIST OF ABBREVIATIONS AND ACRONYMS

AVE   Average Variance Extracted

Covid-19 Corona Virus Disease, the breakout in 2019

CSCL   Computer Supported Collaborative Learning

D&M   DeLone & McLean

ERT   Emergency Remote Teaching

HEI   Higher Education Institution

IS   Information System

MOOC   Massive Open Online Course

PLS   Partial Least Square

SEM   Structural Equation Modeling

TAM   Technology Acceptance Model

TTD   Theory of Transactional Distance

VIF   Variance Inflation Factor

VoIP   Voice over Internet Protocol

VUCA   Volatile, Uncertain, Complex, and Ambiguous environments

1. INTRODUCTION

1.1. BACKGROUND AND PROBLEM IDENTIFICATION

The 21st century has been marked by a rapid increase in new technology usage since its early years. One can say that this is the era of disrupting technologies. Already in the first decade, societies all around the globe have started to change communication channels. Social networking platforms like Orkut or ICQ (I Seek You) come and go. People began to use Voice over Internet Protocol (VoIP) technology. Twelve years after being founded, Skype created its first version for business. Although streaming technology has existed since the 90th, its boom came at first, with Netflix disrupting Blockbuster and causing Blockbuster to go bankrupt in 2010 (McDonald & Smith-Rowsey, 2016). Those are a few examples of the speed at which new technologies are changing the world and bringing diverse industry sectors to a volatile, uncertain, complex, and ambiguous (VUCA) environment. It is not new that organisations that do not adapt to their environment may lose their competitive advantage or even their entire market (Daychoum, 2018). Organisational adaptation can be described in many forms; nowadays, business model innovation plays a massive role in multiple industries. Under business model innovation, one can understand a new creation or complete redesign, including a business model's development, adjustment, alteration, and implementation (Geissdoerfer et al., 2018).

Furthermore, diverse industry sectors are facing the necessity to transform digitally. Still, it is essential to distinguish between digitising and going through a digital transformation, while digitising means going from analogue to digital processes, creating operational excellence, being digital, or going through a digital transformation means archiving rapid business innovation (Ross et al., 2019). Moreover, paradigm-shifting is a radical form of business transformation, meaning that organisations must rethink their business nature to go through paradigm-shifting (Laudon & Laudon, 2019). Additionally, literature regarding e-learning has increased among academicals, reaching its highest growth rate (550%) by 1990 and 2000 (Aparicio et al., 2014). However, the pandemic has leveraged the rapid digital change that Higher Education Institutions (HEI) have suffered since the early 2020s. Because of the Covid-19 outbreak in December 2019 in China and its global spread in 2020. Covid-19 has quickly brought the world to a pandemic (WHO, 2020). The COVID-19 pandemic is leveraging digital

transformation, and HEIs are also affected (Bai et al., 2020; R. Huang et al., 2020). Because of the pandemic, students in many countries were not allowed to meet in classrooms as before. Therefore, HEIs had to promptly innovate their business model and endure a rapid digital transformation once face-to-face lectures were not possible. For most HEIs worldwide, e-learning was the chosen way to keep lecturing (R. Huang et al., 2020). The spread of Emergency Remote Teaching (ERT) worldwide has developed an urge to identify the factors influencing students' satisfaction and performance regarding the methods implemented by HEIs during the pandemic.

1.2.   SCIENTIFIC MOTIVATION /RESEARCH GAP

HEIS students and faculty members discern e-learning in normal circumstances from e-learning during an emergency (Emergency Remote Learning). By e-learning, in emergency circumstances, HEIs must be flexible and creative to respond to the new needs regarding a crisis. Furthermore, e-learning in emergency circumstances requires more communication and greater reflection than face-to-face educational experiences. HEIs need to adapt to the new students' responses and demands if they want students to keep having a positive experience. (Aguilera-Hermida, 2020).

HEIs are implementing innovative strategies to guarantee the continuity of academic education. (Zhu & Liu, 2020). Academical courses are being delivered during the pandemic by diverse online platforms, video-conferencing tools, and other software to enhance the students learning experience (Aguilera-Hermida, 2020; Chakraborty et al., 2021). There is still a research shortage regarding the efficiency of student-professor and student-student interaction and communication. Additionally, academic studies regarding the effectiveness of learning by an online assessment during an emergency still lack quantity (Chakraborty et al., 2021).

This thesis analyses the factors determining students' satisfaction and performance in HEIs regarding ERT e-learning systems during the Covid-19 pandemic.

1.3. STUDY OBJECTIVES

This thesis aims to analyse the digital transformation focusing on the paradigm-shifting of HEIs and how they have innovated and transformed their business models due to Covid-19. This thesis compares existing literature about the main relevant termini in a literature review. Furthermore, this thesis analyses the status quo of higher education institutions' paradigm shift regarding students' opinions about the e-learning systems HEIs implemented during the Covid-19 pandemic. Focusing on the business model innovation and digital transformation HEIs have recently undergone due to the Covid-19 pandemic, meaning offering hybrid or e-learning courses only instead of the traditional face-to-face classes.

It is essential to present a review of how far the paradigm-shifting of HEIs due to Covid-19 have been studied. Aiming to create a relevant quantitative survey to analyse the status quo of students' satisfaction with HEIs in ERT situations, analyse the success and impact of students on e-learning usage during the pandemic to identify relevant factors for HEIs regarding other possible future ERT situations and a post-Covid-19 future for e-learning systems and teaching models.

This thesis identifies which factors influence the performance and satisfaction of students during the COVID-19 pandemic. The latent variables are user satisfaction and individual impact. Meaning here the students as the users, by users' satisfaction, and their performance, by individual impact. The independent variables are divided into three main pillars of information systems technology: people, technology and systems, and processes. For that, the main objectives of the survey are:

1. (O1) Identify the influence of dimension regarding the people (students) using the information systems.
    a. (O1a) Identify the influence of students' interaction & collaboration on students' satisfaction and performance.
    b. (O1b) Identify the influence of sociability on students' satisfaction and students' interaction & collaboration.
    c. (O1c) Identify the influence of grit on students' satisfaction, performance, and perceived flexibility.

2. (O2) Identify the influence of dimension regarding the technology and systems used on the student's satisfaction.
    a. (O2a) Identify the influence of system quality on students' satisfaction.
    b. (O2b) Identify the influence of information quality on students' satisfaction.
3. (O3) Identify the influence of dimension regarding the processes adopted by HEIs during the pandemic on the student's satisfaction, performance, and sociability.
    a. (O3a) Identify the influence of perceived flexibility on students' satisfaction and performance.
    b. (O3b) Identify the influence of the environment on students' sociability.
4. (O4) Identify the digital transformation of HEIs based on students' satisfaction and performance regarding the usage of e-learning platforms during the Covid-19 pandemic.

After identifying the critical variables, the formulation and description of the hypotheses are presented following the rules of the empirical solution-driven style (Decker & Werner, 2016). Furthermore, for O1, O2, and O3, a quantitative survey was created and analysed using the structural equation modelling (SEM) technique. The results and discussion chapters compare the analysis results to the existing literature. Finally, after comparing the analysis results with existing literature, a theoretical model is introduced following the natural science rules according to March & Smith (1995). This thesis follows the positivist philosophical perspective.

2. LITERATURE REVIEW

Once many organisations fail to go through a paradigm-shifting (Laudon & Laudon, 2019), it is beneficial to analyse if the business model innovations and digital transformation HEIs are going through are sustainable in a post-Covid-19 future. In aiming to reduce Covid-19 infections, face-to-face classes and interactions were not possible anymore, as the WHO published in their Covid-strategy-update from 14.April.2020 "Community-level measures to reduce contact between individuals, such as the suspension of mass gatherings, the closure of non-essential places of work and educational establishments, and reduced public transport"(WHO, 2020, p.9). Suddenly, all interactions in HEIs had to change from face-to-face to interaction using remote devices.

Once the COVID-19 novel is not over, it is necessary to understand what factors are significant for HEIs to enable enrolled students to graduate successfully. Additionally, understanding the essential factors for successful graduation during the Covid-19 pandemic enables universities to be better prepared for possible future states of emergency. Determining what factors are essential for HEIs to undergo a rapid digital transformation on ERT is essential (Aguilera-Hermida, 2020; Bai, et al., 2020; Buttler et al., 2021; Chakraborty et al., 2021; Wilcox & Vignal, 2020). Furthermore, it is crucial to identify and analyse which factors during the pandemic have influenced students' satisfaction and performance and determine the influence grades to have a better overview for the future. Since the way companies work and the future workforce is also changing because of computerisation (Frey & Osborne, 2017) and are likely to change more rapidly due to the pandemic.

Moreover, the capacity of computers is expanding at a fast pace, and they are likely to continue to expand their cognitive capacity scope (Brynjolfsson & McAfee, 2011). Furthermore, workforce transformation enables and supports digital transformation (Eden et al., 2019). Logically, HEIs must adapt sustainably, beyond the current pandemic situation, to better serve the workforce of the future, namely the students.

Since the middle of April 2020, courses were delivered first in online modus only, and there was no preparation time. HEIs had to transition to ERT, and students' interaction with their peers or educators has changed drastically. Students and universities had to overcome various

difficulties all at once (Aguilera-Hermida, 2020). Technology-mediated interaction was the only way people could communicate in many countries worldwide (Aguilera-Hermida, 2020). Some universities have developed online teaching systems faster or better than others. Some researchers have investigated the development of HEIs and the response of students in ERT to find out which factors influence the success of those changes. But even before the COVID-19 breakout, e-learning and information systems acceptance were already studied in diverse forms.

The following table presents a literature review describing the methods and results of e-learning and other relevant studies ex-ante the COVID-19 outbreak.

Table 1 - E-learning ex-ante the COVID-19 outbreak

	Year	Method	Results	Author(s)
Ex ante COVID-19 outbreak	2000	Quantitative empirical survey	Flexibility and an interactive environment play a more significant role in the student's satisfaction, as the ease of use.	Arbaugh, 2000
	2002	Quantitative empirical survey	The result shows that students' satisfaction is influenced by the online environment rather than by student characteristics inputs by web-based courses.	Thurmond et al., 2002
	2003	Literature review	Results show that the new input changes are primarily incremental but not in nature. The construct service quality was added, and organisational and individual impact were merged, creating the construct net benefits.	DeLone & McLean, 2003
	2005	Literature review and empirical research	The result shows that the significance of interaction related to perceived learning occurs in the following order: instructor-student, student-student, and student-content. Furthermore, distance learning flexibility plays a less critical role, although being significant too.	Marks et al., 2005;
	2007	Quantitative empirical survey	The results show that social interaction is the most determinant factor influencing group learning performance, cooperation, dynamics and formation. In addition, high-performing groups are characterised by functioning "social relationships, social cohesion and a sense of community" that foster a good learning environment, information sharing and collaborative activities.	Kreijns et al., 2007
	2008	Quantitative empirical survey	"The results revealed that learner computer anxiety, instructor attitude toward e-Learning, e-Learning course flexibility, e-Learning course quality, perceived usefulness, perceived ease of use, and diversity in assessments are the critical factors affecting learners' perceived satisfaction." (p.1183)	Sun et al., 2008
	2008	Quantitative empirical module testing	Results show that the "Interactive Service Module" helped the students engage in the learning activities and that content could be accessed asynchronously by a synchronous course because online discussions could be saved and used later.	Y.-M. Huang et al., 2008
	2009	Quantitative empirical survey	Results show that "grit, life satisfaction, and optimistic explanatory style" influence individual teacher performance. However, once investigated simultaneously, only life satisfaction and grit predicted teacher performance significantly (p.543).	Duckworth & Quinn, 2009
	2015	Literature review and empirical research	Results show a relation between communication methods, student satisfaction, and social presence perception. However, communications methods such as asynchronous, synchronous, or combined influence over student self-regulation have not been confirmed.	Moallem, 2015
	2016	Quantitative empirical survey	Individualistic and collectivistic culture dimensions impact students' individual and organisational achievements and students' satisfaction.	Aparício et al., 2016
	2017	Literature review and empirical research	CANOE, usability, and flow are crucial to users' joy with gamified online courses. CANOE and usability are determinant factors for perceived usefulness. "Pleasure in use and perceived usefulness are determinants of usage intention", as well as intention to use, and flow are factors that determine the usage of "gamified online courses." (p.45)	Piteira et al., 2017
	2017	Quantitative empirical survey	Grit influences satisfaction with e-learning systems. Furthermore, grit represents a subordinate construct of "perseverance effort (PE)" and "consistency of interest (CI)", and grit has a direct positive impact on student satisfaction and individual performance. (p.397)	Aparício et al., 2017
	2018	Literatur review & empirical research	In Brazil, the quality of information and system and collaboration are determinants for e-learning systems' success. Additionally, assessment diversity, learner interaction, and instructor attitude are determinants for e-learning success in general.	Cidral et al., 2018
	2018	Qualitative literature review	A theoretical framework for several online courses which are supported through an e-learning platform. The following concepts support the framework as main pillars: course (meaning target group, objectives, outcomes, content, and main topics); "gamification; cognitive absorption and flow; and personality." (p. 7)	Piteira et al., 2018
	2019	Quantitative empirical survey	Gamification combined with the IS success model from D&M drives users to greater success by MOOCs than the IS success model from D&M alone.	Aparício et al., 2019

The following table presents a literature review of ERT and distance learning for this thesis relevant studies ex-post the COVID-19 outbreak.

Table 2 - E-learning ex-post the COVID-19 outbreak

	Year	Method	Results	Author(s)
Ex post COVID-19 outbreak	2020	Quantitative empirical survey	Results show a positive influence of "long-term orientation" on the usage of e-learning systems and their perceived net benefits. Furthermore, e-learner satisfaction, Collaboration, and information quality have an impact on e-learning systems usage.	Cidral et al., 2020
	2020	Mixed methods; Quantitative and qualitative	After a transition period, students' cognitive engagement, motivation and efficacy have decreased, although technology usage increased. Additionally, a preference for face-to-face in opposition to e-learning methods was detected.	Aguilera-Hermida, P., 2020
	2020	Quantitative and Qualitative empirical survey	Results show that ERT is effective in synchronous, asynchronous, or mixed distance learning. Students saw advantages and disadvantages in an eighter way, suggesting that a mixture of both synchronous and asynchronous distance learning is most effective. Furthermore, students indicate that "opportunities for students" to engage interactively are crucial in any distance learning method. (p.374)	Wilcox & Vignal, 2020
	2020	Quantitative empirical survey	The result shows that students prefer face-to-face classes because, by ERT, less interaction, more distraction, and less engagement were detected, negatively influencing students' perceived satisfaction and making understanding less effective. Furthermore, a reduction in perceived interaction impacted the students' satisfaction negatively.	Bai et al., 2020
	2020	Quantitative empirical survey	Except for the attitude and perceived usefulness relationship, all significant components and relationships of TAM hold true in this study.	Sukendro et al., 2020
	2021	Quantitative empirical survey	Participants prefer to learn in physical classrooms over e-learning. Still, participants find e-learning in emergency circumstances a useful alternative to physical classrooms, and they evaluate their professor's performance in online teaching as improving since the pandemic began	Chakraborty et al., 2021
	2021	Quantitative empirical survey	The most important factors related to quality are professors' support, comprehension of students' situations, involvement of students' opinions on final exams format, schedule flexibility, and good organisation and logistics by the university administration body.	Buttler et al., 2021
	2021	Quantitative empirical survey	The D&M-IS Success dimensions had the most significant impact on the three investigated models. Instructor support impacts the usage of e-learning and quality (measured by the D&M-IS Success dimensions) in a positive direction.	Altalbe, A., 2021

2.1. THEORETICAL FOUNDATION

The following section shows the theoretical foundation and a literature review focusing on the concepts essential for understanding distance learning success and ERT development by HEIs.

Table 3 - Distance learning concepts overview

Period	Titel	Covid-19	TAM	D&M-IS Success	Satisfaction	Culture	Personal characteristics	Motivation	Gamification	MOOCs	Asynchronous	Synchronous	Interaction	Sociability	Instructor/Professor	Perceived Flexibility	Enviroment	Diversity in assessment	SEM	ERT	Author(s)
Ex ante COVID-19 outbreak	Virtual Classroom Characteristics and Student Satisfaction with Internet-Based MBA Courses		x		x		x						x			x					Arbaugh, 2000
	Evaluation of Student Satisfaction: Determining the Impact of a Web-Based Environment by Controlling for Student Characteristics				x		x								x		x	x			Thurmond, et al., 2002
	A Structural Equation Model of Predictors for Effective Online Learning				x		x						x		x	x		x	x		Marks et al., 2005;
	Measuring perceived sociability of computer-supported collaborative learning environments										x			x			x				Kreijns et al., 2007
	What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction.		x	x			x						x			x	x	x			Sun et al., 2008
	Toward interactive mobile synchronous learning environment with context-awareness service										x	x		x							Huang et al, 2008
	Positive predictors of teacher effectiveness				x		x														Duckworth & Quinn, 2009
	A dynamic analysis of the interplay between asynchronous and synchronous communication in online learning: The impact of motivation							x			x	x									Giesbers et al., 2014
	The Impact Of Synchronous And Asynchronous Communication Tools On Learner Self-Regulation, Social Presence, Immediacy, Intimacy And Satisfaction				x		x				x	x	x	x							Moallem, 2015
	Cultural impacts on e-learning systems' success			X	x	X													x		Aparício, et al., 2016
	CANOE e Fluxo: Determinantes na adoção de curso de programação online gamificado		x				X		X										x		Piteira, et al., 2017
	Grit in the path to e-learning success			X	x		X												x		Aparício, et al., 2017
	E-learning success determinants: Brazilian empirical study			X	x		x						x		x			X	x		Cidral, et al., 2018
	Computer Programming Learning: How to Apply Gamification on Online Courses?						x		X				x	x							Piteira, et al., 2018
	Gamification: a key determinant of massive open online course (MOOC) success			X	x				X	X			x						x		Aparício et al., 2019
Ex post COVID-19 outbreak	Students' long-term orientation role in e-learning success: A Brazilian study	X				X															Cidral, et al., 2020
	College students' use and acceptance of emergency online learning due to COVID-19	X	X				X	x							X		X			X	Aguilera-Hermida, 2020
	Using an extended Technology Acceptance Model to understand students' use of e-learning during Covid-19: Indonesian sport science education context	X	X																		Sukendro et al., 2020
	Opinion of students on online education during the COVID-19 pandemic	X							x						X		X				Chakraborty et al., 2021
	Student input on the effectiveness of the shift to emergency remote teaching due to the COVID crisis: Structural equation modeling creates a more complete picture	X													X	X			X	X	Buttler et al., 2021
	Antecedents of Actual Usage of e-Learning System in High Education During COVID-19 Pandemic: Moderation Effect of Instructor Support	X	X	X											X					X	Altalbe, A., 2021

Content Delivering

At first, it is essential to differentiate the learning possibilities HEIs use to pass content to their students. While traditional learning in HEIs is considered as learning in courses where the content is mainly delivered orally, written, and face-to-face. Web-facilitated courses are the ones that take place physically, with a per cent between 1% and 29% of web-based delivered content using web pages or course management systems technology, e.g. moodle usage, to deliver syllabus, scripts, and assignments (Allen et al., 2007). Hybrid and blended learning are synonymous (Bonk & Graham, 2005; R. Huang et al., 2020). The concept of blended learning has increased in importance since the earliest two thousand in corporate and academic contexts. Blended learning is a combination of modalities and methods, including the mixture of face-to-face and computer-mediated academic and non-academical course introductions, by which from 30% up to 79% of content has to be delivered online (Allen et al., 2007; Bonk & Graham, 2005). Last but not least, online courses are the ones with 80% or more of the content being delivered online (Allen et al., 2007).

Synchronous and Asynchronous Distance Learning

Both synchronous and asynchronous distance learning are free from location, meaning that instructors and students do not need to be on the same site for taking place on a course, but the second also includes freedom regarding time once asynchronous distance learning courses are prepared by the instructor and can be viewed at any later time by the students (Y.-M. Huang et al., 2008). Several studies research synchronous and asynchronous distance learning methods, resulting in the conclusion that both methods can be very effective (Buttler et al., 2021; Giesbers et al., 2014; Hrastinski et al., 2010; Pfaffman, J, 2008; Wilcox & Vignal, 2020). The decisive factor of distance learning effectiveness and success seems to lie elsewhere and not in the synchroneity of time instructors and students spend in front of their teaching and learning devices (Buttler et al., 2021).

Personality

Distinct authors address students' personalities and culture as factors influencing students' satisfaction and performance regarding distance learning (Aparicio, Bacao, et al., 2016; Aparicio et al., 2017; Cidral et al., 2020). As Aparicio et al. (2017) identified, grit influences

students' satisfaction with e-learning in a non-ERT context. Grit, a concept studied by psychologists and educational and health researchers, shows that students who have high levels of perseverance, effort, passion and consistency of interest in long-term goals are likely to outperform students who have talent only, without passion and perseverance in long term goals as perspective (Aparicio et al., 2017; Duckworth et al., 2009).

Sociability

Donath (1997) states that people online seek affirmation, support, and affiliation, rather than only information. Analogue to students in a pandemic situation, the need for support, affirmation and social contact is likely to have increased. Some authors found out in their results that trust, interpersonal relationships and a sense of community can reduce students quitting their courses because developing positive group dynamics decreases feelings of loneliness (Rovai, 2001; Kreijns et al., 2007; Phillips, 1990). Sociability is essential for a healthy distance learning environment. Kreijns et al. state that "environments enable and facilitate socio-emotional processes such as affiliation and getting to know each other, which aim to develop interpersonal relationships, trust-building, social cohesiveness, and a sense of community and the emergence of a sound social space" (2007, p.178).

Interactive Learning

Huang et al.'s main aim were to overcome the difficulty mobile devices posed for e-learning due to their size and hardware capacity. Nowadays, mobile devices' size and hardware capacity do not impose an obstacle for e-learning anymore once mobile devices have developed a lot since 2008. Nevertheless, Huang et al. still discuss actual problems regarding the difficulty e-learning imposes on interactivity in a distance learning environment. The authors have created the "Interactive Service Module" (Y.-M. Huang et al., 2008). By adding a feedback and interaction mechanism, the authors could investigate the influence of interaction on synchronous distance learning. Their results show that interactive learning activities increased the interest and engagement of learners. Although mobile devices' challenges in 2008 are not relevant anymore, interactive e-learning activities may play a significant role in ERT by HEIs.

Interaction & Collaboration

The effectiveness of synchronous or asynchronous e-learning is investigated in various studies, ex-ante and ex-post the Covid-19 outbreak. Results of those studies show that both ways are effective. (Buttler et al., 2021). Nevertheless, other studies show that interaction plays a decisive role in students' satisfaction with either synchronous or asynchronous e-learning (Aguilera-Hermida, P, 2020; Buttler et al., 2021).

Furthermore, engaging with peers and instructors is essential in an asynchronous or synchronous learning environment (Aguilera-Hermida, 2020; Buttler et al., 2021; Y.-M. Huang et al., 2008; Kreijns et al., 2007; Moallem, 2015; Marks et al., 2005; Wilcox & Vignal, 2020). Additionally, Bai et al. (2020) observed that students' preference for face-to-face classes in ERT was because the distance learning environment of their universities lacked interaction (Aguilera-Hermida, 2020; Bai et al., 2020; Buttler et al., 2021). Diverse studies regarding distance learning identified that interaction and collaboration play a significant role in student satisfaction. Likewise, interaction and collaboration are crucial for students' motivation (Moallem, 2015).

Environment

The environment is related to the student's educational experience during the programme of their HEI (Thurmond et al., 2002). Knight (1994) noticed that environmental determinants influence the outcome of students, meaning that HEIs policies can affect the time a student needs to complete a degree. Furthermore, based on the "Seven Principles for Good Practice in Undergraduate Education", regarding the encouragement of "student-faculty contact", "cooperation among students", and "active learning", as well as prompt feedback giving, time on task emphasis, high expectations communication, and respect for different ways of learning from Chickering & Gamson (1989, p.140), Thurmond et al. developed a list of web-based environmental scales, which are used in this thesis to verify the influence of HEIs environment over the sociability among students.

Perceived Flexibility

Flexibility by e-learning means that communication in this context is independent of place and time, meaning that course conversations can continue over time without students having to

compete for recognition of educators and peers in the time frame of a face-to-face classroom (Dede, 1990; Harasim, 1990; Finley, 1992; Leidner & Jarvenpaa, 1995; Arbaugh, 2000). Furthermore (Marks et al., 2005) find it critical to examine flexibility, focusing not only on instructor-student or student-student interaction but also exploring student-content interaction, once the last englobes the advantage of perceived flexibility regarding work-life balance (Marks et al., 2005).

Information Systems (IS) Theory

The Information System (IS) success was studied by several researchers in the last century. In the early 90, DeLone & McLean (1992) investigated the different aspects of IS success and organised them in a taxonomic review. Their research results in a descriptive model, including six significant constructs "system quality, information quality, use, user satisfaction, individual impact, and organisational impact." (DeLone & McLean, 1992, p.88). The IS success model from Delone and Mclean is proven to be relevant for researchers regarding e-learning. (Altalbe, 2021; Aparicio et al., 2016, 2017, 2019; Cidral et al., 2020; Cidral et al., 2018; Sun et al., 2008). From the six constructs of the descriptive IS success model, only four, considered the most relevant for ERT in HEIs, are investigated in this thesis.

System Quality

From the technical level of IS, the system quality construct measures "the Information Processing System Itself ", meaning ease of use, details aggregation, human aspects, system accuracy, and response time (DeLone & McLean, 1992, p.64).

Information Quality

Representing the semantic level of IS, the information quality construct measures the output of the information system, meaning the information quality that users can get from the system regarding appreciation and usefulness, accuracy, reliability, relevance, and completeness of the information. (DeLone & McLean, 1992).

User Satisfaction

From the effectiveness level of IS user satisfaction, the construct reflects the user "response to the use of the output of an information system" (DeLone & McLean, 1992, p.68), meaning

the successful interaction between user and system focussing on the satisfaction of the subject, and repeated utilisation of the system (Aparicio et al., 2017; Cidral et al., 2018; DeLone & McLean, 1992; Sun et al., 2008). This thesis focuses on the efficiency, effectiveness, and adequate support that the information system offers its user and if the user would repeat the experience in another course setting of free will.

Individual Impact

Individual impact means the impact of the system's information output on the user's behaviour and performance (DeLone & McLean, 1992). The individual impact is measured by speed, productivity, ease, and usefulness, in which the system helps the user to accomplish tasks (Aparicio et al., 2017; Urbach et al., 2010).

2.2.   THEORETICAL MODEL

Based on the dimensions and studies described in the previous chapters, this chapter presents the proposed research model, including ten dimensions. The research model has two dependent variables: user (student) satisfaction and individual impact, and one independent and dependent variable: User satisfaction. The independent variables explaining both the user satisfaction and the individual impact of students regarding e-learning during the COVID-19 pandemic are divided into three main pillars of information systems: people, technology and systems, and processes. Furthermore, these variables are:

- Grit, sociability, and interaction & collaboration - representing people;

- System quality and information quality - representing technology and systems;

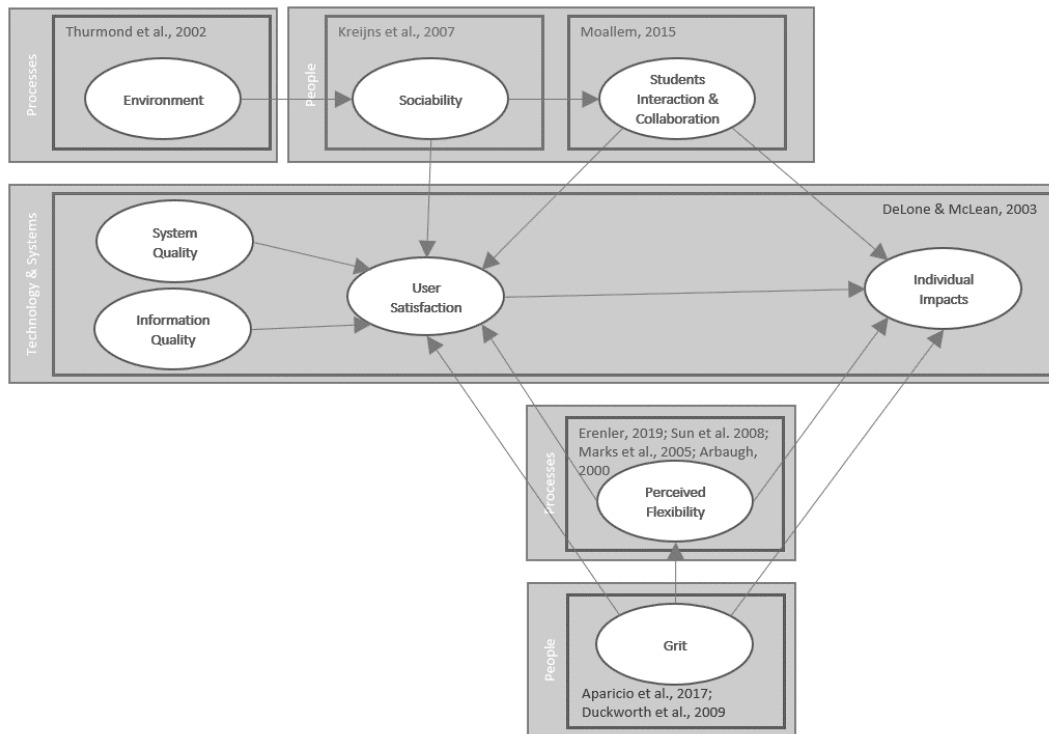- Environment and perceived flexibility - representing processes.

Diagram 1 - Research Model

2.3.   HYPOTHESES

As Duckworth et al. state, "Grit, defined as perseverance and passion for long-term goals, has been shown to predict the accomplishment in challenging circumstances." (2009, p.541). Furthermore, the authors point out that mediation analyses revealed that people with gritty personalities typically work harder than their cohorts staying committed to their goals until their achievement, which may improve not only direct the performance but also benefit the individuum through skills accumulation (Aparicio et al., 2017; Duckworth et al., 2009).

Once ERT by HEIs is considered quite challenging for students (Aguilera-Hermida, P, 2020; Buttler et al., 2021), this research investigates the following hypothesis:

H1a. Grit has a positive impact on users' satisfaction

H1b. Grit has a positive impact on individual impact

H1c. Grit has a positive impact on perceived flexibility

Social interaction is a crucial determinant in group dynamics and group formation. A well-functioning social space enables open communication, which benefits collaborative work and

sharing of important information. Furthermore, social interactions are seen as the main element influencing group collaboration, thereby influencing students' learning performances in a Computer-Supported Collaborative Learning (CSCL) environment (Kreijns et al., 2007). Therefore, this research states the following hypothesis:

H2a. Sociability has a positive impact on users' satisfaction

H2b. Sociability has a positive impact on interaction & collaboration

Moore (1989) suggests that interaction regarding e-learning is a "very imprecise" concept in his time. So, he defined the "three types of interaction" being those "learner-content interaction, learner-instructor interaction and learner-learner interaction" (p.1). Interaction & collaboration focuses on the last kind of the three interactions described by Moore (1989). However, Hong's (2002) results indicate no relationship between interaction with fellow students and outcome. Furthermore, Sun et al. (2008) declare that learners' perceived interaction with others positively influences e-learner satisfaction as insignificant. Other authors investigated a positive relationship between interaction and student satisfaction and motivation (Moallem, 2015). Aguilera-Hermida (2020) states that as challenges in ERT increase anxiety, worry may increase while decreasing motivation and achievement.

Furthermore, she states that more research on the reduction of face-to-face contact, lack of social interaction, motivation strategies, and cognitive engagement improvement in ERT by HEIs is still lacking (Aguilera-Hermida, P, 2020). This paper investigates the relationship between student-student interaction & collaboration in ERT on users' satisfaction and individual impact due to the challenging situation a worldwide pandemic poses on students. The following hypotheses are defined:

H3a. Interaction & collaboration has a positive impact on users' satisfaction

H3b. Interaction & collaboration has a positive impact on individual impact

System quality means the ease of use, the system's accuracy, the capacity of details aggregation, and the response time a system needs. The IS success theory from DeLone & McLean (1992, 2003, 2002) has been analysed by various authors (Altalbe, 2021; Aparicio et al., 2016, 2017, 2019; Cidral et al., 2018; Sun et al., 2008). Those authors have also validated System Quality's influence on Users' Satisfaction. This research investigates the influence of

system quality on users' satisfaction in ERT by HEIs. For that, this thesis investigates the following hypotheses:

H4. System quality has a positive impact on users' satisfaction

By HEIs, the information quality of their e-learning system must be proven by the institution's academic and administrative body. Furthermore, most professors have gone through an academic career to become professors. So, filling in the requests regarding accuracy, reliability, and relevance is given by most HEIs. Still, it is essential to investigate if also, in ERT, the information quality has a positive impact on student satisfaction. For that, this thesis investigates the following hypothesis:

H5. Information quality has a positive impact on users' satisfaction

According to Thurmond et al. (2002), variables regarding the environment in which students experience their educational path in HEIs, such as the ones focussing on assessment and assignments feedback peace, time spent on studying, and participation in class discussions, are crucial for understanding ERT in HEIs, and what the students are experiencing during the pandemic. For that, these variables were chosen to evaluate the environmental educational experience of students.

Additionally, the relationship between environment and sociability is investigated in this thesis. Here sociability focuses on the e-learning platforms provided by the universities, the possibility of spontaneous and informal conversation, the feeling of loneliness that students may experience, and the possibility of developing a good work relationship with peer students (Kreijns et al., 2007). For researching these relationships, the following hypothesis is investigated.

H6. Environment has a positive impact on sociability

Before the COVID-19 novel, the need for place independence through education increased among those who combine work, family, and studies (Arbaugh, 2000). After the COVID-19 breakout, place independence by education or ERT turned out to be a reality all around the globe (Aguilera-Hermida, P, 2020; Altalbe, 2021; Buttler et al., 2021; Chakraborty et al., 2021; Sukendro et al., 2020). For that, the following hypothesis investigates how far perceived flexibility plays a role in students' satisfaction and performance in an ERT modus:

H7a. Perceived flexibility has a positive impact on users' satisfaction

H7b. Perceived flexibility has a positive impact on individual impact

According to the IS success theory from DeLone & McLean (1992), individual impact aims to measure the success of information systems usage regarding the individuum using the system and the impact the system usage has on the user. This study analyses the individual impact regarding the pace and ease of task accomplishment, productivity, and usefulness of the e-learning system compared to face-to-face classes in HEIs. This research investigates the influence of students' satisfaction on their individual impact during the Covid-19 pandemic in universities. For that, the following hypothesis is investigated:

H8. User satisfaction has a positive impact on individual impact.

3. METHODOLOGY

This thesis follows as epistemological orientation, a positivistic philosophy, in a natural science approach (March & Smith, 1995). Furthermore, this thesis tests existing theories and justifies users' satisfaction and individual impact as latent variables since they are influenced by different dimensions from the three main pillars of information systems: people, processes, and systems. This thesis analyses the driver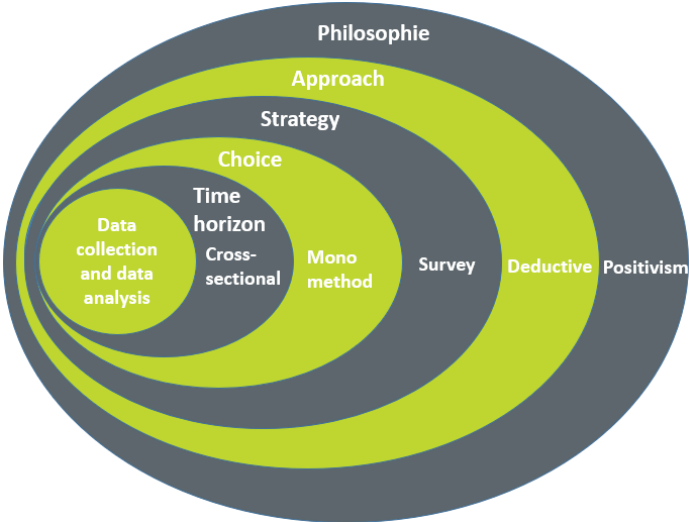s and views and how the surveyed population evaluates the paradigm-shifting changes regarding the digital transformation HEIs have recently experienced in a deductive approach.

Figure 1 - Research Onion - adapted from Saunders et al. (2007)

The methodological structure of this thesis follows the AILMRaD approach (Abstract, Introduction, Literature, Methodology, Results and Discussion) using an Hourglass Model (Decker & Werner, 2016).

The structural model is based on a literature review and is validated by a quantitative survey. The data were collected cross-sectional, meaning that data were collected in a short period of six months in the context of the COVID-19 pandemic.

The chapter "Literature Review" englobes literature-based positivistic philosophical research on each relevant termini, concept and constructs analysed. More specifically, the core of the literature-based segment englobes a review of the existing literature about the digital transformation HEIs are experiencing and the usage of e-learning during the COVID-19 pandemic. Furthermore, this thesis presents research on the acceptance and achievement of students regarding the newly implemented e-learning technologies in HEIs. This thesis focuses on the paradigm-shifting due to Covid-19 and the organisational change HEIs have undertaken.

This thesis englobes empirical objectivistic primary quantitative research substantiated through a quantitative survey with students from HEIs. The survey uses a 7-point scale (from

strongly disagree (1 point) to strongly agree (7 points), and Qualtrics as a web-based platform to gather the data.

The causal modelling method PLS-SEM technique maximises the dependent latent constructs explained variance and evaluates the quality of data based on the characteristics of the measurement model, as well as providing robust evaluations of the structural model. The SEM PLS approach is excellent for "prediction and theory development" (Hair et al., 2011, p.140).

The measurement specification corresponds to the reflective measurement model, meaning that the reflective indicators (measures) represent a construct outcome (or effect).

Therefore, the reflective indicators are seen as the sample that represents all available items in the construct's conceptual domain. The scale, or set of reflective indicators, used in this thesis was created based on validated literature and a mixture of scales from various validated studies.

In this thesis, the researched validated constructs are sociability (S) (Kreijns et al., 2007), grit (G) (Aparicio et al., 2017; Duckworth et al., 2009), system quality (SQ), information quality (IQ) (Altalbe, 2021; Aparicio, Bação, et al., 2016; Aparicio et al., 2017, 2019; Cidral et al., 2020; Cidral et al., 2018; DeLone & McLean, 1992; Sun et al., 2008), interactive synchronous learning (ISL) (Y.-M. Huang et al., 2008), and environment (E) (Kreijns et al., 2007; Sun et al., 2008; Thurmond et al., 2002). The latent variables are students interaction & collaboration (SIC) (Aguilera-Hermida, P, 2020; Buttler et al., 2021; Y.-M. Huang et al., 2008; Kreijns et al., 2007; Moallem, 2015; Marks et al., 2005), user satisfaction (US) (Aparicio, Bação, et al., 2016; Aparicio et al., 2017, 2019; Arbaugh, 2000; Cidral et al., 2018; DeLone & McLean, 1992; Marks et al., 2005; Moallem, 2015; Thurmond et al., 2002), individual impact (II) (Aparicio et al., 2017; DeLone & McLean, 1992; Urbach et al., 2010), and perceived flexibility (PF) (Arbaugh, 2000; Buttler et al., 2021; Y.-M. Huang et al., 2008; Marks et al., 2005; Sun et al., 2008). All constructs were evaluated on their validity.

The validated scales were slightly modified to include the pandemic in the scope of the concept of the validated scales (see Appendix C - Table 11 - Scales).

The survey also included general questions regarding respondents' age, country of studies, participation in classes regarding time (synchronous, asynchronous, students that read

material without class participation, students that learn from colleagues, and other modalities), and regarding the physical classes' participation (on campus, at home (online), hybrid, or other), (Table 4). A pilot survey was made with twenty participants to evaluate the clarity, precision, and coherence of the components of the questionnaire.

4. RESULTS AND ANALYSIS

Sample characterisation

The total population of the survey corresponds to N = 156, almost corresponding to the "sample size recommendation in PLS-SEM for a statistical power of 80%" (J. Hair et al., 2014, p.21) with a significance level of 5%. The larger the sample size, the greater the precision and consistency of PLS-SEM estimations. For that, in this thesis, N > as the minimum sample size following the "rules of thumb" to the Partial Least Square (PLS) Structural Equation Modeling (SEM) stated by Hair, Ringle & Sarstedt (2011), for N being larger than ten times the number of arrows pointing at a latent variable within the PLS structural model. The sample for the empirical survey was collected online.

Table 4 – Respondents' Characterization

Age classification	N	Percentage
<20 (A)	27	17%
20-29 (B)	102	65%
30-39 (C)	20	13%
>=40 (D)	7	4%
Total	156	100%
Gender	**N**	**Percentage**
Male	62	40%
Female	94	60%
Total	156	100%
In which country are you studying?	**N**	**Percentage**
Angola	1	0.6%
Brazil	2	1.3%
Chile	1	0.6%
Croatia	1	0.6%
Germany	28	17.9%
Guatemala	1	0.6%
India	1	0.6%
Italy	3	1.9%
Latvia	1	0.6%
Mozambique	2	1.3%
Peru	1	0.6%
Poland	1	0.6%
Portugal	110	70.5%
Switzerland	1	0.6%
Tunisia	2	1.3%
Total	156	100%
During the pandemic I usually participate on on-line classes - Selected Choice	**N**	**Percentage**
1 - In real-time (synchronous)	124	79%
2 - See videos later (asynchronous)	20	13%
3 - I just read the provided resources, I do not participate on classes	7	4%
4 - I prefer to interact with my collegues and learn from them	3	2%
5 - Other modality	2	1%
Total	156	100%
Right now I am attending classes: - Selected Choice	**N**	**Percentage**
1 - Hybrid way, sometimes I go to campus other times I stay at home	60	38%
2 - At home	48	31%
3 - On campus	43	28%
4 - Other	5	3%
Total	156	100%

Students of HEIs were contacted by email, which contained a hyperlink to the survey. This hyperlink could be open via desktop or mobile device for a period of 4 months. This thesis utilises the Smart PLS 3 professional software to validate the collected data. The average values of each indicator substituted missing values. Table 4 shows the respondents' demographic distribution in characteristics such as age, gender, country of studies, and university attendance divided in attendance time and place (by the time the questionnaire was answered).

Evaluation of the measurement model

The constructs were analysed using various indicators such as Cronbachs' Alpha, Composite Reliability, and Average Variance Extracted (AVE) for the measurement model evaluation to analyse the convergent validity. Next, the Fornell-Larker test was made, as well as the Cross-loadings were examined to analyse the discriminant validity of the constructs. According to J. Hair et al. (2014), Cronbachs' Alpha values should be between 0.60 - 0.90. Table 5 shows that not all constructs lay within the optimal range. Here, two constructs present values under 0.60, environment and grit, and two constructs present values over 0.90, individual impact and system quality. Although s Cronbach's alpha is a traditional and conservative criterion when analysing internal consistency, it presents limitations regarding the population. This study presents a relatively small population, which can reduce the explanatory power of Cronbachs' Alpha. Other composite reliability techniques were applied to analyse the construct's validity and reliability. To analyse the constructs' validity and reliability is highly recommended because of the population size. The composite reliability also considers the outer loadings by the variable's indicator.

Table 5 - Construct Reliability

Construct Reliability	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)	Discriminant Validity
Environment	0.582	0.824	0.702	yes
Flexibity	0.905	0.927	0.682	yes
Grit	0.511	0.804	0.672	yes
Individual Impacts	0.922	0.945	0.81	yes
Information Quality	0.906	0.934	0.781	yes
Sociability	0.866	0.909	0.715	yes
Students Interaction Collaboration	0.861	0.907	0.71	yes
System Quality	0.936	0.955	0.84	yes
User Satisfaction	0.892	0.922	0.705	yes

The composite reliability analysis should present values between 0.60 - 0.70 to be acceptable and between 0.70 - 0.90 to be satisfactory. Here both environment (0.824) and grit (0.804) constructs are in the satisfactory range. Individual impact and system quality, perceived flexibility, and user satisfaction present values higher than 0.90. Additionally, values lower than 0.60 indicate an absence of internal consistency regarding the composite reliability. Table 5 shows that no constructs present values under 0.60. Furthermore, to analyse the convergent validity of the AVE (Average Variance Extracted), the outer loadings should be higher than 0.708. Still, studies in the social science domain may present weaker values regarding the outer loadings, being outer loading over 0.50 acceptable because those means that the construct explains at least 50% of the variance (Hair et al., 2014). Table 5 shows that 7 out of 9 constructs present an AVE > 0.708, and no construct presents an AVE < 0.50.

Additionally, the Fornell-Larcker criterion is used to analyse if any construct has higher variance with its related indicators than all other constructs within a measurement model. According to J. Hair et al., *"Overall, cross-loadings, as well as the Fornell-Larcker criterion, provide evidence for the constructs' discriminant validity."* (2014, p. 112).

By the Fornell-Larcker-criterion, each construct's square root AVE must be larger than the construct's highest correlation with another construct present in the measurement model, meaning that this analysis is identical to the comparison of the AVE to the squared correlations among all constructs in the measurement model. In table 6, all values laying on the diagonal (in the intersection of each construct column with themselves in the same construct row) are higher than the values of the construct intersection with other constructs, both regarding the intersection with all other constructs values in columns and rows (e.g., perceived flexibility & perceived flexibility (0.826) is higher than perceived flexibility & environment (0.545), 0.826 > 0.416 (grit & perceived flexibility). The analysis should be carried on until the last value of the column or row, here 0.826 > 0.485 (user satisfaction & perceived flexibility).

Table 6 - Fornell-Larker Test

Test Fornell-Larker	Environment	Flexibity	Grit	Individual Impacts	Information Quality	Sociability	Students Interaction Collab.	System Quality	User Satisfaction
Environment	0.838								
Flexibity	0.545	0.826							
Grit	0.227	0.416	0.82						
Individual Impacts	0.384	0.761	0.469	0.9					
Information Quality	0.377	0.261	0.453	0.351	0.884				
Sociability	0.424	0.396	0.3	0.386	0.521	0.845			
Students Interaction Collaboration	0.266	0.134	0.156	0.145	0.403	0.552	0.842		
System Quality	0.456	0.325	0.436	0.442	0.661	0.513	0.447	0.917	
User Satisfaction	0.498	0.496	0.485	0.561	0.693	0.612	0.416	0.739	0.84

For analysing the discriminant validity, the cross-loadings were verified. For that, the outer loadings indicators of each associate construct were analysed to determine if they were more significant than the loadings of the other constructs (see Appendix A - Table 9 - Cross-loadings).

Table 7 - HTMT Heterotrait-Monotrait Ratio

HTMT	Environment	Flexibity	Grit	Individual Impacts	Information Quality	Sociability	Students Interaction Collab.	System Quality	User Satisfaction
Environment									
Flexibity	0.745								
Grit	0.41	0.603							
Individual Impacts	0.518	0.822	0.678						
Information Quality	0.5	0.293	0.665	0.382					
Sociability	0.588	0.446	0.451	0.431	0.586				
Students Interaction Collaboration	0.365	0.157	0.243	0.162	0.453	0.636			
System Quality	0.594	0.351	0.631	0.476	0.718	0.568	0.499		
User Satisfaction	0.67	0.547	0.716	0.613	0.768	0.696	0.477	0.8	

Academicals such as Hair, Sarstedt, Ringle, Henseler, & Sinkovics, have noticed that the cross-loadings are more liberal than the Fornell-Larcker-criterion. For that, Henseler et al. (2015) have researched a new criterion called Heterotrait-Monotrait Ratio of correlations, short HTMT, "for assessing discriminant validity in variance-based SEM" (Henseler et al., 2015, p. 116). According to them, discriminant validity is achieved when HTMT values are lower than 0.90. All constructs present HTMT values under 0.90, as shown in Table 7. Meaning that all constructs in the measure model achieve discriminant validity.

Table 8 - Hypotheses Results

Hypotheses Bootstrap test (5000 sub-samples)	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Significance Level
Environment -> Sociability	0.424	0.43	0.068	6.246	0	***
Flexibility -> Individual Impacts	0.609	0.612	0.06	10.139	0	***
Flexibility -> UserSatisfaction	0.21	0.208	0.058	3.607	0	***
Grit -> Flexibility	0.416	0.422	0.069	6.053	0	***
Grit -> Individual Impacts	0.116	0.113	0.063	1.844	0.065	NS
Grit -> User Satisfaction	0.059	0.062	0.058	1.01	0.313	NS
Information Quality -> User Satisfaction	0.27	0.269	0.082	3.303	0.001	**
Sociability -> Students Interaction Collab	0.552	0.556	0.059	9.344	0	***
Sociability -> User Satisfaction	0.176	0.177	0.052	3.395	0.001	**
Students Interaction Collab -> Individual Impacts	-0.046	-0.047	0.054	0.859	0.39	NS
Students Interaction Collab -> User Satisfaction	0.006	0.005	0.06	0.095	0.924	NS
System Quality -> User Satisfaction	0.373	0.374	0.066	5.636	0	***
User Satisfaction -> Individual Impacts	0.222	0.222	0.069	3.237	0.001	**

Note: NS = non-Significant, *p < 0.05, **p < 0.01, ***p < 0.001.

Evaluation of the structural model

To analyse if two or more indicators are explaining the same phenomenon, meaning that they are highly correlated, the collinearity of the indicators, each indicator was analysed by the VIF (Variance Inflation Factor) tolerance. According to J. Hair et al. VIF "value should be higher than 0.20" and lower than 5 (2014, p. 149). Results show that no indicator presents values <= 0,20, and the indicator presenting the highest VIF (system quality VIF = 2.075) is far lower than 5, meaning that all indicators are free from multicollinearity or collinearity issues (see Appendix B - Table 10 - Inner VIF).

The bootstrapping procedure was used to assess the structural model quality and significance of the structural model. In the bootstrapping procedure, five thousand subsamples were generated and replaced randomly based on the collected data set. Furthermore, the hypotheses' relationships were tested. And the coefficient of model determination R^2 to evaluate the structural model. Results show that the structural model explains 70,5% (R^2) of user satisfaction variance and 63,5 % (R^2) of individual impact variance. Furthermore, the model explains 30,5% of interaction & collaboration, 17,3% of perceived flexibility, and 18% of sociability variances.

The relationship path perceived flexibility impacts user satisfaction presents a high significance (p = 0), while grit influence over user satisfaction is not statistically significant (p = 0.313). Additionally, information quality impact on user satisfaction shows a medium significance (p = 0.001), sociability influence over user satisfaction presents a medium significance (p = 0.001), and students interaction collaboration impact on user satisfaction is not statistically significant (p = 0.924). Furthermore, system quality influences user satisfaction and shows a high significance (p = 0).
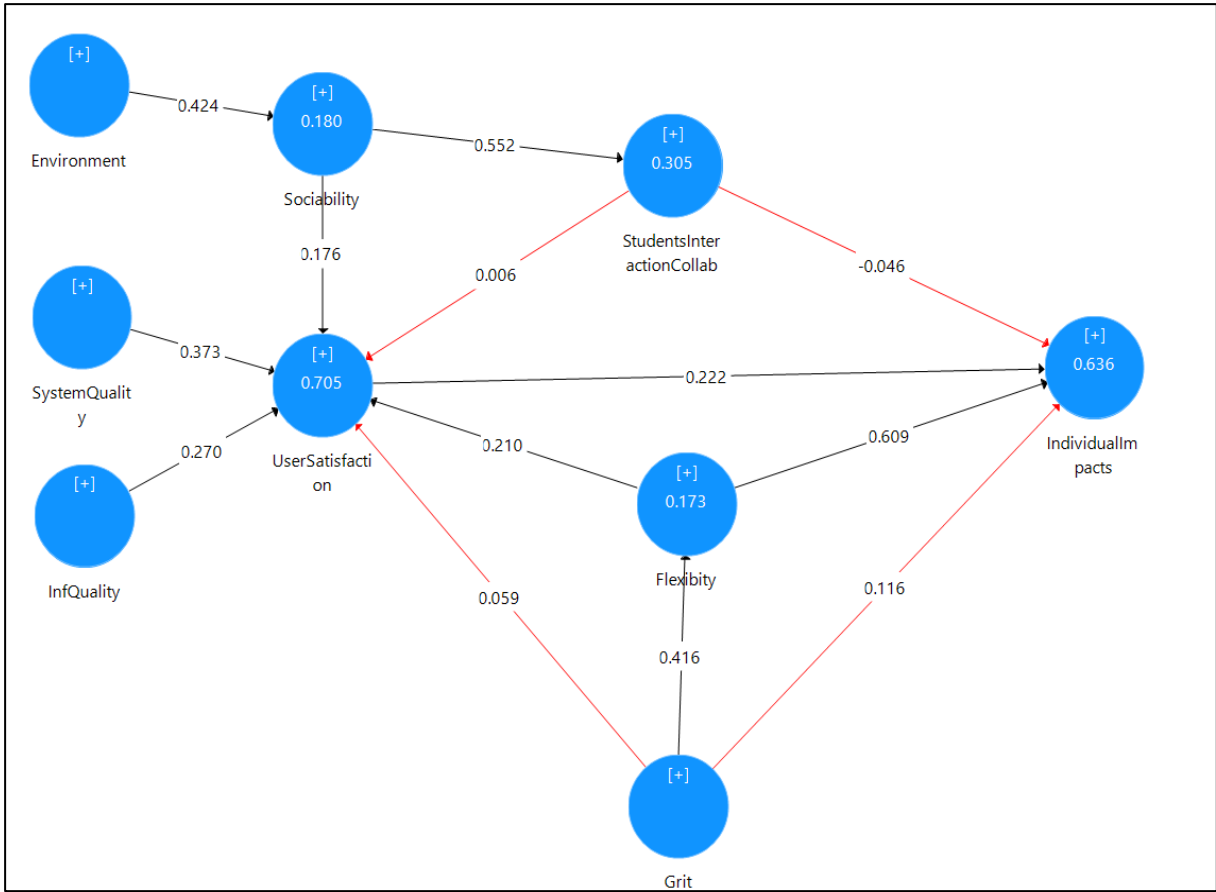

Figure 2 - Structural Model

Additionally, regarding the individual impact paths, perceived flexibility impact over individual impact presents a high significance (p = 0), and grit influence over individual impact is not statistically significant (p = 0.065). Students' interaction & collaboration influence over individual impact is not statistically significant (p = 0.39). And user satisfaction effect over individual impact presents a medium significance (p = 0.001).

Furthermore, the following relationship paths: grit impacts perceived flexibility, sociability influences students' interaction & collaboration, and environment impacts sociability show high significance in all three relationships (p = 0).

5. DISCUSSION

The structural model supports most hypotheses empirically and statistically. The following hypotheses are empirically supported: H1c. Grit has a positive impact on perceived flexibility, H2a. Sociability has a positive impact on users' satisfaction, H2b. Sociability has a positive impact on students' interaction & collaboration, H4. System quality has a positive impact on users' satisfaction, H5. Information quality has a positive impact on users' satisfaction, H6. Environment has a positive impact on sociability, H7a. Perceived flexibility has a positive impact on users' satisfaction, H7b. Perceived flexibility has a positive impact on individual impact, and H8. User satisfaction positively impacts Individual Impacts. Only the following hypotheses are identified as non-significant (p>0.05): 1a. Grit positively impacts users' satisfaction, hypothesis 1b. Grit has a positive influence on Individual Impact, hypothesis 3a. Interaction & collaboration impact users' satisfaction, hypothesis 3b. Interaction & collaboration influence individual impact.

H1a. Grit has a positive impact on users' satisfaction

On the one hand, the lack of statistical support for H1a indicates insufficient evidence to affirm that gritty students are more satisfied with the e-learning systems of their HEIs in ERT, meaning the e-learning systems of their universities during the Covid-19 pandemic than non-gritty students. On the other hand, the relationship between grit and students' satisfaction with e-learning usage in a non-ERT situation is statistically significant, showing at least a small statistical effect, according to Aparicio et al. (2017). Regarding ERT during the pandemic, grit does not influence user satisfaction with e-learning systems by HEIs students, at least not if compared to face-to-face classes during the pandemic. The fact that grit does not influence students' satisfaction during the pandemic could indicate that user satisfaction may be experienced differently by ERT in comparison to a non-ERT e-learning environment.

H1b. Grit has a positive influence on individual impact

The same applies to H1b. Hypothesis H1b affirms that grit positively impacts students' individual impact in ERT is not statistically significant. Other than suspected, a gritty personality does not influence students' individual impact when comparing productivity increase, ease of task accomplishment, and usefulness of e-learning in ERT to the same scales

in a non-ERT situation. The lack of statistical evidence regarding the positive influence of grit over individual impact in HEIs in ERT situations could mean that students' intrinsic motivation does not overrule external motivation regarding using e-learning systems in ERT. Further research could be done to determine which external motivation factors influence students' individual impact.

H1c. Grit has a positive impact on perceived flexibility

Hypothesis 1c presents a high significance, meaning that gritty students present higher levels of perceived flexibility than their peers, even during the pandemic in the ERT model in HEIs. Perhaps the concept of satisfaction in ERT compared to a non-ERT is challenging to accept, even for gritty students. But when students have to reflect on their time management effectiveness and time-saving aspects of remote learning, grit influences the student's perceived flexibility. From the perceived flexibility perspective, the empirical study confirms that students with gritty personalities recognise the positive effects of e-learning in ERT as non-gritty students. Meaning also that gritty students can accomplish more because of the flexibility e-learning provides them in the challenging situation of ERT. From that perspective, gritty students outperform non-gritty students regarding consistency of interest, and objectives achievement, as stated by Aparicio et al. (2017) and Duckworth et al. (2009).

H2a. Sociability has a positive impact on users' satisfaction

H2b. Sociability has a positive impact on students' interaction & collaboration

Results show that hypothesis 2a presents a medium significance. Meaning that e-learning systems allow students to easily communicate, in spontaneous or informal ways, helping students not feel lonely and increasing the possibility for students to develop a good work relationships with their colleagues. Furthermore, sociability increases the students' satisfaction with the e-learning systems of their universities. Furthermore, hypothesis 2b presents a high significance, which means that e-learning systems that have functions to increase the sociability of the students also increase the interaction & collaboration of students in matters of information sharing, ideas discussion, group work and collaboration among students in general.

H3a. Students' interaction & collaboration has a positive impact on users' satisfaction

H3b. Students' interaction & collaboration has a positive influence on individual impact

The paths interaction & collaboration -> users' satisfaction and interaction & collaboration -> individual impact are not supported by the results of the empirical study, presenting p = 0.924 and p = 0.39, respectively.

Although other authors such as Aguilera-Hermida (2020), Buttler et al. (2021), Y.-M. Huang et al. (2008), Kreijns et al. (2007), Marks et al. (2005), Wilcox & Vignal (2020) and Moallem, (2015) affirm that interaction and collaboration among students are crucial for students' motivation.

On the one hand, the empirical analysis shows that there is insufficient evidence that students who share information, discuss their ideas, and work in groups, are more satisfied with the e-learning systems of their universities during the pandemic. And regarding the impact of interaction & collaboration on individual impact, this is the only result in this study that shows a negative, statistically non-significant impact.

On the other hand, according to Aguilera-Hermida (2020), the lack of social interaction may be prejudicial to students' success and cognitive engagement. In conclusion, more research must be done to prove if the comparison of teaching models is relevant regarding the relationship between interaction & collaboration and users' satisfaction and to prove if the impact of interaction & collaboration on individual impact during the pandemic is negative and if it is statistically significant in other contexts. Furthermore, comparing the e-learning systems usage satisfaction and the satisfaction of students with their university in general regarding face-to-face classes before the Covid-19 pandemic may play a role in the relationship between interaction & collaboration and users' satisfaction. Still, the data collected and analysed in this study do not provide statistically significant evidence to support any of both assumptions: interaction & collaboration impacts users' satisfaction, and interaction & collaboration influences individual impact.

H4. System quality has a positive impact on users' satisfaction

System quality has a positive impact on users' satisfaction is also affirmed with a high significance in this empirical study, which supports the result of Urbach et al. (2010).

H5. Information quality has a positive impact on users' satisfaction

Also, Hypothesis 5, information quality positively impacts users' satisfaction, is statistically proven with p = 0.001, which presents a medium significance, supporting the results from Urbach et al. (2010). Additionally, one can affirm that the information quality of lecture content impacts the students' satisfaction in universities during the pandemic.

H6. Environment has a positive impact on sociability

Hypothesis 6 affirms with a high significance that students who have spent more time studying than before the pandemic, and have participated actively in scheduled discussions, are also not feeling lonely. Additionally, those students are developing good work relationships with their peers because they can quickly contact other students through the e-learning systems from their universities. Furthermore, those students are aware of the possibility of having spontaneous and informal exchanges with their peers through the e-learning systems of their universities.

H7a. Perceived flexibility has a positive impact on users' satisfaction

H7b. Perceived flexibility has a positive impact on individual impact

The empirical study shows that perceived flexibility positively impacts users' satisfaction (high significance p = 0), affirming H7a. Students who are highly effective in their work and time management and who appreciate the flexibility of remote learning compared to on-site teaching models are more satisfied with the e-learning systems' usage of their HEIs, as students who present low perceived flexibility. The positive influence of perceived flexibility on individual impact confirms the results found by Arbaugh (2000). Additionally, students with high perceived flexibility are likely to have a better individual impact on their studies (Hypothesis 7b, p = 0). In those cases, ERT improves students' productivity, allowing them to accomplish tasks more efficiently and faster than face-to-face classes. Generally, students with high perceived flexibility evaluate the e-learning systems as more valuable than face-to-face classes.

H8. User satisfaction has a positive impact on individual impact

Regarding hypothesis 8, the empirical results show that students who are satisfied with their universities' e-learning systems have a better individual impact than those who are unsatisfied

with their university's e-learning systems during the pandemic, with an intermediate significance ($p = 0.001$).

In sum, this research contributes to the academic understanding of factors influencing students' satisfaction and individual impact in HEIs during the Covid-19 pandemic. Moreover, this research shows evidence that grit positively impacts perceived flexibility. The positive influence of sociability on user' satisfaction and students' interaction & collaboration is confirmed.

The statistical evidence also validates the positive impact of information quality and system quality on user satisfaction, as well as the influence of the environment on sociability during the pandemic in higher education institutions.

In addition, the results confirm the positive effect of perceived flexibility on user satisfaction, confirming similar results found by other authors. Also, the influence of user satisfaction on individual impact is validated.

6. LIMITATIONS AND RECOMMENDATIONS FOR FUTURE WORKS

Covid-19 has proven that a rapid digital transformation is possible in HEIs and diverse industries. Furthermore, a significant share of digital transformation settled during the Covid-19 pandemic are likely to endure after the pandemic and be part of the "new normal". In conclusion, measuring which factors influence students' e-learning satisfaction, flexibility, and individual performance during covid-19 in higher education institutions is crucial to improve HEIs preparation for possible challenges in the post-Covid-19 future.

The results show four factors which impact students' satisfaction: sociability, system quality, information quality, and perceived flexibility. Additionally, two factors influence individual impact: perceived flexibility and user satisfaction. Furthermore, grit influences perceived flexibility, environment impacts sociability, and sociability impacts students' interaction and communication. According to the results, the other hypotheses analysed in the context of this study are not statistically relevant. This study was conducted during the Covid-19 pandemic and englobed the students' opinions during the ERT in HEIs.

This study does not assess the post-Covid-19 perception of students. Furthermore, the population of this study is limited to a small sample. All respondents were enrolled in universities in Europe or at least in an Erasmus program in Europe. Additionally, the survey was done in English language only. Doing a multi-lingual survey can increase the reach of respondents. Increasing the reach of possible respondents to a broader scope could increase the number of responses. Increasing the responses' total numbers influence the results, not only in quantity but also in significance.

In this survey, only HEI students were interviewed to add the view of professors in HEIs during the pandemic or post-pandemic situation could improve the accuracy regarding which factors are the most relevant factors for user satisfaction and individual impact in HEIs in ERT situations.

Furthermore, comparing results from studies during the pandemic with post-pandemic results can increase the general understanding of students' satisfaction, individual impact, preferences, and factors influencing successful graduation. Additionally, one could analyse

results from respondents who prefer to keep using the e-learning systems of their universities even after the pandemic to understand which factors are ERT-related and ERT-independent. Also, other personality and cultural characteristics such as individualism and collectivism could be analysed to understand if those cultural factors influence students' interaction & collaboration and satisfaction in the post-Covid 19 future.

REFERENCES

Aguilera-Hermida, P. (2020). College students' use and acceptance of emergency online learning due to COVID-19 |. Elsevier Enhanced Reader. https://doi.org/10.1016/j.ijedro.2020.100011

Alfred P. Rovai. (2001). Classroom community at a distance A comparative analysis of two ALN-based university programs. 19 September 2001, 4, 105–118. https://doi.org/10.1016/S1096-7516(01)00053-7

Allen, I. E., Seaman, J., & Garrett, R. (2007). Blending In: The Extent and Promise of Blended Education in the United States. 35.

Altalbe, A. (2021). Antecedents of Actual Usage of e-Learning System in High Education During COVID-19 Pandemic: Moderation Effect of Instructor Support. IEEE Access, 9, 93119–93136. https://doi.org/10.1109/ACCESS.2021.3087344

Aparicio, M. (2016). E-Learning Systems Success: A Theoretical Model. https://run.unl.pt/bitstream/10362/21392/1/D0025.pdf

Aparicio, M., Bação, F., & Oliveira, T. (2014). Trends in the e-Learning Ecosystem: A Bibliometric Study. In 20th Americas Conference on Information Systems, AMCIS 2014.

Aparicio, M., Bação, F., & Oliveira, T. (2016). Cultural impacts on e-learning systems' success. Internet and Higher Education, 31, 58–70. https://doi.org/10.1016/j.iheduc.2016.06.003

Aparicio, M., Bacao, F., & Oliveira, T. (2017). Grit in the path to e-learning success. Computers in Human Behavior, 66, 388–399. https://doi.org/10.1016/j.chb.2016.10.009

Aparicio, M., Oliveira, T., Bacao, F., & Painho, M. (2019). Gamification: A key determinant of massive open online course (MOOC) success. Information & Management, 56(1), 39–54. https://doi.org/10.1016/j.im.2018.06.003

Arbaugh, J. B. (2000). Virtual Classroom Characteristics and Student Satisfaction with Internet-Based MBA Courses. Journal of Management Education, 24(1), 32–54. https://doi.org/10.1177/105256290002400104

Bai, Xue, Ola, Ade, Reese, Serena, Eyob, Ephrem, & Bazemore, Shelly. (2020). A Study Of The Effectiveness Of Remote Instruction From Students Perspectives. Issues In Information Systems, Volume 21(Issue 4), 143–155. https://doi.org/10.48009/4_iis_2020_143-155

Balakrishnan, R., & Das, S. (2020). How do firms reorganise to implement digital transformation? Strategic Change, 29(5), 531–541. Scopus. https://doi.org/10.1002/jsc.2362

Bonk, C. J., & Graham, C. R. (2005). The Handbook of Blended Learning: Global Perspectives, Local Designs. John Wiley & Sons.

Brynjolfsson, E., & McAfee, A. (2011). Race Against the Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy. Brynjolfsson and McAfee.

Buttler, T., George, D., & Bruggemann, K. (2021). Student input on the effectiveness of the shift to emergency remote teaching due to the COVID crisis: Structural equation modeling creates a more complete picture. International Journal of Educational Research Open, 2–2, 100036. https://doi.org/10.1016/j.ijedro.2021.100036

Chakraborty, P., Mittal, P., Gupta, M. S., Yadav, S., & Arora, A. (2021). Opinion of students on online education during the COVID-19 pandemic. Human Behavior and Emerging Technologies, 3(3), 357–365. https://doi.org/10.1002/hbe2.240

Chickering, A. W., & Gamson, Z. F. (1989). Seven principles for good practice in undergraduate education. Biochemical Education, 17(3), 140–141. https://doi.org/10.1016/0307-4412(89)90094-0

Cidral, W. A., Oliveira, T., Felice, M. D., & Aparicio, M. (2018). E-learning success determinants: Brazilian empirical study. Computers and Education, 122, 273–299. https://doi.org/10.1016/j.compedu.2017.12.001

Cidral, W., Aparicio, M., & Oliveira, T. (2020). Students' long-term orientation role in e-learning success: A Brazilian study. Heliyon, 6(12), 1–12. https://doi.org/10.1016/j.heliyon.2020.e05735

Dataset on the Acceptance of e-learning System among Universities Students' under the COVID-19 Pandemic Conditions | Elsevier Enhanced Reader. (n.d.). https://doi.org/10.1016/j.dib.2020.106176

Daychoum, M. (2018). 40+20 Ferramentas e Técnicas de Gerenciamento. Brasport.

Decker, C., & Werner, R.,. (2016). Academic research and writing. https://www.isbn.de/buch/9783981558616_academic-research-and-writing.htm

DeLone, W. H., & McLean, E. R. (1992). Information Systems Success: The Quest for the Dependent Variable. Information Systems Research, 3(1), 60–95. https://doi.org/10.1287/isre.3.1.60

DeLone, W. H., & McLean, E. R. (2002). Information systems success revisited. Proceedings of the 35th Annual Hawaii International Conference on System Sciences, 2966–2976. https://doi.org/10.1109/HICSS.2002.994345

DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. Journal of Management Information Systems, 19(4), 9–30.

Donath, J. S. (1997). Inhabiting the virtual city: The design of social environments for electronic communities. Massachusetts Institute of Technology, Program in Media Arts & Sciences. http://papers.cumincad.org/cgi-bin/works/Show?2a09

Duckworth, A. L., Quinn, P. D., & Seligman, M. E. P. (2009). Positive predictors of teacher effectiveness. The Journal of Positive Psychology, 9.

Eden, R., Burton-Jones, A., Casey, V., & Draheim, M. (2019). Digital Transformation Requires Workforce Transformation. MIS Quarterly Executive, 18(1), 1–17. https://doi.org/10.17705/2msqe.00005

Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? Technological Forecasting and Social Change, 114, 254–280. https://doi.org/10.1016/j.techfore.2016.08.019

Geissdoerfer, M., Vladimirova, D., & Evans, S. (2018). Sustainable business model innovation: A review. Journal of Cleaner Production, 198, 401–416. https://doi.org/10.1016/j.jclepro.2018.06.240

Giesbers, B., Rienties, B., Tempelaar, D., & Gijselaers, W. (2014). A dynamic analysis of the interplay between asynchronous and synchronous communication in online learning: The impact of motivation. Journal of Computer Assisted Learning, 30(1), 30–50. https://doi.org/10.1111/jcal.12020

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a Silver Bullet. Journal of Marketing Theory and Practice, 19(2), 139–152. https://doi.org/10.2753/MTP1069-6679190202

Hair, J., Hult, G. T., Ringle, C., & Sarstedt, M. (2014). A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM). 2014 Faculty Bookshelf. https://digitalcommons.kennesaw.edu/facbooks2014/39

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. Journal of the Academy of Marketing Science, 43(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8

Hong, K.-S. (2002). Relationships between students' and instructional variables with satisfaction and learning from a Web-based course. The Internet and Higher Education, 5(3), 267–281. https://doi.org/10.1016/S1096-7516(02)00105-7

Hrastinski, S., Keller, C., & Carlsson, S. A. (2010). Design exemplars for synchronous e-learning: A design theory approach. Computers & Education, 55(2), 652–662. https://doi.org/10.1016/j.compedu.2010.02.025

Huang, R., Liu, D. J., Guo, J., Yang, J., Wei, X. F., Knyazeva, S., Li, M., Zhuang, R. X., Looi, C. K., & Chang, T. (2020). Guidance on Flexible Learning during Campus Closures: Ensuring course

quality of higher education in COVID-19 outbreak Rights and Permissions Please cite the work as follows.

Huang, Y.-M., Kuo, Y.-H., Lin, Y.-T., & Cheng, S.-C. (2008). Toward interactive mobile synchronous learning environment with context-awareness service. Computers & Education, 51(3), 1205–1226. https://doi.org/10.1016/j.compedu.2007.11.009

Jeanne W. Ross, Cynthia M. Beath, & Martin Mocker. (2019). Designed for Digital: How to Architect Your Business for Sustained Success. The MIT Press. http://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=2247469&lang=pt-pt&site=ehost-live

Knight, D. W. E. (1994). Why the Five-Year (or Longer) Bachelors Degree'?: An Exploratory Study of Time to Degree Attainment. 21.

Kreijns, K., Kirschner, P. A., Jochems, W., & van Buuren, H. (2007). Measuring perceived sociability of computer-supported collaborative learning environments. Computers & Education, 49(2), 176–192. https://doi.org/10.1016/j.compedu.2005.05.004

Laudon, K., & Laudon, J. (2019). Management Information Systems: Managing the Digital Firm, EBook, Global Edition. Pearson Education, Limited. http://ebookcentral.proquest.com/lib/novaims/detail.action?docID=5821092

March, S. T., & Smith, G. F. (1995). Design and natural science research on information technology. https://doi.org/10.1016/0167-9236(94)00041-2

Marks, R. B., Sibley, S. D., & Arbaugh, J. B. (2005). A Structural Equation Model of Predictors for Effective Online Learning. Journal of Management Education, 29(4), 531–563. https://doi.org/10.1177/1052562904271199

Moallem, M. Ph.D. (2015). The Impact Of Synchronous And Asynchronous Communication Tools On Learner Self-Regulation, Social Presence, Immediacy, Intimacy And Satisfaction In Collaborative Online Learning: Vol. 5 Volume 3, Issue 3. The Online Journal of Distance Education and e-Learning. http://www.tojdel.net/journals/tojdel/volumes/tojdel-volume03-i03.pdf#page=62

Moore, M. G. (1989). Editorial: Three types of interaction. American Journal of Distance Education, 3(2), 1–7. https://doi.org/10.1080/08923648909526659

Pfaffman, J. (2008). Handbook of Research on Educational Communications and Technology: A Project of the Association for Educational Communications and Technology. In Handbook of Research on Educational Communications and Technology: A Project (p. 927). Routledge. https://books.google.de/books?hl=pt-PT&lr=&id=GgCPAgAAQBAJ&oi=fnd&pg=PA225&dq=+Computer-mediated+communications+technologies&ots=AaYXHRO1s4&sig=oFcR7726X6-

QyEi25dWNcGk7UPc&redir_esc=y#v=onepage&q=Computer-mediated%20communications%20technologies&f=false

Phillips, C. (1990). Making friends in the 'electronic student lounge'. Distance Education, 11(2), 320–333. https://doi.org/10.1080/0158791900110210

Smith-Rowsey, D. (2016). The Netflix Effect: Technology and Entertainment in the 21st Century. Bloomsbury Academic. https://doi.org/10.5040/9781501309410

Sukendro, S., Habibi, A., Khaeruddin, K., Indrayana, B., Syahruddin, S., Makadada, F. A., & Hakim, H. (2020). Using an extended Technology Acceptance Model to understand students' use of e-learning during Covid-19: Indonesian sport science education context. Heliyon, 6(11), e05410. https://doi.org/10.1016/j.heliyon.2020.e05410

Sun, P.-C., Tsai, R. J., Finger, G., Chen, Y.-Y., & Yeh, D. (2008). What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction. Computers & Education, 50(4), 1183–1202. https://doi.org/10.1016/j.compedu.2006.11.007

Thurmond, V. A., Wambach, K., Connors, H. R., & Frey, B. B. (2002). Evaluation of Student Satisfaction: Determining the Impact of a Web-Based Environment by Controlling for Student Characteristics. American Journal of Distance Education, 16(3), 169–190. https://doi.org/10.1207/S15389286AJDE1603_4

Urbach, N., Smolnik, S., & Riempp, G. (2010). An empirical investigation of employee portal success. The Journal of Strategic Information Systems, 19(3), 184–206. https://doi.org/10.1016/j.jsis.2010.06.002

WHO. (n.d.). Strategic preparedness and response plan for the novel coronavirus. World Health Organization. Retrieved 26 December 2021, from https://www.who.int/publications-detail-redirect/strategic-preparedness-and-response-plan-for-the-new-coronavirus

Wilcox, B., & Vignal, M. (2020). Recommendations for emergency remote teaching based on the student experience. The Physics Teacher, 58(6), 374. https://doi.org/10.1119/10.0001828

APPENDIX A

Appendix A

- Table 9 - Cross-loadings

Cross-loadings	Environment	Flexibity	Grit	Individual Impacts	Information Quality	Sociability	Students Interaction Collab	System Quality	User Satisfaction
E_1	**0.887**	0.535	0.215	0.35	0.386	0.402	0.26	0.475	0.494
E_3	**0.785**	0.358	0.161	0.289	0.227	0.299	0.176	0.263	0.321
Flex1	0.444	**0.883**	0.396	0.674	0.217	0.324	0.146	0.287	0.411
Flex2	0.367	**0.897**	0.414	0.751	0.181	0.385	0.081	0.276	0.453
Flex3	0.449	**0.737**	0.327	0.463	0.274	0.209	0.033	0.181	0.339
Flex4	0.455	**0.823**	0.323	0.633	0.19	0.397	0.18	0.297	0.412
Flex5	0.509	**0.871**	0.382	0.653	0.267	0.301	0.133	0.301	0.453
Flex8	0.518	**0.725**	0.185	0.554	0.183	0.327	0.073	0.257	0.381
G2	0.185	0.34	**0.827**	0.404	0.334	0.276	0.091	0.337	0.398
G3	0.188	0.341	**0.812**	0.365	0.41	0.215	0.166	0.378	0.397
II_1	0.333	0.592	0.356	**0.85**	0.323	0.3	0.114	0.412	0.502
II_2	0.352	0.737	0.477	**0.933**	0.323	0.386	0.154	0.419	0.524
II_3	0.33	0.67	0.381	**0.924**	0.282	0.371	0.136	0.368	0.471
II_4	0.365	0.729	0.463	**0.892**	0.335	0.329	0.117	0.395	0.522
IQ_1	0.345	0.202	0.414	0.309	**0.902**	0.483	0.37	0.548	0.629
IQ_2	0.256	0.17	0.387	0.247	**0.893**	0.421	0.297	0.592	0.591
IQ_3	0.395	0.286	0.466	0.392	**0.892**	0.503	0.405	0.628	0.642
IQ_4	0.331	0.263	0.328	0.286	**0.847**	0.43	0.346	0.569	0.582
S1	0.283	0.212	0.205	0.266	0.488	**0.827**	0.54	0.536	0.536
S2	0.402	0.404	0.318	0.373	0.422	**0.803**	0.379	0.395	0.535
S3	0.386	0.395	0.257	0.308	0.395	**0.88**	0.434	0.421	0.485
S4	0.365	0.332	0.236	0.36	0.453	**0.87**	0.506	0.377	0.51
SIC1	0.236	0.191	0.082	0.169	0.339	0.464	**0.877**	0.348	0.333
SIC2	0.216	0.078	0.123	0.135	0.377	0.455	**0.891**	0.405	0.393
SIC3	0.26	0.069	0.131	0.109	0.357	0.534	**0.877**	0.401	0.356
SIC4	0.175	0.12	0.202	0.072	0.276	0.397	**0.713**	0.351	0.317
SQ_1	0.368	0.27	0.408	0.382	0.602	0.471	0.42	**0.892**	0.63
SQ_2	0.45	0.302	0.394	0.429	0.565	0.444	0.399	**0.925**	0.696
SQ_3	0.445	0.297	0.377	0.39	0.661	0.462	0.373	**0.909**	0.677
SQ_4	0.406	0.322	0.418	0.419	0.599	0.503	0.448	**0.94**	0.701
US_1	0.431	0.364	0.424	0.441	0.632	0.525	0.385	0.707	**0.901**
US_2	0.495	0.363	0.352	0.426	0.677	0.572	0.417	0.717	**0.904**
US_3	0.461	0.421	0.412	0.462	0.67	0.516	0.4	0.73	**0.913**
US_4	0.346	0.304	0.337	0.331	0.521	0.471	0.356	0.466	**0.753**
US_5	0.339	0.606	0.495	0.663	0.39	0.474	0.186	0.44	**0.704**

Appendix B - Table 10 - Inner VIF

Inner VIF	Environment	Flexibity	Grit	Individual Impacts	Information Quality	Sociability	Students Interaction Collab.	System Quality	User Satisfaction
Environment						1			
Flexibity				1.411					1.375
Grit		1		1.383					1.471
Individual Impacts									
Information Quality									2.062
Sociability							1		1.938
Students Interaction Collaboration				1.221					1.565
System Quality									2.075
User Satisfaction				1.795					

Appendix C - Table 11 - Scales

Constructs	Original Scale	Adapted Scale	Author(s)
User Satisfaction 1	US1 How adequately does the e-learning system support your area of study? US2 How efficient is the e-learning system? US3 How effective is the e-learning system? US4 Are you satisfied with the e-learning system on the whole?	How adequately does the e-learning system support your study during the Pandemic? How efficient you find to use a e-learning system in your university? How effective is the e-learning system in your university? Are you satisfied with the e-learning system as Emergency Remote Teaching during the Pandemic on the whole?	Cidral et al. 2020; DeLone & McLean, 2003; 1992
User Satisfaction 2	US1 If I had an opportunity to take another course via the Internet, I would gladly do so.	If I had an opportunity to take another remote course after the Pandemic, I would gladly do so.	Aparício, et al., 2017; Sun et al., 2008
Individual Impact	II1 The e-learning system enables me to accomplish tasks more quickly. II2 The e-learning system increases my productivity. II3 The e-learning system makes it easier to accomplish tasks. II4 The e-learning system is useful for my job	In comparison to face to face classes: II1 In comparison to face to face classes the e-learning system enables me to accomplish tasks more quickly. II2 In comparison to face to face classes the e-learning system increases my productivity. II3 In comparison to face to face classes the e-learning system makes it easier to accomplish tasks. II4 In comparison to face to face classes the e-learning system is useful for my studies.	Aparício, et al., 2017; Urbach et al., 2010
Grit	PE1 I finish whatever I begin PE2 Setbacks do not discourage me. PE3 I am a hard worker. CI1 I often set a goal but later choose to pursue a different one. (R) CI2 I have been obsessed with a certain idea or project for a short time but later lost interest. (R) CI3 I have difficulty maintaining my focus on projects that take more than a few months to complete. (R)	PE1 I finish whatever I begin. PE2 Setbacks during the Pandemic do not discourage me. PE3 I am a hard worker. CI1 I often set a goal but later (due to unforeseen events) I choose to pursue a different one. (R) CI2 I have been obsessed with a certain idea or project for a short time but later lost interest. (R) CI3 I have difficulty maintaining my focus on projects that take more than a few months to complete. (R)	Aparício, et al., 2017; Duckworth & Quinn, 2009
Enviroment	E.1. I received comments on assignments or examinations for this course in a timely manner. E.2. This course offered a variety of ways of assessing my learning (quizzes, written work, oral presentation, etc.) E.3. I spent more time studying for this course than for other courses. E.4. I actively participated in scheduled discussions about the course material (such as an online discussion group or a computer conference).	E.1. I received comments on assignments or examinations for "most" of my courses in a timely manner. E.3. I spent more time studying during the Pandemic as before. E.4. I actively participated in scheduled discussions about courses material (such as an online discussion group or a computer conference).	Thurmond, et al., 2002
Perceived flexibility	Taking this class via the Internet allowed me to arrange my work for the class more effectively. The advantages of taking this class via the Internet outweighed any disadvantages. Taking this class via the Internet allowed me to spend more time on non-work-related activities. There were no serious disadvantages to taking this class via the Internet. Taking this class via the Internet allowed me to arrange my work schedule more effectively. Taking this class via the Internet saved me a lot of time commuting to class. Taking this class via the Internet allowed me to take a class I would otherwise have to miss. Taking this class via the Internet should allow me to finish my degree more quickly.	Taking classes remotely/ via the Internet allowed me to arrange my work for the classes more effectively. The advantages of taking classes remotely/ via the Internet outweighed any disadvantages. Taking classes remotely/ via the Internet allowed me to spend more time on non-work-related activities. There were no serious disadvantages to taking classes remotely/ via the Internet. Taking classes remotely/ via the Internet allowed me to arrange my work schedule more effectively. Taking classes remotely/ via the Internet saved me a lot of time commuting to class. Taking classes remotely/ via the Internet allowed me to take a class I would otherwise have to miss. Taking classes remotely/ via the Internet should allow me to finish my degree more quickly.	Arbaugh, 2000
Information Quality	IQ1 The information provided by e-learning system is useful. IQ2 The information provided by e-learning system is understandable. IQ3 The information provided by e-learning system is interesting. IQ4 The information provided by e-learning system is reliable.	IQ1 The information provided by e-learning system is useful. IQ2 The information provided by e-learning system is understandable. IQ3 The information provided by e-learning system is interesting. IQ4 The information provided by e-learning system is reliable.	Cidral et al. 2020; Aparício, et al., 2017; Urbach et al., 2010; DeLone & McLean, 2003; 1992
System Quality	SysQ1 The e-learning system is easy to navigate. SysQ2 The e-learning system allows me to find easily the information I am looking for. SysQ3 The e-learning system is well structured. SysQ4 The e-learning system is easy to use.	SysQ1 The e-learning system is easy to navigate. SysQ2 The e-learning system allows me to find easily the information I am looking for. SysQ3 The e-learning system is well structured. SysQ4 The e-learning system is easy to use.	Cidral et al. 2020; Aparício, et al., 2017; Urbach et al., 2010; DeLone & McLean, 2003; 1992
Sociability	This CSCL environment enables me to easily contact my team mates I do not feel lonely in this CSCL environment This CSCL environment allows spontaneous informal conversations This CSCL environment enables me to develop good work relationships with my team mates	The e-learning environment of my university enables me to easily contact with other students. I do not feel lonely in the e-learning environment used by my university. The e-learning environment of my university allows spontaneous informal conversations. The e-learning environment of my university enables me to develop good work relationships with my team colleagues.	Kreijns et al., 2007
Students Interaction & Collaboration	I share information with other students. I discuss my ideas with other students. I collaborate with other students in the class. Group work is a part of my activities.	I share information with other students. I discuss my ideas with other students. I collaborate with other students in the class. Group work is a part of my activities.	Moallem, 2015
Mobile Synchronous Learning	Comparing to traditional read-based styled mobile learning, the interactive synchronous learning activity increased your motivation when learning by mobile device The activity – ''teacher assigns questions/ questionnaire'' increased your will of joining interactive activities during mobile synchronous learning Comparing to traditional read-based styled mobile learning, the interactive mobile synchronous learning increased your learning efficiency	Comparing to traditional learning, the interactive synchronous e-learning activity increased my motivation when learning. The activity – ''teacher assigns questions/ questionnaire'' increased my will of joining interactive activities during the synchronous e-learning. Comparing to traditional learning, the interactive synchronous e-learning increased my learning efficiency.	Huang et al., 2008