NOVA IMS Information Management School

DOCTORAL PROGRAMME

Information Management

Specialization in Information and Decision Systems

Determinants of e-learning success

Wilmar Cidral

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Information Management

December 2021

NOVA Information Management School
Universidade Nova de Lisboa

Information Management

DETERMINANTS OF E-LEARNING SUCCESS

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DETERMINANTS OF E-LEARNING SUCCESS

By

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Gratitude and love to Ana Flávia, Gabriel, and Cinthia.

Gratitude and love to my parents, Oswaldo Cidral, and Maria Cacilda Cidral.

Gratitude and love to my brother, Alisson Magno Cidral (in memoriam).

Gratitude and love to my mother and father-in-law, Nuti, and Roland Ristow (in memoriam).

ACKNOWLEDGMENTS

A thesis is a painful but rewarding journey, and it is only possible thanks to great resilience and the support of many people. My deepest thanks to my supervisors, Professor Tiago Oliveira and Professor Manuela Aparício, who gave me continuous support throughout the Ph.D. Program. My thanks to Professor Tiago Oliveira for reinforcing and supporting the research theme and making it possible to connect with Professor Manuela Aparício. My special thanks to Professor Manuela Aparício for always being there, supporting me in every detail, and at times, she was more than a supervisor, but a living example of a human being and a professional.

I also thank my Brazilian colleagues who felt that we supported each other in good and tense moments during the time we spent together. Many thanks to NOVA IMS professors who ensure excellence in teaching and research, emphasizing students' potential in this critical phase. Congratulations to Universidade Nova de Lisboa and Information Management School.

I congratulate and thank Professor Mitsuru Yanaze (ECA - Escola de Comunicação e Artes / USP - Universidade de São Paulo) for his courage in establishing a partnership between USP ECA and NOVA IMS. Thank you, Professor Massimo Di Felice, for being the co-supervisor in Brazil.

I would also like to thank Valéria Barreira for her high-quality English translation, especially for her time and patience to arrive at the best text. Thank you very much, my friends and Professors at Sustentare, Robson Piucco, James Hunter, and Wladimir Ribeiro Prates, for clearing up my doubts in statistics. And to you, my son Gabriel Ristow Cidral, gratitude for your contributions to Machine Learning.

My cordial gratitude to all my professors at USP ECA and NOVA IMS, colleagues and academic staff. To all anonymous people, Brazilians and Portuguese nationals who participated in the research, because without their contribution, empirical studies would not have been possible.

I thank all my family and friends for their support.

Eternal gratitude to my loves Ana Flávia, Gabriel, and Cinthia, who were deprived of my presence and have always been there to listen and support me.

For all the care, support, encouragement, understanding, and love, my deepest thanks. These are the memories I keep inside me! Thanks.

ABSTRACT

E-learning systems have been emerging globally. These systems are facilitators in the learning process, playing a key role in universities and organizations' educational strategies. Due to the recent increase in the use of e-learning systems in different scenarios, the way people learn and access knowledge consequently leads to a paradigm shift. Not only does e-learning enable individuals to develop skills in several areas but it is also genuinely flexible. New trends reveal that e-learning systems will likely grow massively. This medium may seem to be the answer to all learning barriers, but users' characteristics and their level of involvement in e-learning systems' success have yet to be better explored. Understanding the determinants of e-learning success is crucial for defining instructional strategies. This thesis seeks to theorize, proposing successful models of e-learning systems, taking into account user characteristics, pedagogical perspectives, and technological aspects. This thesis presents three successful theoretical models and reports the empirical studies for each of the models' validations. The first model determines the impact of satisfaction on the success in e-learning systems. The second model assesses the cultural impact (long-term orientation) and its effect on the success of e-learning. The third model evaluates the e-learning system in a cross-country comparison. The studies were carried out through an electronic survey distributed to higher education students at various education levels and from multiple universities. The studies apply quantitative methods and validate theoretical models using structural equation modeling (SEM). This thesis offers important insights as it presents a theoretical framework to guide e-learning studies. The results demonstrate that first, user's perceived satisfaction and use are determinants in the individual impact of e-learning. Also, students' long-term orientation influences the positive relationship between e-learning systems' use and the perceived net benefits, demonstrating cultural impact on e-learning success. Furthermore, the cross-country comparison findings revealed that e-learning use and e-learners' satisfaction are significant determinants of individual impact and the organizational impact of e-learning success for Brazilian and Portuguese students. Another finding was that in both countries, information quality impacts positively on e-learning systems' use and learners' satisfaction. These results demonstrate that the quality of the information and system quality explain the user's satisfaction with the e-learning systems and the success at the individual and organizational levels. For future work, we suggest empirical tests with machine learning.

Keywords: E-learning success, user's perceived satisfaction; success model; long-term orientation; e-learning cross country comparison.

RESUMO

Os sistemas de e-learning têm emergido globalmente. Esses sistemas são facilitadores no processo de aprendizagem, desempenhando um papel fundamental nas estratégias educacionais nas universidades e organizações. Devido ao recente aumento da utilização de sistemas de e-learning em diferentes cenários, consequentemente, a forma como as pessoas aprendem e acessam o conhecimento leva a uma mudança de paradigma. O e-learning não apenas permite que os indivíduos desenvolvam habilidades em várias áreas, mas também é genuinamente flexível. Novas tendências revelam que os sistemas de e-learning provavelmente crescerão enormemente. Este meio pode parecer a resposta a todas as barreiras de aprendizagem, mas as características dos usuários e seu nível de envolvimento no sucesso dos sistemas de e-learning ainda precisam ser mais bem explorados. Compreender os determinantes do sucesso do e-learning é crucial para definir estratégias instrucionais. Esta tese busca teorizar, propondo modelos de sistemas de e-learning de sucesso, levando em consideração as características do usuário, as perspectivas pedagógicas e os aspectos tecnológicos. Esta tese apresenta três modelos teóricos bem-sucedidos e relata os estudos empíricos para cada uma das validações dos modelos. O primeiro modelo determina o impacto da satisfação no sucesso em sistemas de e-learning. O segundo modelo avalia o impacto cultural (orientação de longo prazo) e seu efeito no sucesso do e-learning. O terceiro modelo avalia o sistema de e-learning em uma comparação entre países. Os estudos foram realizados por meio de questionário eletrônico distribuído a estudantes do ensino superior de diversos níveis de ensino e de diversas universidades. Os estudos aplicam métodos quantitativos e validam modelos teóricos usando modelagem de equações estruturais (SEM). Esta tese oferece insights importantes, pois apresenta um quadro teórico para orientar os estudos de e-learning. Os resultados demonstram que, primeiro, a satisfação percebida do usuário e o uso são determinantes no impacto individual do e-learning. Além disso, a orientação de longo prazo dos alunos influencia a relação positiva entre o uso dos sistemas de e-learning e os benefícios percebidos, demonstrando o impacto cultural no sucesso do e-learning. Além disso, os resultados da comparação entre países revelaram que o uso do e-learning e a satisfação dos alunos são determinantes e significativos no impacto individual e organizacional do sucesso do e-learning para alunos brasileiros e portugueses. Outra descoberta foi que, em ambos os países, a qualidade da informação tem um impacto positivo no uso dos sistemas de e-learning e na satisfação dos alunos. Estes resultados demonstram que a qualidade da informação e a qualidade do sistema explicam a satisfação do utilizador com os sistemas de e-learning e o sucesso a nível individual e organizacional. Para futuros trabalhos, sugerimos ensaios empíricos com machine learning.

Palavras-chave: sucesso no e-learning; satisfação percebida do usuário; modelo de sucesso; orientação de longo prazo; comparação de e-learning entre países.

GRAPHICAL ABSTRACT

What factors lead people to succeed in e-learning?

Research Question

Studies & Methodology

Meta study of e-learning concepts ecosystem

Literature review / Bibliometric study (digital libraries . Google Trends) / N-gram analysis

E-learning success & satisfaction

Literature review
Empirical studies

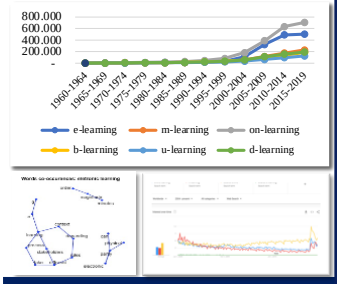
E-learning success & long-term orientation

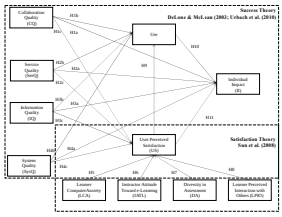
Literature review
Empirical studies

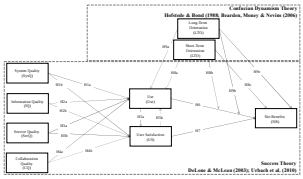
Cross-country comparison e-learning success

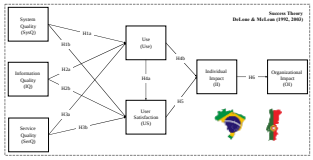
Literature review
Empirical studies

Researchs Models for Empirical Studies









Results

- The e-learning concepts ecosystems are very similar: e-learning, on-learning, b-learning, u-learning, and d-learning
- In digital libraries, a growth trend for all terms; a highlight of demand and growth of online learning and e-learning
- Google Trends signals growth for the online course (voice of society for learning solution) and a decreased tendency to online learning and e-learning (academic trends focusing on research)

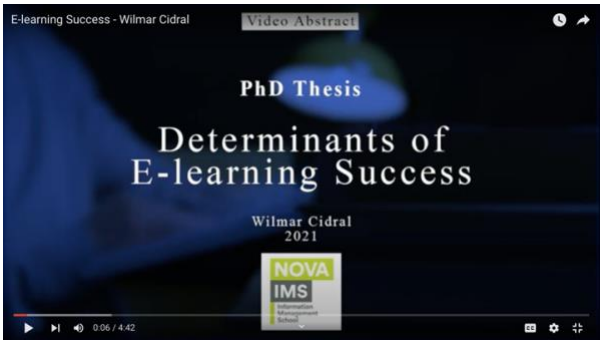
- Collaboration, information and system quality are success determinants
- User satisfaction dimensions are success determinants
- User satisfaction has a direct and indirect effect on learners' individual impact

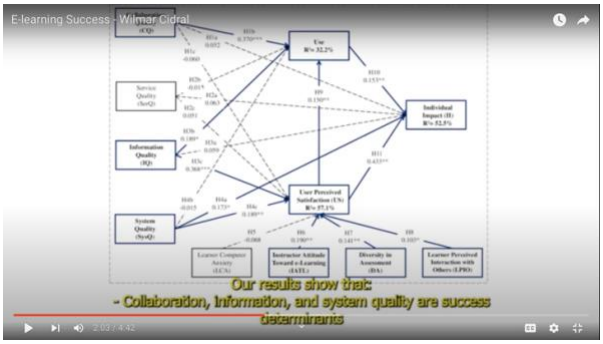
- Students' long-term orientation influences the positive relationship between e-learning systems' use and the perceived net benefits
- System and information quality, and e-learning systems use are determinants of e-learning user satisfaction
- Collaboration quality and information quality are determinants of e-learning systems usage

- Brazilian and Portuguese students evaluated the effect of system quality on use and service quality on e-learning use differently
- The cross-country comparison confirms that information quality and user satisfaction have similar behaviors. These lead to similarities regarding the individual impact and organizational impact in the success of e-learning

VIDEO ABSTRACT

www.sustentare.net/e-learning-success





PUBLICATIONS

Journal Articles

Cidral, W. A., Oliveira, T., Di Felice, M., & Aparicio, M. (2018). E-learning success determinants: Brazilian empirical study. Computers & Education, 122, 273–290. 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), e05735. https://doi.org/10.1016/j.heliyon.2020.e05735

Cidral, W., Oliveira, T. & Aparicio, M. (2021). Determinants of e-learning success: Cross-country comparison (Brazil *vs.* Portugal) (submitted to a top journal; under review).

Cidral, W., (2021). Meta study of main concepts of e-learning ecosystem (under review).

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Abbreviations & Acronyms

3-TUM	Three-tier Use Model
ACM	Association for Computing Machinery
ADDIE	Analysis, Design, Development, Implement, Evaluate
AHP	Analytic Hierarchy Process
AIS	Association for Information Systems
ALE	Artificial Learning Environments
AS-CSE	Application-Specific Computer Self-Efficacy
AU	Actual Usage
AVE	Average Variance Extracted
b-learning	Blended Learning
BI	Behavioral Intention
c-learning	Classroom Learning
c-MOOC	Connective MOOC
CA	Cronbach's Alpha
CAE	Computer Assisted Education
CAI	Computer Assisted Instruction
CAL	Computer Assisted Learning
CBE	Computer Based Education
CFL	Computer Facilitated Learning
CLO	Cultural Learning Objects
CMI	Computer Managed Instruction
CMS	Course Management System
COVID 19	Corona Virus Disease 2019

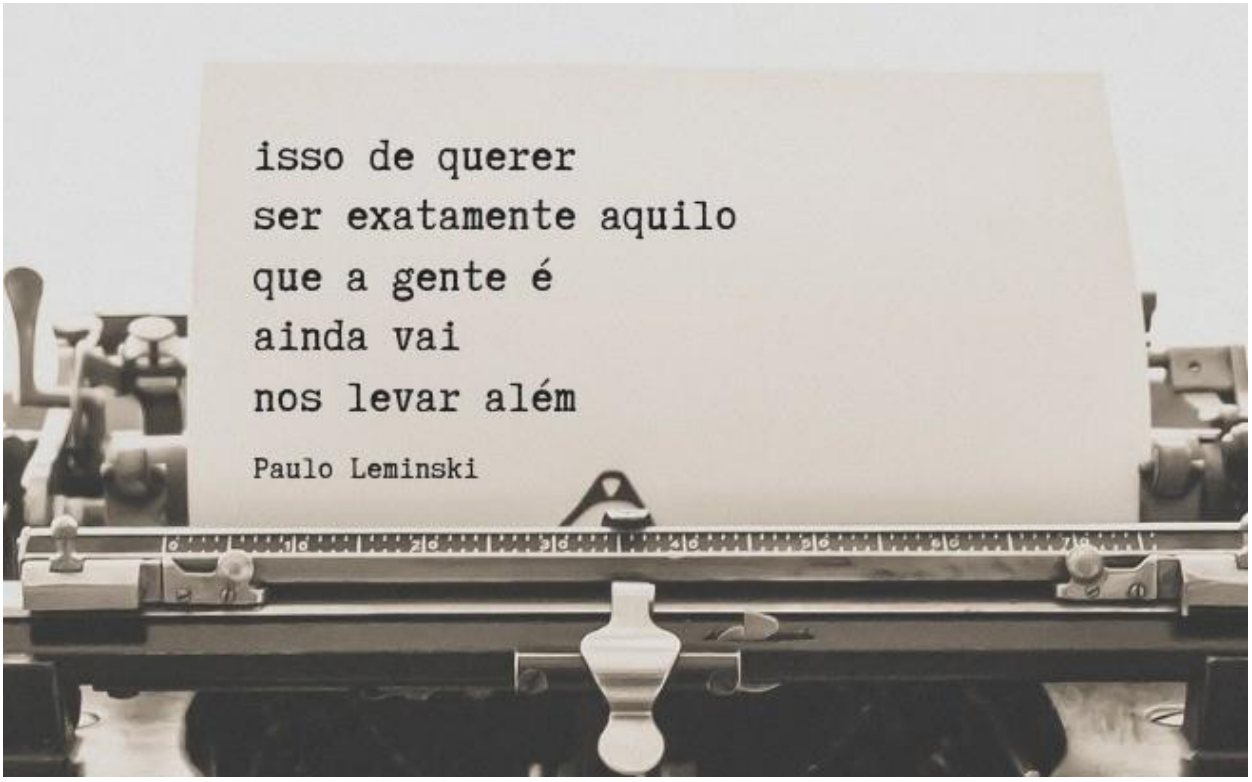
CP-ABE	Ciphertext-Policy Attribute-Based Encryption
CQ	Collaboration Quality
CR	Composite Reliability
CSCL	Computer Support for Collaborative Learning
CSF	Critical Success Factors
CWAM	Course Website Acceptance Model
d-learning	Distance Learning
D&M	DeLone & McLean
DA	Diversity Assessment
DEDT	Decomposed Expectancy Disconfirmation Theory
D&MM	DeLone & McLean Model
DOLE	Distance Object Learning and Evaluation
e-learning	Electronic Learning
EBSCO	Elton B. Stephens Company
ECM	Expectation-Confirmation Model
EDT	Expectancy Disconfirmation Theory
ElAM	E-learning Acceptance Measure
ETA	Educational Technology Acceptance
EUCS	End-User Computing Satisfaction
FC	Facilitating Conditions
GPA	General Academic Performance
HELAM	Hexagonal E-Learning Assessment Model
HPT	Human Performance Technology
HTMT	Heterotrait-Monotrait
IATL	Instructor Attitude Toward Learning

IBL	Internet Based Learning
IC	Individualism/Collectivism
ICT	Information Communication Technology
II	Individual Impact
ILM	Internet Based Learning Medium
IQ	Information Quality
IS	Information Systems
ISI Web of Science	Institute for Scientific Information Web of Science
ISSA	Information System Success Antecedents
ISS	Information System Success
IT	Information Theory
JAPELAS	Japanese Polite Expressions Learning Assisting System
JSTOR	Journal Storage
KM	Knowledge Management
KMS	Knowledge Management Systems
LCA	Learner Computer Anxiety
LCMS	Learning Content Management Systems
LMS	Learning Management Systems
LOOC	Little Open Online Course
LPIO	Learner Perceived Interaction with Others
LTO	Long-Term Orientation
m-learning	Mobile Learning
Mega	Mega University
MELSS	Model for Measuring E-Learning Systems Success
MF	Masculinity/Femininity

MIS	Management Information Systems
ML	Machine Learning
ML	Machine Learning
MLE	Maximum Likelihood Estimate
MOOC	Massive Open OnLine Course
NB	Net Benefits
NLP	Natural Language Processing
NPS	Net Promoter Score
OAL	Online Active Learning
on-learning	Online Learning
P2P	Peer-to-Peer
PD	Power Distance
PEOU	Perceived Ease of Use
PISA	Program for International Student Assessment
PLATO	Programmed Logic for Automatic Teaching Operations
PLS	Partial Least Square
PU	Perceived Usefulness
QWL	Quality of Work Life
REAL	Rich Environments for Active Learning
RFID	Radio-Frequency Identification
RO	Research Objectives
ROI	Return on Investment
SaaS	Software as a Service
SDL	Self-Directed Learning
SDT	Self Determination Theory

SE	Self-Efficacy
SEM	Structural Equation Modeling
SerQ	Service Quality
SN	Subjective Norms
SPOC	Small Private Online Course
SRE	Self-Regulatory Efficacy
STEM	Science, Technology, Engineering and Mathematics
STO	Short-Term Orientation
SULOM	Semantic-Oriented Ubiquitous Learning Object Model
SysQ	System Quality
TAM	Technology Acceptance Model
TANGO	Tag Added learNinG Objects
TPB	Theory of Planned Behavior
TRI	Technology Readiness Index
u-learning	Ubiquitous Learning
UA	Uncertainty Avoidance
UIUC	University of Illinois at Urbana-Champaign
ULE	Ubiquitous Learning Environments
ULO	Ubiquitous Learning Objects
US	User Satisfaction
UTAUT	Unified Theory of Acceptance and Use of Technology
VBT	Variance-Based Technique
VLE	Virtual Learning Environment
VSM	Value Survey Module
WBL	Web Based Learning

WBSI	Western Behavioral Sciences Institute
WebCT	Course Content Management System
WELS	Web-Based E-Learning System
WVS	World Value Survey
x-MOOC	MITx & EDx MOOC



[my translation]

by wanting to be exactly what we are, we will end up farther

Paulo Leminski

CHAPTER I . CONTEXTUALIZATION AND INTRODUCTION

1.1. Introduction

This chapter begins by overviewing the research question and main research goals. It also lays out the methodological approach, the publications and their relationship with the various research design phases.

1.1.2. Research context

This thesis is developed in the context of information management. It seeks to examine information systems and contribute to building the theory of e-learning success. This study proposes a theoretical framework and three models to be applied at an individual level. This research presents the main success factors upon which academy and corporations can base their decisions in the e-learning success contexts.

1.1.3. Motivation

Technological advancements in the area of training, development and information technology have revolutionized learning. The delivery of learning services in the web has experienced major changes over the last three decades. The ever-increasing spread of knowledge through internet-enabled phones, smartphones and tablets, which are increasingly multifunctional, slimmer and sophisticated, combined with fast, good quality and affordable communication networks, have encouraged universities, schools and training companies to develop and provide good quality e-learning content.

E-learning is a new educational paradigm. Besides the ongoing educational methodology development, the approaches to digitally shared knowledge and media is a new field of research. The content, the interfaces and the methodology aim to drive the student forward, otherwise human improvement is delayed. Based on the Information Success Model (DeLone & McLean, 1992, 2003; Urbach, Smolnik,

& Riempp, 2010), Theories of Information Systems' Satisfaction (Sun et al., 2008), and Confucian Dynamism Theory (Bearden,Money, & Nevins, 2006; Hofstede & Bond, 1988), the empirical studies evaluate e-learning success and find out if e-learning is successful in education.

In the World Economic Forum 2017, Thomas Frey (2017), said: *"I've been predicting that by 2030 the largest company on the internet is going to be an education-based company that we haven't heard of yet"*. The fact that education has e-learning as an exponential force is motivating.

The main motivational factors to do this research are presented as follows:

(1) Even though past literature has covered certain drivers of e-learning success, this has not been enough to explain the theme, indicating that new constructs or relationships should be explored, thus contributing to advancement in knowledge;

(2) Previous research on e-learning success based on cultural aspects analysis is rather limited. Studies that use cultural values can provide several new insights about how culture influences individual e-learning behavior;

(3) International studies on e-learning success between countries are scarce, leaving us with an interesting area for research. This is important for e-learning because the globalization of knowledge, life, business and information systems is followed by an increasing need to understand differences and similarities between customers in different cultural contexts; and

(4) This study may enable us to build models of e-learning success that integrate different theories.

1.1.4. Research focus

This study set out to understand the main drivers of a meta study of key concepts of e-learning, e-learning success & satisfaction, e-learning success & long-term orientation and cross-country e-learning success, as presented in Figure 1.1.

The research focuses on blending social science and learning with information systems (IS) theories. The multidisciplinary focus is because the e-learning process uses information communication technology (ICT) to deliver educational content.

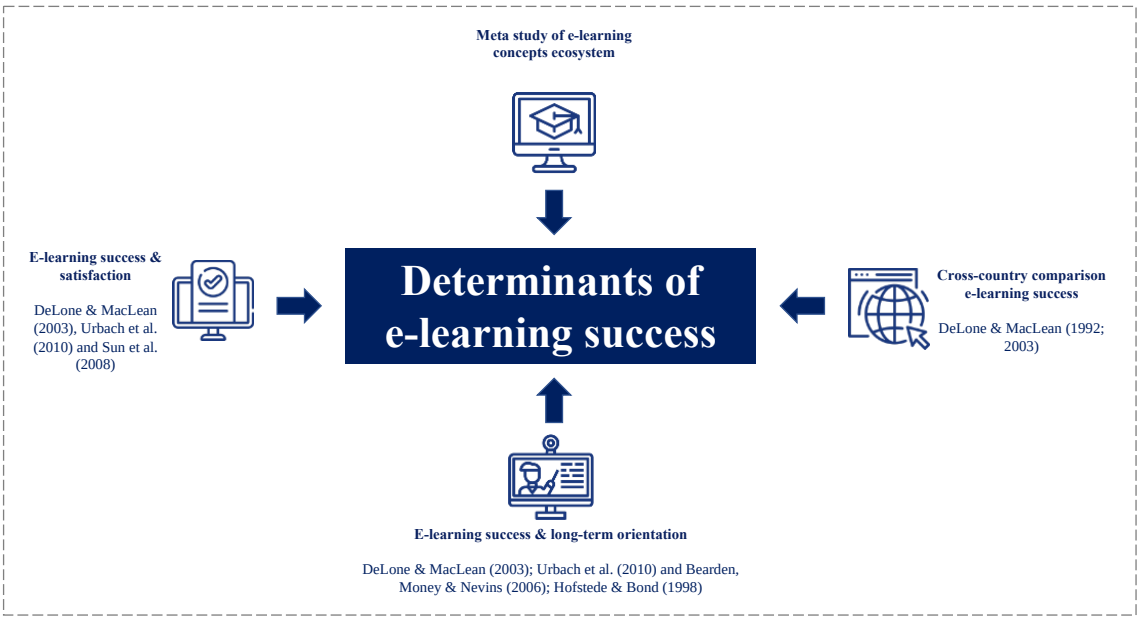


Figure 1.1 - Studies' determinants of e-learning success

In order to better understand e-learning success, it is important to study it in different contexts, samples, groups, countries and with different theoretical models, so as to identify relevant factors, to extend them, and to contribute to knowledge about e-learning. Therefore, four separate studies were developed, as presented in Figure 1.1.

The visual representation of the research on cross-country e-learning success can be seen in Figure 1.2; the bubbles are a proportional representation of the long-term orientation (LTO) for Brazil and Portugal.

Figure 1.2 - Comparison between Brazil and Portugal about Confucian Dynamism Theory (Bearden, Money, & Nevins, 2006; Hofstede & Bond, 1988)

In this thesis, the object of research is e-learning systems used at university level (undergraduate, graduate degree, master's degree, doctoral degree, and professional degree). The focus is to answer the following research question:

What factors lead people to succeed in e-learning?

1.1.5. Research objectives (RO)

In order to achieve a better understanding of the main drivers of e-learning success, as well as their satisfaction, cultural contexts and cross-country comparison, the research was carried out through different studies, presented in Chapters II, III, IV, and V.

The main goals of this thesis are first, to understand the success factors of e-learning; second, to build one "meta study of e-learning concepts ecosystem", and third, to build and validate three "empirical studies". The results of this thesis are intended to be shared at scientific computers science conferences and in journal articles. The research objectives (RO) of this thesis are guided by the following research issues:

(RO1) Identify the motivations that lead people to adopt e-learning systems;

(RO2) Identify the factors that lead to e-learning success;

(RO3) Identify the users' satisfaction level of e-learning systems;

(RO4) Identify the net benefits / success of e-learning systems;

(RO5) Develop three e-learning success models;

(RO6) Compare and contrast cross-country e-learning success, between Brazil and Portugal;

(RO7) Validate the theoretical models; and

(RO8) Publish the results.

Table 1.1 shows the relationship between research objectives and the articles (research studies).

Table 1.1 - Research objectives (RO) *vs* articles (research studies)

	Article 1 **Chapter II**	**Article 2** **Chapter III**	**Article 3** **Chapter IV**	**Article 4** **Chapter V**
Study **Context**	Meta study	Information Success Model (DeLone & McLean, 2003; Urbach et al., 2010) + Theory of Information Systems' Satisfaction (Sun et al., 2008)	Information Success Model (DeLone & McLean, 2003; Urbach et al., 2010) + Confucian Dynamism Theory: (Bearden, Money, & Nevins, 2006; Hofstede & Bond, 1988)	Information Success Model (DeLone & McLean, 1992; 2003
	main concepts of e-learning ecosystem	e-learning success and satisfaction	e-learning success and long-term orientation	e-learning success cross-coutry comparison between Brazil and Portugal
RO1	√	√	√	√
RO2	√	√	√	√
RO3		√		
RO4		√	√	√
RO5		√	√	√
RO6				√
RO7		√	√	√
RO8	√	√	√	√

1.2. Methodological approach

There are several approaches to describing and understanding the real world. It is the role of the researcher to choose the lens through which he or she sees this reality. The choice of lens brings about different results and understandings. This way of viewing the world is called epistemology, i.e, the science of knowledge. Smith (2006) claims that despite the existence of a broad range of paradigms, positivism and interpretivism are the dominant epistemological ones in information systems research. In behavioral information systems research the positivist paradigm is the one mainly employed (Orlikowski & Baroudi, 1991).

In view of the claims of Smith (2006) and Orlikowski & Baroudi (1991) above, this study will employ the positivist paradigm, because the research has a controlled and structural approach, identifies a clear research topic, constructs appropriate hypotheses and adopts a suitable research methodology (Carson et al., 2001).

This research addresses e-learning success through the use of cross-sectional surveys and correlates the score of all independent determinants. This study also used survey instruments to collect and analyze data on e-learning systems use, satisfaction, culture and success. The following section will explore the methodological procedure in more detail.

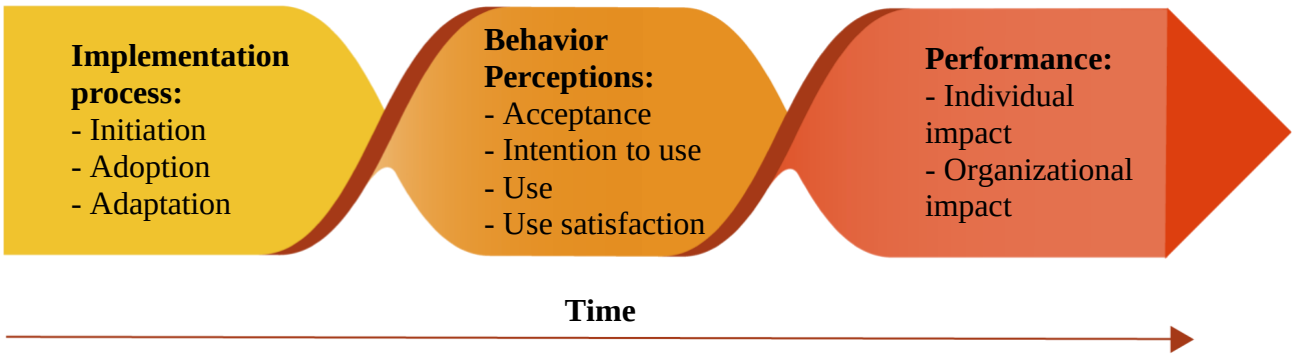


Figure 1.3 - Dependent variables in ISSA research (Larsen, 2003)

Larsen (2003) conceptualized IS success antecedents (ISSA), and carried out extensive studies on information system success variables of various models (Figure 1.3). The dependent variables tended to cluster around a relatively small set of variables.

Table 1.2 - Methodological approach

Objective	Method	Instruments
Understand the main concepts of e-learning ecosystem	Literature review	Scientific papers & articles
Understand the main concepts of e-learning ecosystem trends	Bibliometric study	Scientific digital libraries search engines
View the relation among words of main concepts of e-learning ecosystem	N-gram language models	Bi-gram (N=2) analizes
Identify the factors that lead learners to e-learning success	Literature review on e-learning studies	Scientific papers & articles
Identify the users' satisfaction factors on e-learning systems	Literature review on e-learning studies	
Identify the net benefits of e-learning systems	Literature review on e-learning studies & on information systems success	
Construct theoretical e-learning success models	Literature review	
- Test hypotheses - Test successful e-learning models	Structural equation modeling (SEM) using partial least squares (PLS)	Questionnaires & statistical software for equation modeling (SmartPLS)

Finally, for "meta study of e-learning concepts ecosystem" we used literature review, bibliometric study, and N-gram analysis. For the three empirical studies we used literature review and SEM Partial Least Squares (PLS) to validate the results and draw conclusions. This technique was chosen because: (1) it allowed us to test the research model with many latent variables; (2) the research type is correlational; and (3) there is no data distribution assumption (Ringle, Wende, & Becker, 2015); see Table 1.2.

1.2.1. Theoretical framework

The overall structure of this thesis takes the form of six chapters. Chapter I is Contextualization and Introduction. Chapter II presents the meta study of main concepts of e-learning ecosystem. Chapter III

presents the Information System Success Theory (DeLone & McLean, 2003; Urbach et al., 2010), and Theories of Information Systems' Satisfaction Model (Sun et al., 2008). In Chapter IV, the study presents the D&M IS Success Model (DeLone & McLean, 2003; Urbach et al., 2010), combined with Confucian Dynamism Theory (Bearden, Money, & Nevins, 2006; Hofstede & Bond, 1988). In Chapter V, the study presents the D&M IS Success Model (DeLone & McLean, 1992; 2003) comparing countries. These models are used as the theoretical framework of the research, and were tested using structural equation modeling (SEM), namely using variance-based techniques, i.e., partial least square (PLS). Figure 1.4 shows the overall research model of empirical studies on the success of e-learning. Following Anderson & Gerbing (1988) guidelines, our analysis was done in two different steps: (1) reliability and validity assessment of the measurement model, and (2) structural model assessment and hypotheses testing. Chapter VI is Conclusion.

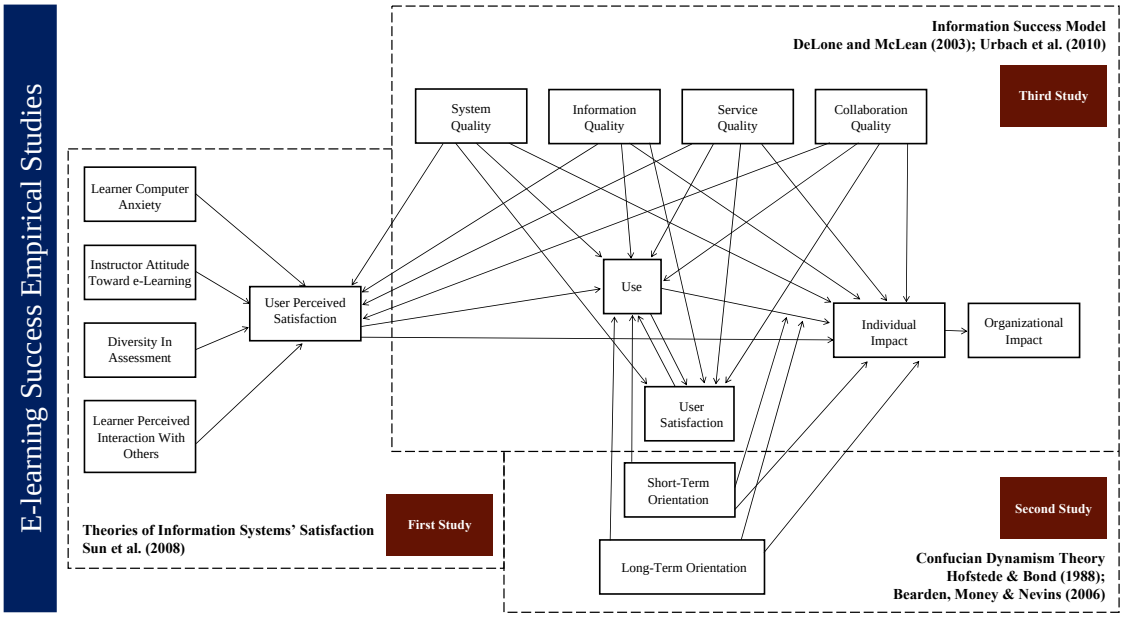


Figure 1.4 - Overall research model of empirical studies

1.2.2. Quantitative research methods

Regarding quantitative research methods, the research used a cross-sectional online survey design to assess the main determinants of e-learning success. Data collection was conducted by targeting local

adult population that studied or used e-learning in universities. To narrow down the field of study, the study addressed only higher education institutions, such as colleges, universities, and university centers, either public or private. To minimize bias and obtain respondents, it was emphasized that all the data would be treated with total confidentiality and that the identity of the respondent could not be inferred. Students' responses included both the classroom mode with e-learning as support (blended learning) and 100% e-learning.

1.3. Path of research

This study is a collection of separate studies of interrelated subjects, namely e-learning success, cross-country comparison, cultural e-learning success. These are reported in separate chapters. The current stage of each one and path design of the studies is presented in Figure 1.5, as follows.

Thesis Structure			Publication	Authors	Year	Publisher
Chapter I		-Introduction -Research Problem -Objectives		Cidral	2014 to 2016	
Chapter II	Literatrure review	-Literature review -Bibliometric studie -N-gram analysis	Meta study of main concepts of e-learning ecosystem	Cidral	n.a.	Study in peer review (third round)
Chapter III	Literatrure review	-Identification of factors of e-learning success -Models constructions and validation in e-learning context -E-learning success in system, cultural and cross country context	E-learning success determinants: Brazilian empirical study	Cidral, Oliveira, Aparício & Di Felice	2018	Computers & Educations
Chapter IV	Literatrure review	Empirical studies	Students' long-term orientation role in e-learning success: A Brazilian study	Cidral, Oliveira & Aparício	2020	Heliyon
Chapter V	Literatrure review	Empirical studies	Determinants of e-learning success: Cross-country comparison (Brazil *vs* Portugal)	Cidral, Oliveira & Aparício	n.a.	Study in peer review
Chapter VI		Conclusions: main findings, limitations and future studies				
Appendixes		Empirical studies, additional data, and summary studies of e-learning success				

Figure 1.5 - Thesis structure and publications

This study will conclude with the presentation of the major conclusions of the research studies, according to what is presented in Chapters II, III, IV, V and VI. The articles from Chapters III and IV were accepted for publication by international journal with a blind review process.

1.4. Thesis structure

This thesis is structured in six chapters as illustrated in Figure 1.5. Chapter I is a contextualization and introduction. It presents the research context, motivation, research focus, research objectives, methodological approach, theoretical framework, quantitative research methods, path of research and thesis structure. Chapter II introduces the meta study of main concepts of e-learning ecosystem with literature review, bibliometric study on the e-learning systems related concepts, and N-gram analysis of e-learning concepts ecosystem. Chapter III presents a theoretical model of e-learning systems success. This model includes the impact of the user perceived satisfaction on the individual perception of success. This model was validated empirically, and the results are presented. In Chapter IV we present a success model for e-learning, considering a cultural approach - the long-term orientation as a success factor. This model was validated through an empirical study. Chapter V presents a success model with cross-country comparison. This model was validated empirically, and the results are presented. Chapter VI presents the conclusions, the main findings of the studies, limitations and future studies.

CHAPTER II . META STUDY OF MAIN CONCEPTS OF E-LEARNING ECOSYSTEM

E-learning systems currently play an important role in our society. They facilitate the connection that instructors have with students in the teaching process. Moreover, they enable more learners to access wider knowledge. The methodological design of the meta study was carried out through three approaches: (1) literature review, to understand the main concepts of e-learning ecosystem; (2) bibliometric study, to understand the main concepts of e-learning ecosystem trends; and (3) N-gram language models, to view the relation among words of main concepts of e-learning ecosystem. In this paper, we present the terms e-learning (electronic learning), m-learning (mobile learning), on-learning (online learning), b-learning (blended learning), u-learning (ubiquitous learning), and d-learning (distance learning) related concepts and report their development over time. We also present a systematic evolutionary search through various scientific digital libraries, and Google Trends and compare the results. We synthesize the main concepts of e-learning ecosystem definitions to provide a contribution to their understanding.

2.1. Introduction

Technological advancements in the areas of training, development and information technology have revolutionized learning. The delivery of learning services through the web has changed dramatically over the last three decades. Internet-enabled phones, smart phones and tablets are increasingly multifunctional, slimmer and sophisticated and operate on fast, reliable and affordable communication networks. This has encouraged universities, schools and training companies to develop and provide good e-learning content.

E-learning is a new educational paradigm. Besides the ongoing development of traditional educational methodologies, research now explores ways through which knowledge and education can be digitally transmitted. The educational content, the interface that the student interacts with, and the educational methodology all encourage the student to learn more effectively.

In research and literature, we observed an overlap of concepts, such as e-learning (electronic) and on-learning (online), among other related terms. This article aims, first, to re-evaluate the e-learning concepts ecosystem. Second, to contribute to the understanding of the most common terms, with a

wide review of concepts. And finally, based on the review, to propose a concept synthesis of the main terms of e-learning ecosystem.

This chapter is structured in five sections: the first section presents the introduction. The second one presents a methodological design of the meta study. The third one presents the e-learning concepts ecosystem. The fourth section is a discussion of e-learning concepts ecosystem and suggestion of new focus, bibliometric study results, and N-gram results. Conclusions of e-learning concepts ecosystem, make up the last section.

2.2. Methodological design of the meta study

We structured the methodological design of the meta-study in three approaches: (1) literature review, to identify the most relevant articles and concepts; (2) bibliometric study, to signal trends; and (3) N-gram language models, analyze the relationships between two words at a time for each of the main e-learning concepts ecosystem.

2.2.1. Literature review of current status of e-learning concepts ecosystem

A literature review ensures that a relatively comprehensive census of relevant literature is accumulated (Webster & Watson, 2002). We based our review on Urbach, Smolnik, & Riempp's (2009) approach and it consisted of three steps: (1) selection of literature sources, (2) definition of a time frame for analysis, and (3) selection of articles to be reviewed.

The first step was to choose the literature sources. We considered the most important academic publications. These included Science Direct, ISI Web of Science, Association for Computing Machinery (ACM) Digital Library, Scopus, Emerald, Springer, Taylor & Francis, Elton B. Stephens Company (EBSCO) and Journal Store (JSTOR), among others. For the second step, we defined the

period from 1960 to 2019. Finally, we limited the choice of selected studies to those appropriate for our study. The literature review organized the e-learning systems studies of several authors.

We selected the following key words related to the success of e-learning: "e-learning", "success", "on-learning", based on previous research (Cidral, Oliveira, Di Felice, & Aparicio, 2018). After that, the key words used in the search were selected based on the DeLone & McLean Information System Model (D&M) (DeLone & McLean, 1992; 2003): "information quality", "system quality", "service quality", "use", "user satisfaction", "individual impact", "organizational impact", "net benefits", and from Urbach, Smolnik, & Riempp (2010): "collaboration quality". Table 2.1 contains the key words and authors.

Table 2.1 - Key words researched

Key words	Source
"e-learning"	Cidral, Oliveira, Di Felice, & Aparicio (2018)
"success"	
"on-learning"	
"information quality"	DeLone & McLean (1992; 2003)
"system quality"	
"service quality"	
"use"	
"user satisfaction"	
"individual impact"	
"organizational impact"	
"net benefits"	
"collaboration quality"	Urbach, Smolnik, & Riempp (2010)

As Hart (2009, p. 28) says *"reviewing the work of others you will be able to identify the methodological assumptions and the research strategies"*. Reviewing studies from different authors, but about the

same subject, allows researchers to know methodological views and tools that can be adapted to other situations.

Based on the literature review, and research analysis as in "Trends in the E-Learning Ecosystem: The Bibliometric Study" (Aparicio, Bacao, & Oliveira, 2014b), and "An e-Learning Theoretical Framework" (Aparicio, Bacao, & Oliveira, 2016a), an opportunity to deepen the study was identified, as there was overlapping of certain concepts related to "online learning" and "electronic learning", such as "mobile learning", "blended learning", and "distance learning" (see Table 2.2). As for the "ubiquitous learning" concept, we are based on Weiser (1991).

Table 2.2 - Correlated concepts of e-learning ecosystem

Acronym	Concept	Search terms	Source
e-learning	Electronic Learning	"e-learning" OR "Electronic Learning"	Aparicio, Bacao, & Oliveira (2014b) Aparicio, Bacao, & Oliveira, (2016)
m-learning	Mobile Learning	"m-learning" OR "Mobile Learning"	
on-learning	Online Learning	"on-learning" OR "Online Learning"	
b-learning	Blended Learning	"b-learning" OR "Blended Learning"	
d-learning	Distance Learning	"d-learning" OR "Distance Learning"	
u-learning	Ubiquitous Learning	"u-learning" OR "Ubiquitous Learning"	Weiser (1991)

Therefore, literature reviews, whether holistic or systematic can provide researchers with guides to building knowledge. Conference proceedings, dissertations, thesis and journal articles were also included in order to address bias towards higher effect sizes normally associated with published journal articles (Rosenthal, 1979). This enabled a deeper analysis of concepts and terms, as well as building the timeline of the main concepts of e-learning (see Figure 2.1).

2.2.2. Bibliometric study with digital libraries

We conducted a bibliometric study, which is a quantitative method used to find trends in publications, in those issued from January 1960 to December 2019. Following bibliometric studies guidelines from Pritchard (1969), five digital libraries were selected (3 meta-search engines in research and 2 information systems associations):

(1) ISI Web of Science (Thomas Reuters, 2015);

(2) Google Scholar (Google, 2015);

(3) ACM DL (Association for Computing Machinery - ACM Digital Library, 2015);

(4) Scopus/Science Direct/Elsevier (Elsevier, 2015); and

(5) AISeL (Association for Information Systems Research - AIS eLibrary, 2015).

Table 2.2 contains the list of correlated concepts of e-learning and exact search terms. For each term, we used a double quotation operator. For the concept of e-learning, we used the notation “electronic learning” or “e-learning”. We used both terms because we observed that results were different when we used only “electronic learning” from the literature review of the concepts. We noticed that authors tended to use only “e-learning” without referring to it as an abbreviation of “electronic learning”. We performed the searches within 5-year intervals, from 1960 until 2019 and grouped the data in these 5-year intervals: 1960-1964; 1965-1969; 1970-1974; 1975-1979; 1980-1984; 1985-1989; 1990-1994; 1995-1999; 2000-2004; 2005-2009, 2010-2014, and 2015-2019.

2.2.3. Bibliometric study with Google trends

In the studies of about ten years of research change using Google Trends, Jun, Yoo, & Choi (2018) affirm it is a new source of big data and reveals that Google Trends is used to analyze various variables in a wide range of areas, including IT, communications, medicine, health, business, and economics.

The research had a custom time range from January 2004 to January 2021. The most relevant terms of the bibliometric study with digital libraries were “online learning” and “e-learning”, and these two terms were defined for the research with Google Trends (Google, 2021). We did simulations of the best terminology to be researched, such as on-learning, on learning (without a hyphen), onlinelearning (words without space), e learning (without a hyphen), electronic learning, elearning (words without space), and the terms “online learning” and “e-learning” obtained the best quantitative searches.

As parameterization of the simulations, we chose "worldwide", "all categories", and "web search". We did a simulation with "top" and "rising" to expand the analysis in "related queries".

2.2.4. N-gram analysis

This subsection shows the relations among words of each learning type described in the previous section using a technique called N-gram, describing the most frequent words co-occurrences. N-gram is a natural language processing (NLP) tool that allows the visualization of the relation among words in a text database. In this study, we used a bi-gram chart applied to the texts from Tables 2.4 to 2.9.

As in several NLP techniques, we needed to filter the texts, which means excluding stopwords and applying other procedures. According Jurafsky & Martin (2008) the steps used on the code to filter the text before the N-gram analysis were: (1) to change all texts to lower case; and (2) to remove special characters, numbers and stopwords. The bigram model, for example, approximates the probability of a word given to all the previous words by using only the conditional probability of the preceding word.

This analysis is an intuitive way of estimating probabilities, called the maximum likelihood estimate (MLE).

The N-gram analysis was coded in R language (R Core Team, 2019) and is available on GitLab as a public project (https://gitlab.com/academico/n-gram-e-learning) developed by Prates & Cidral (2019).

2.3. E-learning concepts ecosystem analysis

E-learning provides people with a flexible and personalized way to learn; it allows learning on demand and reduces the overall cost of learning to both the student and the institution. A series of core technologies that can facilitate the design and implementation of e-learning systems is emerging, which is expanding its impact on learning rapidly.

E-learning related concepts have already been extensively studied by Aparicio, Bacao, & Oliveira (2014b). These concepts include computer assisted instruction (CAI), computer-based education (CBE), computer assisted learning (CAL), learning management systems (LMS), computer managed instruction (CMI), computer assisted education (CAE), artificial learning environments (ALE), self-regulatory efficacy (SRE), computer support for collaborative learning (CSCL), rich environments for active learning (REAL), Mega (Mega-University), computer facilitated learning (CFL), learning content management systems (LCMS), massive open online course (MOOC), connective MOOC (c-MOOC), self-directed learning (SDL), internet-based learning medium (ILM), MITx & EDx MOOC (x-MOOC), little open online course (LOOC), and small private online course (SPOC), among others.

As e-learning is an evolving concept, and to understand how it evolves, we studied the historical development of the various types of e-learning modes. Figure 2.1 shows a timeline of the main e-learning concepts ecosystem. The timeline of the concepts was ordered according to the first date it appeared in a publication.

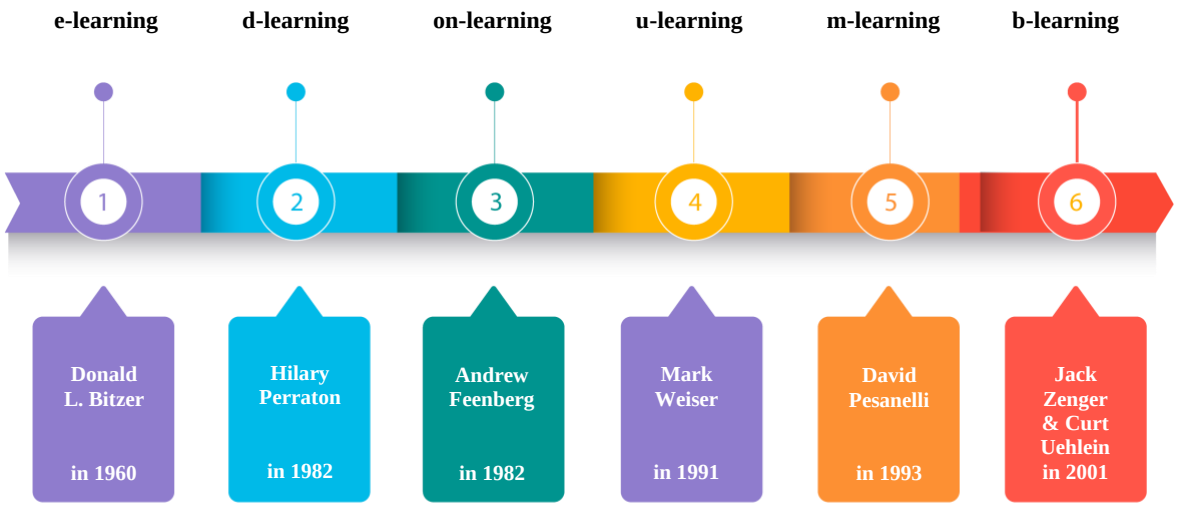


Figure 2.1 - E-learning ecosystem related timeline concepts

2.3.1. Literature review of broad concepts of e-learning ecosystem

The review sampled the most relevant articles by key word combination on each platform. The abstracts from those papers were read and the studies that were not relevant were excluded. During the reading, we also included articles that contained literature reviews. The search resulted in a total of 65 articles. Upon reading these articles, new insights and correlation appeared, and other papers were included.

In Tables 2.3, 2.4, 2.5, 2.6, 2.7, and 2.8, we identify the main contributors to each of the e-learning concepts ecosystem. As stated in the methodology, in order to carry out the N-gram analysis, we transcribed the broad concepts of the terms as they appear in the respective articles.

We also investigated the authors who coined the terms or the first proposed concept about e-learning (electronic learning), m-learning (mobile learning), on-learning (online learning), b-learning (blended learning), u-learning (ubiquitous learning) and d-learning (distance learning).

Table 2.3 - Broad concepts of term electronic learning

Broad concepts of term e-learning	Authors
PLATO (Programmed Logic for Automatic Teaching Operations), computer based education system created in 1960 by Donald L. Bitzer at the University of Illinois at Urbana-Champaign (UIUC). In addition to being used successfully as a teaching tool, PLATO also spawned one of the first successful online communities. In many ways, PLATO's development foreshadowed the internet	Donald L. Bitzer in 1960 *apud* Jones (2015)
. E-learning concept refers to learning via electronic sources, providing interactive distance learning . Use of a web system as a way to access information available, disregarding time and space	White (1983) Morri (1997) Dorai, Kermani, & Stewart (2001) Rosenberg (2000) Piccoli, Ahmad, & Ives (2001)
. Environments do not support interactions in the same way they occur face-to-face . Three types of affordances (e.g., technological, educational and social) are central to design . Different stakeholders of a learning process take different roles depending on the context of learning, which can be partly electronic and partly physical	Kirschner, Strijbos, Kreijns, & Beers (2004)
. The promises and realities of e-learning (e.g., promise: e-learning is a powerful way for people to learn vs reality: as many as half of potential e-learners never show up) . Pointed out the framework for making organization change (implementation of e-learning context)	Cross & Dublin (2002)
. Different stakeholders of a learning process take different roles depending on the context of learning . Worlds can be partly electronic and partly physical, living worlds, inherited worlds . Allow learners to identify the resources needed and allow content experts to update them . Learning goals exist at different levels: - Atomic (order of magnitude 1 minute) - Mini courses (order of magnitude 10 minutes) - Chapter (order of magnitude 100 minutes) - Course (order of magnitude 50 hours)	Rogier, Uras, & van der Veer (2013)
. Application of computer aided collaborative learning model in virtual electronic teaching	Wu (2018)

Table 2.4 - Correlated broad concepts of term mobile learning

Broad concepts of term m-learning	Authors
With a futuristic (21st century) approach, it described how new technologies make it possible for learning to take place anywhere focusing on the concept of a modular plug-in school	Pesanelli (1993)
The cyber mobile, a technology platform combining personal computing, CD-ROMs, fiber network, and wireless access to the internet, may be the next step in mobile library services	Drumm & Groom (1997)
. Design of personal mobile technologies for lifelong learning . Framework for the design of a new genre of educational technology - personal (handheld or wearable) computer systems that support learning from any location throughout a lifetime . Tools for lifelong learning (memory aids, concept and topic maps, case archives and communication devices) that are: (1) highly portable, (2) individual, (3) unobtrusive, (4) available, (5) adaptable, (6) persistent, (7) useful, and (8) intuitive . Pointed the requirements for the software, hardware, communications and interface design of a handheld learning resource, or HandLeR	Sharples (2000)
. One of the first studies, it analyzed how mobile wireless technologies will change web-based instruction and training . Innovative projects at the University of North Carolina at Wilmington, increasing the use of portable handheld computers with wireless internet access to improve teaching and learning	Shotsberger & Vetter (2000; 2001)
. Summarizes a theory of mobile learning that must be tested against the following criteria: - Is it significantly different from current theories of classroom, workplace or lifelong learning? - Does it account for the mobility of learners? - Does it cover both formal and informal learning? - Does it theorize learning as a constructive and social process? - Does it analyze learning as a personal and situated activity mediated by technology? . Framework proposal for analyzing mobile learning - Subject Technological (technologic user) – Semiotic (learner) - Technological Tool (mobile learning technology) – Semiotic Tool (learn - space) - Control Technological Tool (human-computer interaction) – Semiotic (social rules) - Context Technological (physical context) – Semiotic (community) - Object Technological (access to information) – Semiotic (knowledge and skills) - Communication Technological (communication channels and protocols) – Semiotic (conversation and division of labor) - Changed object (revised knowledge and skills)	Sharples, Taylor, & Vavoula (2005)
. M-learning is a recent field of research combining e-learning and mobile computing . Four essential characteristics (devices, mobility, context and location)	Meyer, Chalon, & David (2006)

Broad concepts of term m-learning	Authors
The authors make a distinction between designed activity, carefully crafted in advance, and user-generated activity arising from learners' own spontaneous requirements	Kukulska-Hulme, Traxler, & Pettit (2007)
. As an extension of e-learning where the focus is on the use of mobile devices . Change of mindset when designing and planning learning environments and goals . Communication facilities at any time or location and the provision of learning content dynamically dependent on the learner's location, context and device	Matthee & Liebenberg (2008)
. Four requirements for a general framework for mobile learning: (1) generic mobile environment issues, (2) mobile learning contexts, (3) learning experience, and (4) learning objectives	Liu et al. (2008)
. Basic concepts and technology issues: - Asynchronous and web-based learning - Synchronous and real-time distance learning - Mobile learning and situated learning - Multimodal interaction and augmented devices for learning - Content management system and repository . Guidelines for developing m-learning contents: - target user group, - user, -interface design, - limited media selection, - performance and hardware . Future directions: ubiquitous learning, web 2.0, security challenges on the internet, structuring shared content and repositories, peer-to-peer (P2P) and online learning community, applying structure while creating content, and distance learning on grid	Q. Li, Lau, Shih, & Li (2008)
. The rapid development of mobile communication and mobile devices offers the opportunity to develop mobile learning systems that are able to assist us in our daily lives or professional situations . Environment and context are central in determining learning objective and learning content . Advantages for individual or professional lives, such as speed, efficiency, mobility and low cost . Any kind of learning where the learner is not at a static or fixed location, or when the learner takes advantage of mobile technologies	Yin, David, & Chalon (2009)
. Proposed mobile learning framework is designed based on four perspectives: (1) theories of learning, (2) generic mobile environment issues, (3) mobile learning context, (4) learning experience and objectives . Mobile devices combine the features of traditional telephone, text messaging, a diary, wireless internet connection and certain telephones come with personal computer capabilities . Designing content for e-learning differs from designing content for mobile learning. This may be due to many factors which include the physical factor . When a learner learns a learning item in the classroom, they will then take the new knowledge with them outside the classroom. Once	Nordin, Embi, & Yunus (2010)

Broad concepts of term m-learning	Authors
outside, informal discussions might take place with fellow learners that require the knowledge to be revisited and reflected on . Takes place anytime and anywhere . Opportunities for educationalists to provide formal content that can be learnt in informal surroundings . Mobile learning must also consider the use of ubiquitous technology and how the learning community is responding to it	
. It is an extension of distance education, supported by mobile devices equipped with wireless technologies . It offers content, methods, and technologies that reduce the limitations of traditional education . It aims to integrate mobile technology and services into various areas of teaching and learning and thus promote meaningful interactions with information . New learning environment due to the emergence of mobile and wireless technologies . Delivering learning objects into users' daily lives . New interactive and dynamic content must be produced	Pereira & Rodrigues (2013)
Mobile learning is a learning process based on mobile device use that allows knowledge acquisition in an interactive and collaborative way	Díez-Echavarría, Valencia, & Cadavid (2018)

Table 2.5 - Correlated broad concepts of term online learning

Broad concepts of term on-learning	Authors
. One of the earliest educational experiments in international networking. In 1982 the La Jolla, California based Western Behavioral Sciences Institute (WBSI) opened the first educational program employing the computer as the primary means of delivery, Feenberg (1993)	Andrew Feenberg in 1982 *apud* Feenberg (1993; 1999)
. Online learning is also any class that offers its entire curriculum in the online course delivery mode, thereby allowing students to participate regardless of geographic location, time and place . It talks about the role of the instructor that can be altered to become more akin to a facilitator than a lecturer, while the role of students can be altered by allowing them to become active learners	Richardson & Swan (2003)
. Online students gave less positive self-assessments of their perceived content mastery than their campus-based counterparts, despite performing just as well in both summative and formative assignments . A learning experience in which all aspects of teaching and learning, from course delivery to student group work and assessment, are carried out within a web-based medium	Mgutshini (2013)
. The points of taxonomy of the asynchronous online discussion forums are participation, major interaction, participation assessment, lecture engagement, message quantity, time-to-live topic, receiving feedback, learning and activity . Classification of online discussion forum: auxiliary discussion forum, hybrid discussion forum and embedded discussion forum	Abawajy & Kim (2011)
. The study shows that online learning self-efficacy is multidimensional . Online learning self-efficacy is explained with five dimensions: (a) self-efficacy to complete an online course, (b) self-efficacy to interact socially with classmates, (c) self-efficacy to handle tools in a course management system (CMS), (d) self-efficacy to interact with instructors in an online course, and (e) self-efficacy to interact with classmates for academic purposes . Gender, number of online courses taken, and academic status predict self-efficacy . Online learning self-efficacy explains learning satisfaction	Shen, Cho, Tsai, & Marra (2013)
Proposed a framework of active forecasters, which attempts to extend two fully supervised forecasters, exponentially weighed average forecaster and greedy forecaster, to tackle the task of online active learning (OAL) with expert advice	Hao, Hu, Zhao, Hoi, & Miao (2018)

Table 2.6 - Correlated broad concepts of term blended learning

Broad concepts of term b-learning	Authors
Blended learning is a fully integrated instructional design that offers maximum flexibility and variety, in which each employee method contributes its best	Zenger & Uehlein (2001)
It provides an overview about requirements, opportunities, and challenges for distance education technology and hybrid of online and in-class sessions	DeLacey & Leonard (2002)
Blended learning is a technology that is an emerging trend in education context based on online (asynchronous and or synchronous) education technology with face-to-face learning	Young (2002)
. Common types of blended environments: (1) online and face-to-face learning activities, (2) online and face-to-face students, and (3) online and face-to-face instructors . Six goals that educators might espouse as they design blended environments: (1) pedagogical richness, (2) access to knowledge, (3) social interaction, (4) personal agency, (5) cost effectiveness, and (6) ease of revision	Osguthorpe & Graham (2003)
. Blended learning is the combination of different training "media" (technologies, activities, and types of events) to create an optimum training program for a specific audience . The term "blended" means that traditional instructor-led training is being supplemented with other electronic formats; blended learning programs use many different forms of e-learning, perhaps complemented with instructor-led training and other live formats . Differentiated instruction is the provision of content according to the students' learning styles (visual, audio, and kinesthetic), knowledge level, interests, abilities and skills	Bersin (2004)
Blended learning is an effective and low-risk strategy which positions universities for the onslaught of technological developments that will be forthcoming in the next few years	Garrison & Kanuka (2004)
Blended learning involves a planned combination of approaches, such as coaching, attending a course, lunch with colleagues, reading on the beach, referral to a handbook, relationships with classmates, attending seminars, workshops and online communities	Rossett & Schafer (2007)
Reduces face-to-face instruction by incorporating rich, online learning experiences	Garrison & Vaugham (2008)
. The design of multimedia blended learning should emphasize the cultural learning objects (CLO) . Blended learning is considered as the blend of various modes of learning processes that primarily integrate the benefits of online learning and classroom learning (c-learning)	AL-Hun & Al-Sharhan (2009)
. In the last 50 years, fueled by innovations in computers and microchips, several new learning technologies which were initially hyped as revolutions in learning have been introduced: computer-assisted instruction (1960s), interactive video disc (1970s), computer-based training, interactive multimedia (1980s), web-based training,	Dublin (2011)

Broad concepts of term b-learning	Authors
synchronous and asynchronous e-learning (1990s), and learning 2.0 (2000-plus) . It appointed the system-based approach, I3 Change implementation model: (1) Cognitive (inform, awareness), (2) Behavioral (involve, engagement), and (3) Reinforcement (integrate, commitment) . It combined instructional design, ADDIE (analysis, design, development, implement, evaluate) and performance improvement methodologies, HPT (human performance technology)	
. It provided the blended learning environment for the students by making use of the cloud services technology in the e-learning system . The blended e-learning architecture: (1) collaborative leaning, (2) discovery learning, and (3) active learning	Selvi & Perumal (2012)
. The conceptual framework access resources: technology (physical and practical), personal agency, contextual (social and institutional), and digital content . The digital divide was interpreted as: (1) a gap in access to use of ICTs, (2) a gap in the ability to use ICTs, (3) a gap in actual use, and (4) a gap in the impact of use . Data from this study have confirmed that mobile technology has the potential to support blended learning beyond classrooms and computer centers	Mayisela (2013)
. It combines the traditional face-to-face learning and e-learning . The traditional blended learning presents face-to-face teaching and internet-based learning as two different processes that never happen simultaneously . When defining the blended assessment model, the authors took into consideration the main steps: documentation phase, hands-on activities, simulation processes, applications, tuition, testing, review and adjustments	Porumb et al. (2013)
. Flipped and blended classroom are practical and flexible study environments . The study found out that: (1) the call for explanation is an apt conceptualization for supporting independent work, and in particular for the design of learning materials; (2) use of student selected groups that can be flexibly resized or even disbanded enables spontaneous peer support and can avoid frustration about group work; and (3) students greatly appreciate the high degree of flexibility in the course arrangements but find that it causes them to slip from their goals	Isomöttönen & Tirronen (2016)

Table 2.7 - Correlated broad concepts of term ubiquitous learning

Broad concepts of term u-learning	Authors
First proposed ubiquitous computing	Weiser (1991)
. The concept of ubiquitous learning is booming through the introduction of ubiquitous computing in education	Weiser (1993) Weiser, Gold, & Brown (1999)

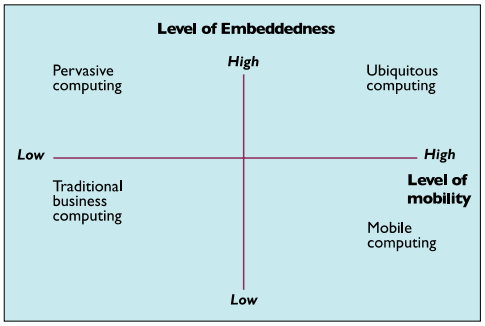
Broad concepts of term u-learning	Authors
. As technology becomes more embedded and integrated with mobility, the barriers between social and technical aspects become mixed; a paradoxical outcome of ubiquitous computing is that it is simultaneously very personal and extremely global . It pointed out that u-learning has a high level of embeddedness and mobility . Figure of dimensions of ubiquitous computing:  	Lyytinen & Yoo (2002)
. It describes the preliminary evaluation of those two systems: (1) Context-aware language-learning support system, JAPELAS (Japanese polite expressions learning assisting system) (2) System, TANGO (tag added learNinG objects), which detects the objects around learner using RFID tags, and provides the learner with the educational information . A ubiquitous e-learning environment has the following characteristics to offer: permanency, accessibility, immediacy, interactivity and situating of instructional activities	Ogata & Yano (2004)
. It proposes term definitions: ubiquitous learning object (ULO) and semantic-oriented ubiquitous learning object model (SULOM) . Incorporating ubiquitous learning into mainstream of education	Li, Gao, Chen, & Huang (2009)
. To grant security to a cloud e-learning environment a fine-grained access control is strongly desired in ubiquitous learning system . Based on the CP-ABE, it proposes a context-aware access control scheme of resources with 5As characteristics of ubiquitous learning: Anyone, Anytime, Anywhere, Anydevice and Anywhat	Yu, Chen, Huang, & Wang (2013)
. It considers teaching and learning strategies that can be adapted to current learners' needs, the ingredients of pedagogy and digital tools are positively inspiring when applied to active learning . The practice of flipping the classroom could be part of ubiquitous learning environments (ULE): learning takes place anywhere and at any time, often digitally and outside the institutional spaces and hours	García-Sánchez & Santos-Espino (2017)
. Ubiquitous learning is a new method that anyone can obtain any knowledge in the way they require at any place and time . Constructed a system of ubiquitous learning mode based on network . Taking into account the on-demand learning, but also taking into account the form, content of the site, how to make everybody love learning	Wang, Zhang, & Yang (2017)

Table 2.8 - Correlated broad concepts of term distance learning

Broad concepts of term d-learning	Authors
Perraton (1988) said: "I proposed in 1982 a definition for distance education as an educational process in which a significant proportion of the teaching is conducted by someone removed in space and/or time from the learner"	Perraton (1982; 1988)
Rocco employees received feedback on their skills by using specially equipped computer workstations, as a way to fight illiteracy	Darazsdi & May (1989)
"Distance education can be broadly defined as the transmission of education or instructional programming to geographically dispersed individuals or groups"	U.S. Congress (1989)
. Given the growing digital divide in the new economy, as an answer to closing the gap between the "IT-haves and have-nots", the organizations may adopt distance learning as an education delivery tool . Distance learning involves many levels of sophistication, interactivity and costs; several investigations on distance learning, suggest that no delivery mode is superior to all others; each system has its pros and cons	Aniebonam (2000)
. Learners' interaction with online community . Studied online learning environments (community, virtual community, and online learning community) . Pointed out that online learning is demanding and unforgiving: - The importance of meeting face-to-face - What community means - Building and maintaining community	Conrad (2002)
In the overview of distance education, the following was analyzed: historical and conceptual foundations, policies, administration, and management, different audiences in distance education, the economics of distance education, and international perspectives	Moore & Anderson (2003)
. The distance object learning and evaluation (DOLE) framework is composed of: question or answer mode, user interface, knowledge base of objects, randomly select an object, answer management, database of assessment records, answer revision/evaluation process, compare and match object characteristics, keyword extraction and specify object areas	Snae, Brueckner, & Hirata (2008)
. Flexible design for distance learning requires using various and appropriate learning-teaching theories, strategies, media, technologies, interaction tools etc. together to enrich the learning environment . Components of flexible design for distance learning: e-learning: (computer based learning CBL tutorials on CD/DVD or PC), (Online learning - internet based learning IBL, web based learning WBL), (m-learning), b-learning: (self-paced learning with printed materials – face-to-face learning in classroom or laboratory)	Karadeniz (2009)

Broad concepts of term d-learning	Authors
. The results reveal that there are different expectations and perceptions of learning environment labels: distance learning, e-learning, and online learning . The effort of providing access to learning for those who are geographically distant . It discusses the most appropriate terminology . Distance education is the most renowned descriptor used when referencing distance learning	Moore, Dickson-Deane, & Galyen (2011)
. E-learning standards resources: - Institute for Electrical and Electronics Engineers IEEE Learning Object Metadata (IEEE LOM) - IMS Content Packaging (IMS-CP) - Sharable Content Object Reference Model (SCORM) - IMS Global Learning Consortium Common Cartridge (IMS-CC) - IMS Global Learning Consortium Learning Design (IMS-LD) . Among these e-learning systems, three can be stressed: - open courseware - learning management systems - online labs . Set of services that allow displaying theoretical content in an organized and controlled way	Sancristobal et al. (2012)

2.3.2. Bibliometric study of e-learning concepts ecosystem by digital libraries

The digital platforms from 1960 to 2019 listed 5,959,540 papers related to the key word combinations (Table 2.9) and showed in detail the number of studies by platform and by key word (see Figure 2.2).

Table 2.9 - Concepts of e-learning ecosystem - Five digital libraries (1960 - 2019)

	e-learning	m-learning	on-learning	b-learning	u-learning	d-learning	Total
ACM DL	470,266	510,513	255,378	485,153	358,005	499,525	**2,578,840**
AIS eLibrary	13,648	7,678	14,670	1,085	956	4,918	**42,955**
Google Scholar	923,360	98,358	1,666,295	63,577	30,481	35,917	**2,817,988**
ISI Web of Science	39,061	25,440	77,273	9,664	247	34,143	**185,828**
Scopus	95,551	41,187	120,345	10,269	15,028	51,549	**333,929**
Total	**1,541,886**	**683,176**	**2,133,961**	**569,748**	**404,717**	**626,052**	**5,959,540**

In Figure 2.2 the high concentration of correlated concepts of e-learning ecosystem in the digital libraries Google Scholar and ACM DL is evident. It shows the importance of using different platforms in a literature review in order to avoid bias.

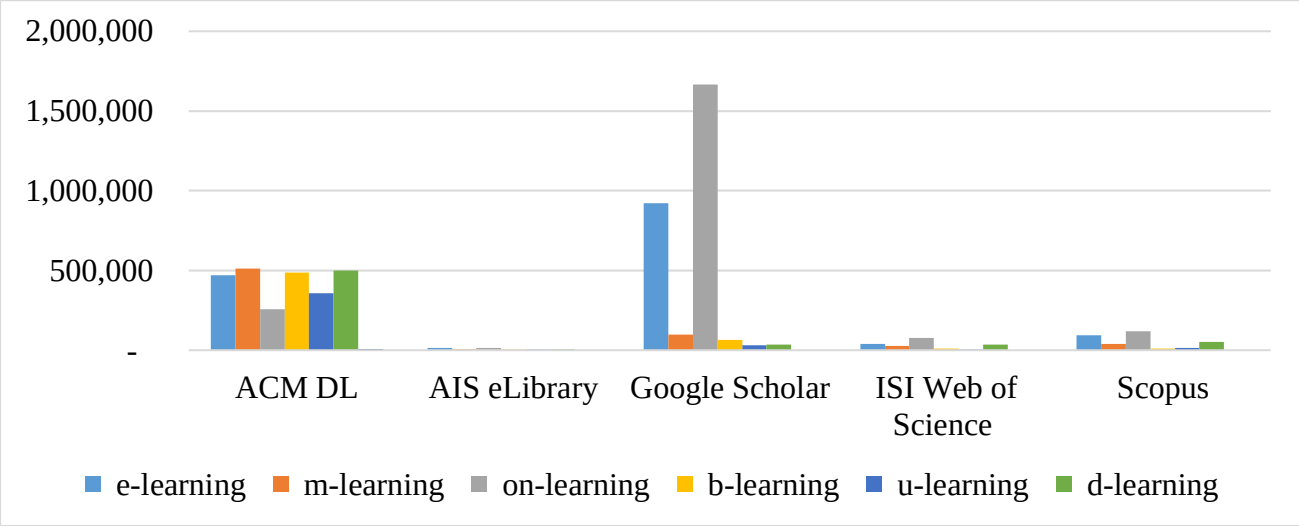


Figure 2.2 - Articles discussing concepts of e-learning ecosystem - Five digital libraries (1960 - 2019)

Figure 2.3 shows the relative importance of the concepts of e-learning ecosystem. Upon examining the results by key word, it can be observed that the main key word cited was online learning (on-learning), followed by electronic learning (e-learning), forming a grouping of highlighted concepts. The main concepts mobile learning (m-learning), distance learning (d-learning), blended learning (b-learning), and ubiquitous learning (u-learning), form a second grouping. The most representative term, on-learning, accounts for 36% of the total publications, e-learning represents 26%. The term mobile learning (m-learning) represents 11% followed by blended learning (b-learning) and distance learning (d-learning), with about same rate, 10%. of the results. The last term is ubiquitous learning (u-learning) representing 7% of the total publications in the digital libraries searched.

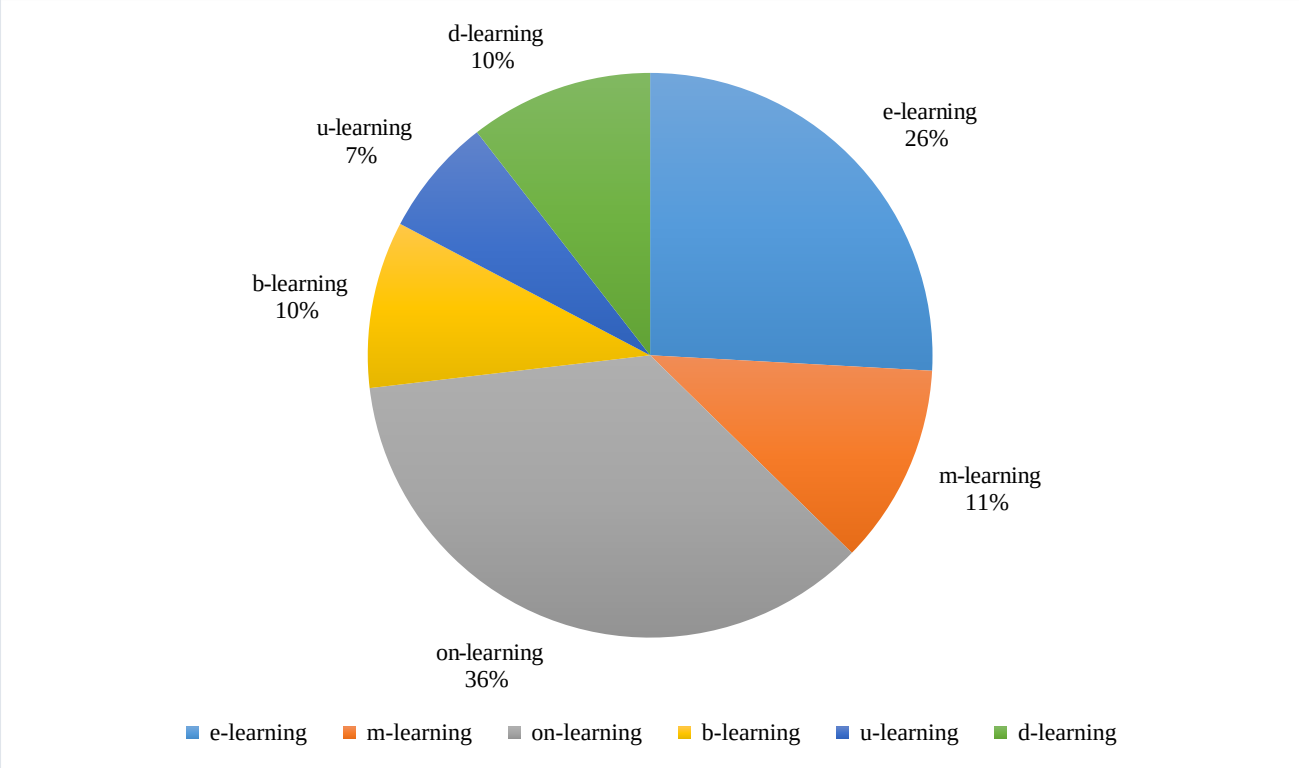


Figure 2.3 - Total search results related to concepts of e-learning ecosystem (1960 - 2019)

In Figure 2.4, despite the start of research in the 1960s, growth accelerated only at the end of the 1980s, perhaps due to the arrival of Internet 2.0, the shareable internet.

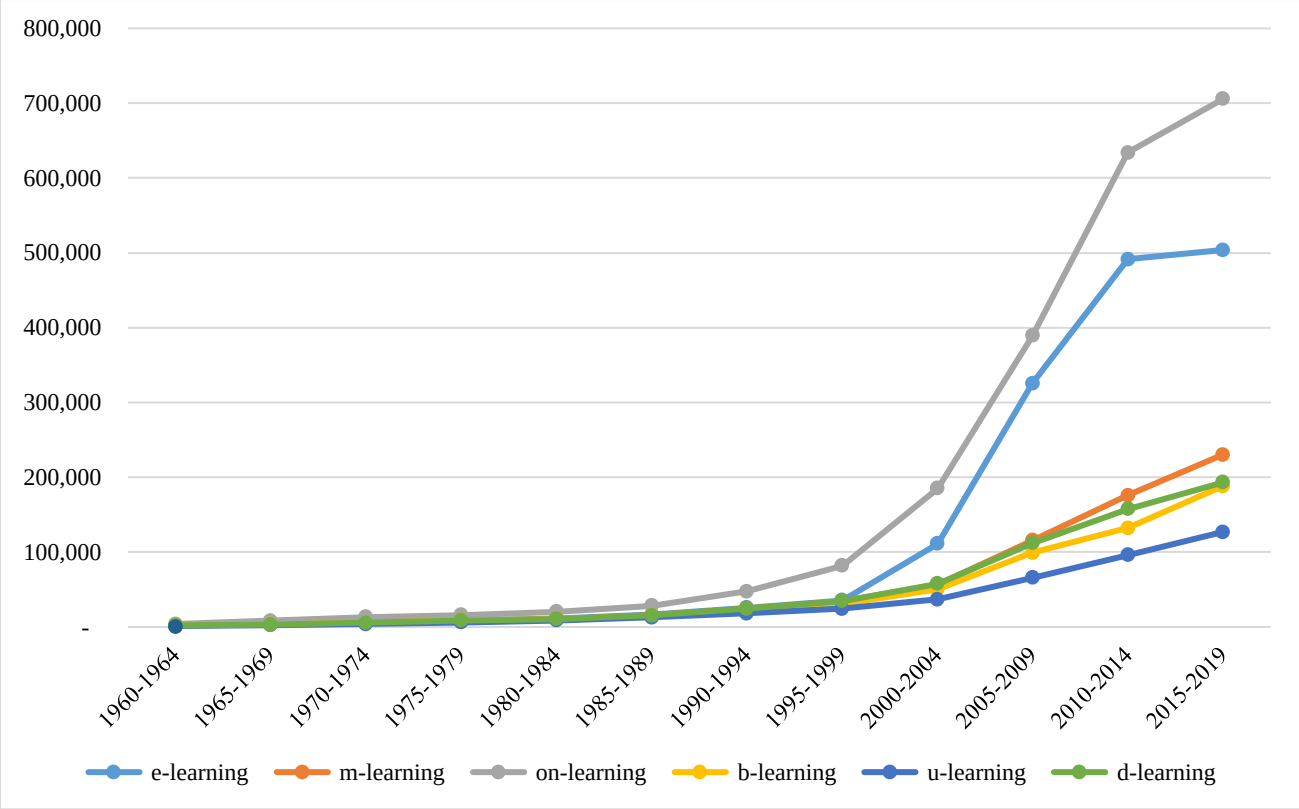


Figure 2.4 - Total results of publication evolution - Five digital libraries (1960 - 2019)

On-learning and e-learning appears to be the terms with the fastest and the highest growth. Other terms (m-learning, b-learning, and u-learning) follow a growth trend. The search for the term distance learning has been growing, but at a slower pace compared to the other terms.

2.3.3. Bibliometric study by Google Trends

Every search term on Google Trends is displayed on a map, showing the areas where that term is popular. The darker tones indicate where a given term is most likely to be searched. As our research aims to compare the terms “online learning” and “e-learning”, they are presented on the world map, with the shaded color signaling the term's popularity. Color intensity represents the percentage of searches for the most searched term in a given region. The search term's popularity is relative to the total number of Google searches performed in a specific period, in a particular location. Table 2.10 shows the terminologies used by Google Trends (Google, 2021) and their respective definitions, and notes.

Table 2.10 - Google Trends terminologies

Interest over time	*"Numbers represent search interest relative to the highest point on the chart for the given region and time. A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as popular. A score of 0 means there was not enough data for this term."*
Interest by region	*"See in which location your term was most popular during the specified time frame. Values are calculated on a scale from 0 to 100, where 100 is the location with the most popularity as a fraction of total searches in that location, a value of 50 indicates a location which is half as popular. A value of 0 indicates a location where there was not enough data for this term."* ***Note:*** *A higher value means a higher proportion of all queries, not a higher absolute query count. So a tiny country where 80% of the queries are for "bananas" will get twice the score of a giant country where only 40% of the queries are for "bananas".*
Releated queries: Indicate that other users search for the same term as you. The **Top** or **Rising** metrics can classify the terms	
Top	- *"Top searches are terms that are most frequently searched with the term you entered in the same search session, within the chosen category, country, or region. If you didn't enter a search term, top searches overall are shown",* - *"The most popular search queries. Scoring is on a relative scale where a value of 100 is the most commonly searched query, 50 is a query searched half as often as the most popular query, and so on".*
Rising	- "*Rising searches are terms that were searched for with the keyword you entered (or overall searches, if no keyword was entered), which had the most significant growth in volume in the requested time period. For each rising search term, you see a percentage of the term's growth compared to the previous time period. If you see "Breakout" instead of a percentage, it means that the search term grew by more than 5,000%",* - *"Queries with the biggest increase in search frequency since the last time period. Results marked "Breakout" had a tremendous increase, probably because these queries are new and had few (if any) prior searches".*

Following the terminologies in Table 2.10, we obtained the graphical output information from the Google Trends Platform (Google, 2021). In Figure 2.5 since the end of 2004, searches for the terms "online learning" and "e-learning" have been falling. It was only at the beginning of 2020 that there was strong growth. Throughout 2020 the values fluctuated considerably, and in 2021 they show a downward trend.

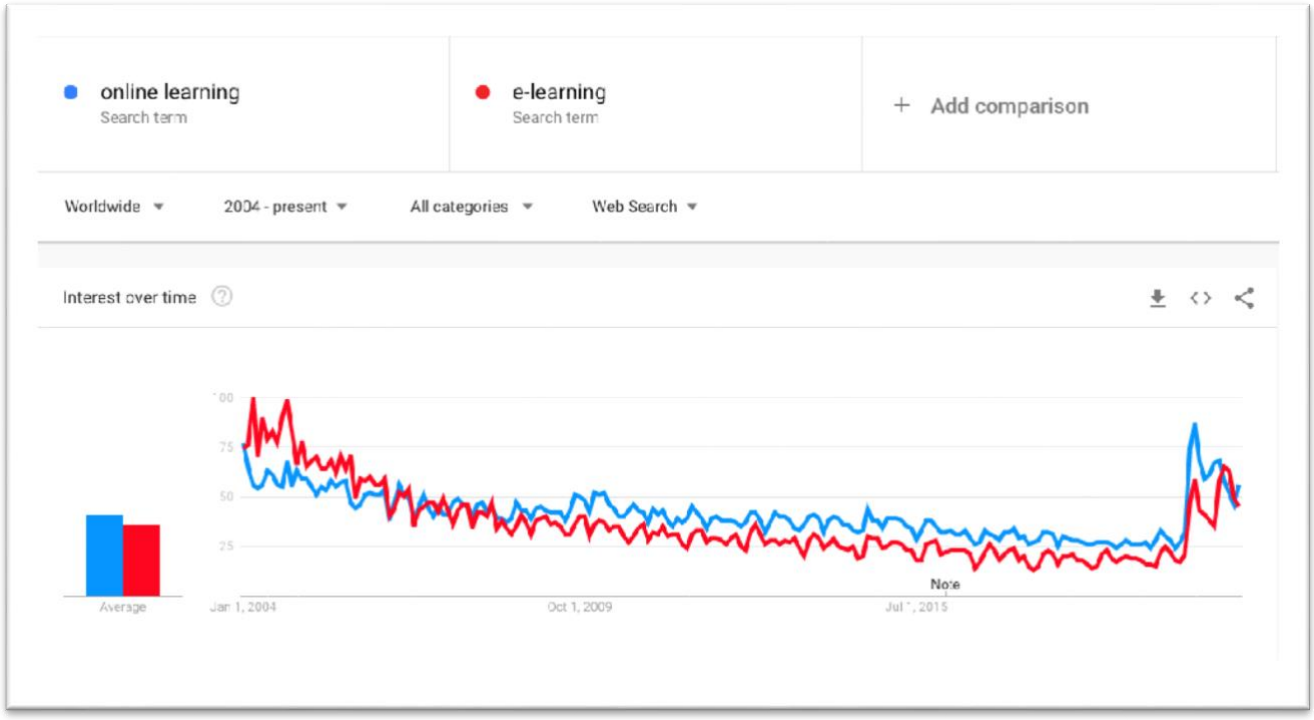


Figure 2.5 – Worldwide interest in online learning and e-learning

Upon analyzing the data set from Jan 2014 to Jan 2021 (Google, 2021), the average was 41 for online learning (blue graph line) and 36 for e-learning (red graph line) (Figure 2.5).

The map shown in Figures 2.6 and 2.7 is the same. Figure 2.6 shows the countries' interest in online learning ranking.

Figure 2.6 - Compared breakdown by region and countries interest in online learning

In North America, "online learning" is more popular, led by the United States and followed by Canada. Results indicate that there is a preference for "online learning" in the Middle East (United Arab Emirates) and Asia (Pakistan) (please see Figure 2.6).

Figure 2.7 - Compared breakdown by region and countries interest in e-learning

In South America and part of Central America, “e-learning” is more popular. In Russia and part of Europe, the preference is for “e-learning”. The study shows that those countries with smaller populations have essential relevance in terms of access (relative analysis and no absolute analysis), such as in Thailand, Portugal, Indonesia, Poland, and Italy. The relative analysis demonstrated that a significant part of these countries' population has an especial interest in “e-learning”. Please see Figure 2.7.

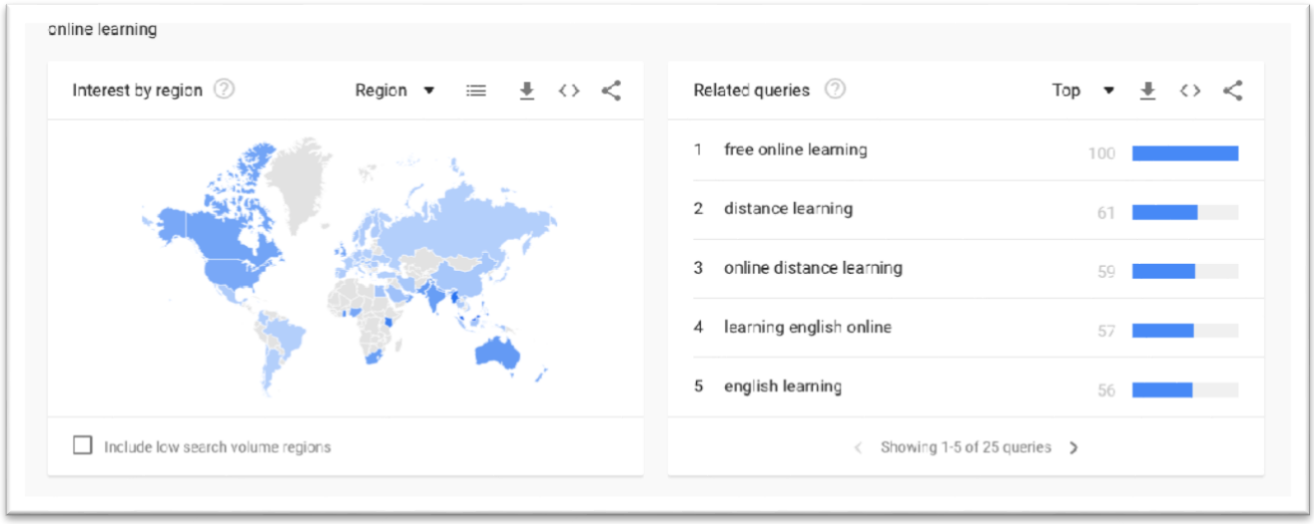


Figure 2.8 - Top related queries from online learning by region

The “top related queries” are most frequently searched with the term entered in the same search session, within the chosen category, country, or region. Figure 2.8 shows the “top related queries” from “online learning” by region: “free online learning”, “distance learning”, “online distance learning”, “learning english online”, and “english learning”.

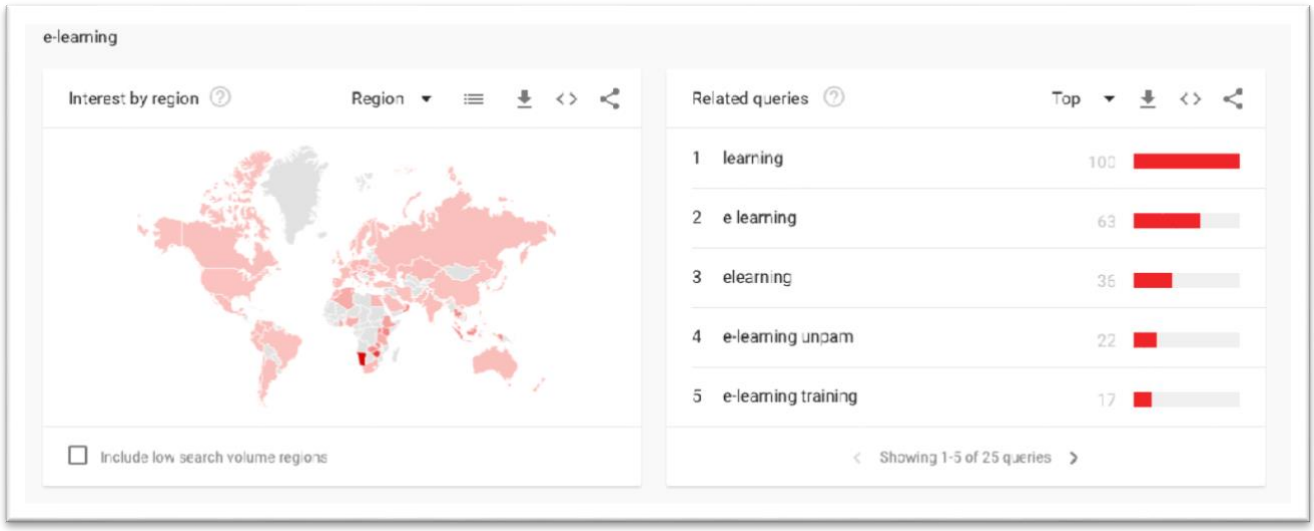


Figure 2.9 - Top related queries from e-learning by region

Figure 2.9 shows “the top related queries” from e-learning by region: “learning”, “e learning”, “elearning”, “e-learning unpam”, and “e-learning training”. In order to expand the analysis of the

related queries, we imput new search terms, “online course”, and “e-learning course" to analyse the interest over time (Figure 2.10).

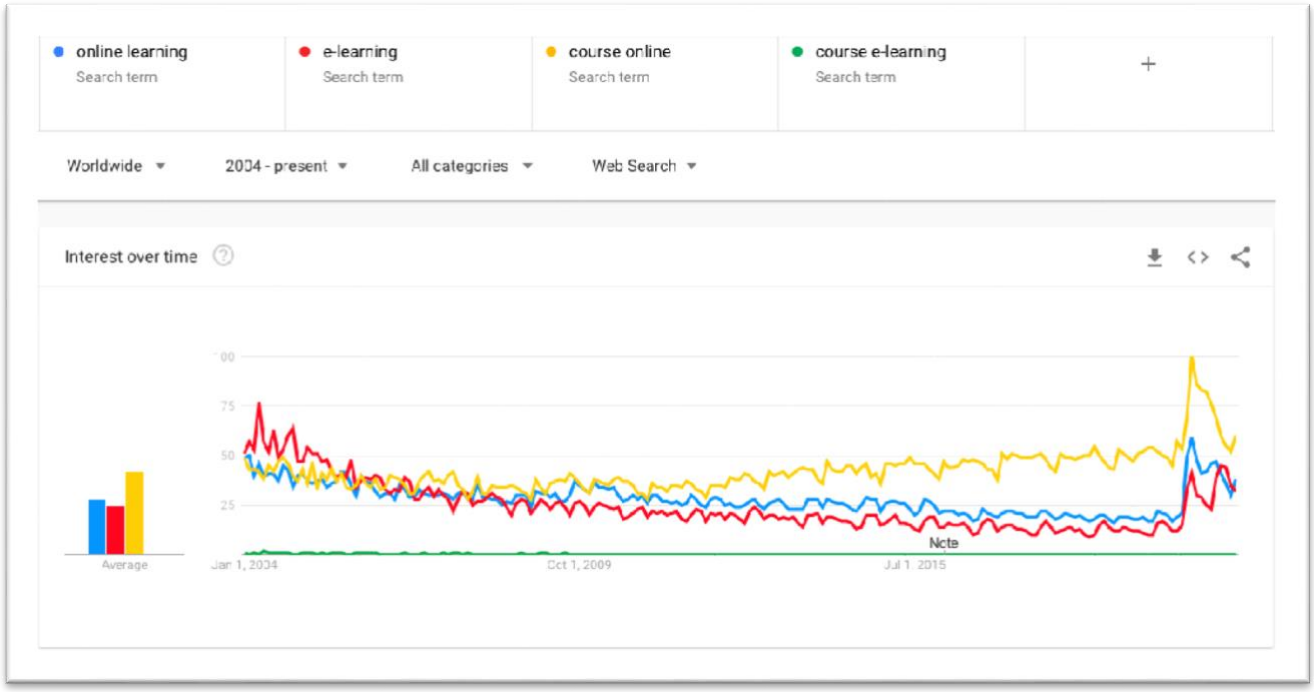
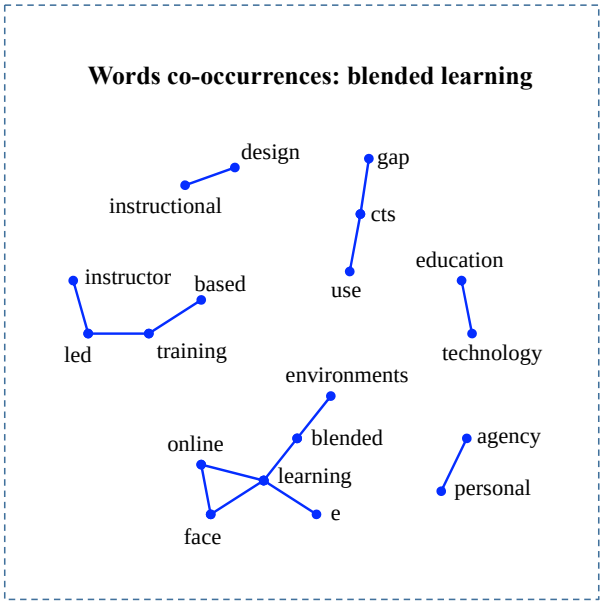


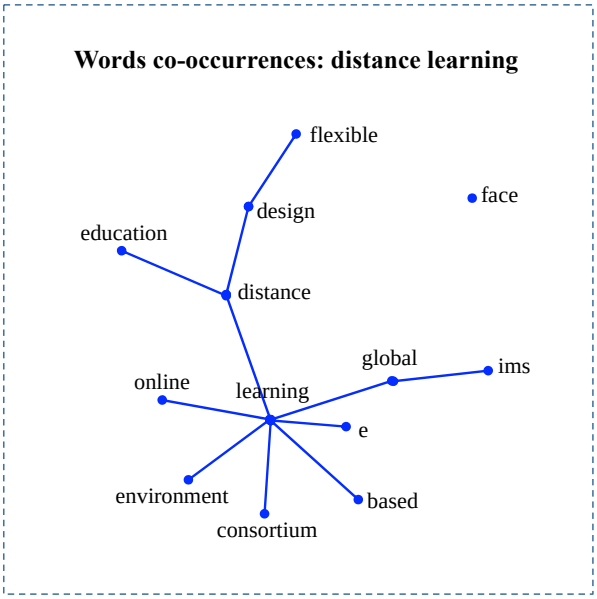
Figure 2.10 - Interest over time worldwide with a mix search terms

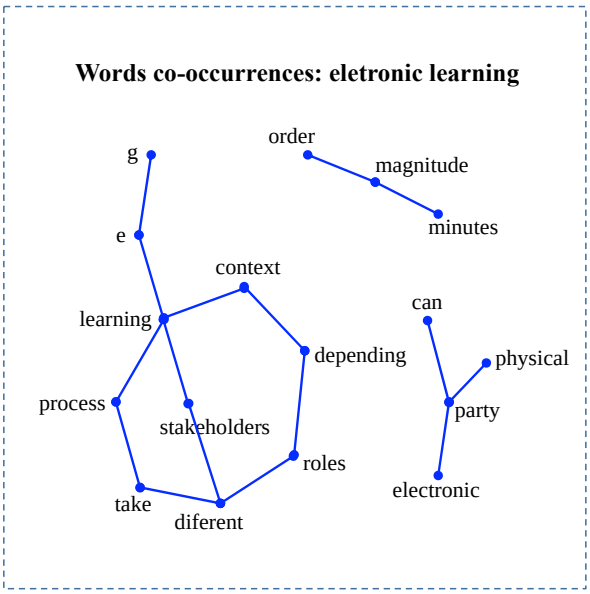
The results point to low demand for “e-learning course”. For “online course,” the request was very significant.

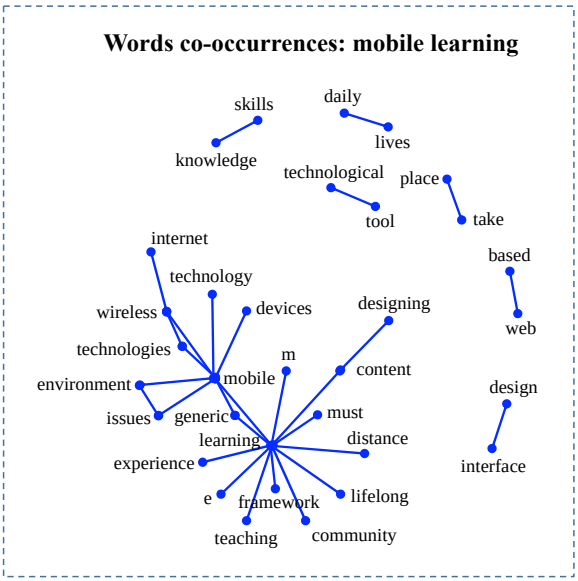
2.3.4. Bi-gram relations and analysis

According to Jurafsky & Martin (2008), the process to create a N-gram chart is basically: (1) to define N, which means the size of the relations - for instance, a bi-gram (N = 2) analyzes the relations between two words each time; (2) to create a table with all N (two in bi-gram case) combinations of words; (3) to count the frequency of occurrence of each two combinations of words; and (4) to plot a network graph (with edges and nodes) showing the relations of words. The figure 2.11 that follows show the bi-gram relations.


Words co-occurrences: blended learning
design
instructional
gap
cts
use
education
technology
instructor
based
led
training
environments
online
blended
learning
e
face
agency
personal


Words co-occurrences: distance learning
flexible
face
design
education
distance
global
ims
online
learning
e
environment
based
consortium


Words co-occurrences: eletronic learning
order
magnitude
minutes
g
e
context
learning
depending
can
physical
party
process
stakeholders
roles
take
diferent
electronic


Words co-occurrences: mobile learning
skills
daily
knowledge
lives
technological
place
tool
take
internet
based
technology
wireless
devices
designing
web
technologies
m
content
environment
mobile
design
issues
generic
must
learning
distance
interface
experience
e
framework
lifelong
teaching
community

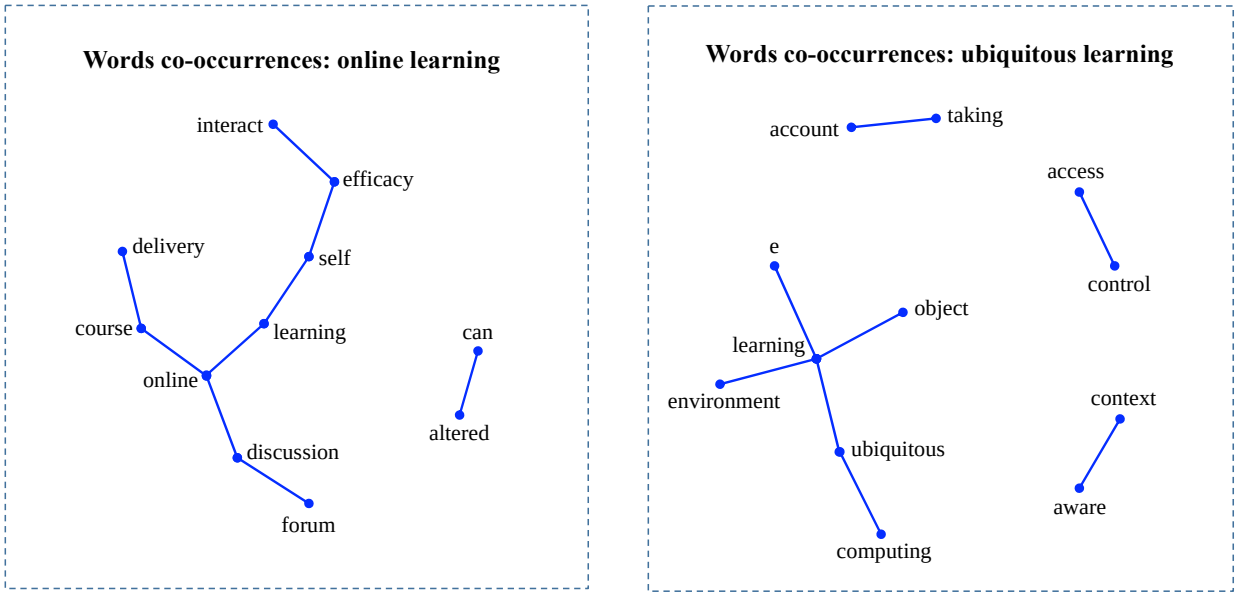


Figure 2.11 - The bi-gram relations of word co-occurrence of e-learning concepts ecosystem

The number of words co-occurrence varied widely for each term of e-learning concepts ecosystem. The term with the highest amount of defined set words co-occurrence was b-learning. It was defined with 6 set words co-occurrence and m-learning was defined with 7 set words co-occurrence. The term e-learning was defined with 3 set words co-occurrence and u-learning was defined with 4 set words co-occurrence. The terms on-learning, and d-learning, both obtained the lowest indexes, with 2 set words co-occurrence. The words co-occurrence vary widely for each term. The only word that appears in all terms is "learning".

As for the agglutination of set words co-occurrence, the term m-learning was the one that most expresses a concept, for example, "skills" and "knowledge", and "design" and "interface" with others. The fact that the term m-learning will has 7 set words co-occurrence, might be a reason for the expression of a concept.

Even with 2 set word co-occurrence, the term d-learning points to cohesion, since only one word co-occurrence “face” was isolated from the set word co-occurrence, as it especially refers to the face-to-face interaction.

The term b-learning was able to express the basic concept of online and face-to-face with set words co-occurrence defined: “environments - blended - learning - online - face-to-face”.

The only term that plotted a link between a set words co-occurrence (oval shape), was the term e-learning, with the words: "learning - process - assuming - different - roles - depending - context - stakeholders".

After analyzing the set words co-occurrence of the term on-learning, it is possible to perceive a logic of the connection and sequence of words. In the first sequence of set words occurrence: “interact - effectiveness - self - learning - online”, it points out the consumption of the content; in the second sequence of set words occurrence: "delivery - course - online", the delivery of the course; and in the third sequence of set words co-occurrence: "forum - discussion - online", it signals the teaching method. A word co-occurrence “online” connects the 3 strings.

As for the term u-learning, there was a fragmentation of set words co-occurrence, making analysis difficult and inefficient.

2.4. Discussion of broad concepts of e-learning ecosystem

The authors listed previously argue that electronic learning differs from face-to-face learning due to media (means of communication with the students). They show the relevance of the different perceptions about the contents from the perspectives of the learners and stakeholders. Mary Alice White coined the e-learning term in 1983 in a journal article entitled “Synthesis of Research on Electronic Learning”. E-learning was defined as *“learning via electronic sources, such as television, computer, videodisc, teletext, videotext”* (White, 1983, p. 13).

O'Malley et al. (2005) have thus defined "mobile learning, or m-learning, as learning that takes place via such wireless devices such as mobile phones, personal digital assistants (PDAs), or laptop computers". Mobile learning is based on mobile devices such as cellular phones, smartphones, PDAs, tablets and laptops. The authors claim that mobile content has to be adapted according to the context and scenarios in which the learning process will occur. Mobile learning is an extension of distance and electronic learning, but due to the media and the context, it is different. For the success of the mobile learning, its advocates argue that they require that dynamic content target the student in different moments and establish requirements for m-learning development, such as the adaptation to the media, the creation of specific content and the understanding of the role of the environment in the process.

One of the earliest educational experiments in international networking was in 1982. The La Jolla, the California-based Western Behavioral Sciences Institute (WBSI) opened the first educational program employing the computer as the primary means of delivery (Feenberg, 1993). The online learning offered parts or a complete education curriculum through the internet. *"Online learning is any class that offers at least part of its curriculum in the online course delivery mode, or as a transmission of information and/or communication via the internet without instructors and students being connected at the same time"*, Richardson & Swan (2003).

Online learning courses have many advantages: no time or place barriers, the opportunity to use the multimedia capacity of the internet to deliver rich content to students, the low costs involved and a longer portfolio of courses (the long tail offer strategy). It is essential to remind the student of the importance of the teacher, instructors and tutors in the learning process. However, one barrier to acceptance of online learning is the lack of personal interaction as a pedagogical tool. In online learning, some prefer to distinguish wholly online learning (Mgutshini, 2013) from the casual use of

technology as a medium or context for education (Abawajy & Kim, 2011). There is thus a lack of consensus on the definition of e-learning among the authors.

Blended learning provides the combination of online and face-to-face pedagogical approaches to meet students' needs. It establishes the mechanism of blended learning by the use of traditional alongside online learning processes. Blended Learning is considered the blend of various modes of learning processes that primarily integrates the benefits of online learning and classroom learning (c-learning). Some authors use the name hybrid learning. In the study by Moore et al. (2011), there were some respondents from the continent of Asia who grouped "blended learning" and "e-learning" as meaning the same. Although there is a clear delineation of each of the terms, there still exists erroneous interpretations among educators.

Ubiquitous learning is a new definition that provides anyone with any knowledge in the way they require in any place and at any time (Wang, Zhang, & Yang, 2017). The concept of ubiquitous learning places the context and the user at the center of the learning process. As technology becomes more embedded and integrated with mobility, the barriers between social and technical aspects become fuzzy. A paradoxical outcome of ubiquitous computing is that it is simultaneously very personal and extremely global. The concept of ubiquitous learning offers specific learning characteristics such as flipped (hybrid) classes and on-demand learning. Also it prescribes adaptability to the user's needs in form and content. Lyytinen & Yoo (2002) pointed out that u-learning should have a high level of embeddedness and mobility.

Some authors highlight the opportunities to learn at a distance with no barriers of place, time or content. Distance learning authors also note that the student and teacher are in different places and/or time. They state that the difference between traditional and distance learning is that distance learning uses

technology to deliver the learning objects. Some similar concepts were used in the literature, such as "dual-mode". Perraton (1998), said: *"I proposed in 1982 a definition for distance education as an educational process in which a significant proportion of the teaching is conducted by someone removed in space and/or time from the learner".*

A widely accepted definition of mobile learning is 'using mobile technologies to facilitate learning', while a popular definition of ubiquitous learning uses the 5A characteristics: Anyone, Anytime, Anywhere, Any device and Any what (Yu et al., 2013). Although these definitions have been given different interpretations, they share a core idea: mobile devices (e. g., personal digital assistants, cellular phones or portable computers), according to Hwang & Tsai (2011).

It is common for researchers to face difficulties when performing meaningful cross-study comparisons in research about correlated concepts of e-learning. Moore et al. (2011) pointed out that there are different expectations and perceptions of learning environment labels: distance learning, e-learning, and online learning. According to Moore et al. (2011), distance learning is referenced more as an ability, whereas distance education is an activity within the ability (of learning at a distance); though Volery & Lord (2000) affirm that both definitions are still limited by the differences in time and place.

2.4.1. Approach of new focus to e-learning concepts ecosystem

The findings show great differences in the meaning of concept terms that are used in the studies, but also provide implications internationally (e.g., cultural impact on the interpretation of terms) for the referencing, sharing, and the collaboration of results detailed in varying research studies. In Table 2.11, we synthesize e-learning concept ecosystem definitions as a contribution to their understanding.

Table 2.11 - Synthesized e-learning concepts ecosystem

Acronym (Description) Synthesized concepts
e-learning (Electronic Learning) It is considered as a learning approach by electronic media, disregarding time and space. The content is delivered via electronic media or sources, covering a wide set of applications and processes, including the internet, intranets, podcast, extranets, satellite, audio, video tape, broadcast, interactive TV, eBook, tablet, CD-ROM, computer-based learning, web-based learning, digital/electronic game, virtual classrooms, web-distributed, radio, web-capable, social media, portals and digital collaboration, providing distance learning content. Today, one of the most important ways to access it is through the world-wide web. New technologies create new possibilities such as the use of virtual reality, radio-frequency identification (RFID), virtual glasses or 3D, to improve the experience of the user.
m-learning (Mobile Learning) Learning content delivery by a mobile. Mobile devices can be considered: cellular phones, smartphones, PDAs, tablets and notebooks. Mobile learning works through technological portability and personal use, accessing data and communicating through wireless technology. The main advantage of m-learning is to always be with the users, and as the learners move and develop m-learning contents, it is necessary to know how to use the context. The technological issues are developing a powerful computing environment, where facilities and intelligent user interfaces are the focus.
on-learning (Online Learning) Online learning is any class that offers at least part of its curriculum in online mode via the internet without the instructors and the students being connected at the same time. The learning experience and all aspects of teaching and learning processes create a distinction between on-learning and e-learning that is based on the media employed. On-learning delivers content mainly through the web.
b-learning (Blended Learning) Blended learning is a fully integrated instructional design that offers flexibility and variety, combining face-to-face with distance learning systems. The types of blended environments are (a) online and face-to-face learning activities, (b) online instructors and face-to-face students, and (c) online students and face-to-face instructors. This learning process includes collaborative learning, discovery learning, and active learning.
u-learning (Ubiquitous Learning) Allowing learners to obtain knowledge and education in the way they want is the goal of ubiquitous learning. In order to understand ubiquitous learning, it is necessary to consider the concept of ubiquitous computing, which has to accomplish the 5 A's: Anyone, Anytime, Anywhere, Any device and Any what. Considering the user's needs, technology becomes more personally embedded and integrated with mobility. Accessibility, permanency, immediacy, interactivity and situating of instructional activities are ubiquitous learning characteristics.
d-learning (Distance Learning) Distance learning is an educational process in which a significant proportion of the teaching is conducted by someone away in space and/or time from the learner. The first use of distance learning (or distance education) was related to sending conventional educational media, like books or class content, by mail. It requires several and appropriate learning-teaching theories, strategies, media, technologies and interaction tools to, together, enrich the learning process. Today, there is hardly any practical difference between d-learning and e-learning.

Upon analyzing the systematic review of Tables 2.3, 2.4, 2.5, 2.6, 2.7, and 2.8, regarding correlated broad concepts of e-learning (electronic learning), m-learning (mobile learning), on-learning (online learning), b-learning (blended-learning), u-learning (ubiquitous learning), and d-learning (distance learning, and summarized in Table 2.11 (synthesized e-learning concepts ecosystem), the results suggest that terms and concepts are remarkably close.

The systematic literature review and its summary in Tables 2.3 to 2.8, show that the various terms and concepts are closely linked. Figure 2.4 shows that the newest term in common use is on-learning (online learning), overtaking the usual and traditional term e-learning (electronic learning). The term b-learning (blended-learning) has unique characteristics as it combines virtual and face-to-face learning. Special attention should be paid to the term u-learning (ubiquitous learning) in relation to its evolution and the possibility of becoming better known and used in the academic and professional environment. This is due to its particularly tangible 5 A's acronym: Anyone, Anytime, Anywhere, Any device and Any what.

2.4.2. Bibliometric study results from digital libraries

The bibliometric study demonstrates the continuing strength of the e-learning ecosystem. All terms related to e-learning are growing. The present bibliometric method points out a favorable scenario for new research specialities, complemented by meta-analysis, literature review and empirical studies.

2.4.3. Bibliometric study results from Google Trends

The trend of evolution in the search for the terms "online learning" and "e-learning" from Google Trends differs from the one found in digital libraries. It is reasonable to hypothesize that the terms "online learning" and "e-learning," because they are more of an academic nature, are less sought after than the term "online course", which is closer to people's daily lives.

2.4.4. N-gram results

This exploratory analysis points out that for greater robustness and analytical power, the N-gram Analysis must be performed with the original articles, because for this first essay, we emphasize that we transcribe the broad concepts of the terms as they appear in the respective articles (according to Tables 2.3 to 2.8, literature review of general concepts of e-learning ecosystem).

2.5. Conclusions

In this study, we identified 6 related e-learning concepts ecosystem used in literature and organized these concepts in a chronological fashion. Several systematic searches according to certain time intervals revealed the publication frequency per concept. We used scientific digital libraries to perform the searches and to do the bibliometric study. We compared the evolution of the main concepts according to the publication number in the different digital libraries. We identified new concepts trends in e-learning and compared their publication growth rate with e-learning growth rate from 1960 to 2019.

We emphasized that we synthesize the ecosystem definitions of the concept of e-learning as a contribution to its understanding, and that future studies may bring evolutions in the concepts. Our findings show that the term online learning leads the number of scientific publications in recent years, followed by e-learning. The results presented a second group of terms formed by mobile learning, distance learning, blended learning and ubiquitous teaching. Although the term distance learning comes from the 1960s, the results still show an upward trend, even if mild.

According to our study, we highlight the timeline of e-learning concepts ecosystem. The first term used was e-learning in 1960. However, although many believe that the first term was distance learning, it was only used in 1982. There are many controversies in this sense.

In digital libraries, there is a growth trend for all terms; a highlight of demand and growth for “online learning” and “e-learning”. Google Trends signals development for online course (one of the possibilities) (voice of society for learning solutions) and a drop tendency for online learning and e-learning (academic trends focusing on research).

The results highlight that the term online learning appears more frequently than the term e-learning, but the term e-learning is still more common in academia. The market and society use the term online learning more colloquially, and this has drawn our attention. Studying new forms of communication and learning is an ongoing process. Besides that, the effects of the pandemic COVID 19 have deeply impacted the world, by profoundly altering our behaviors regarding the adoption of new technologies. This process has become the new paradigm.

CHAPTER III . E-LEARNING SUCCESS DETERMINANTS: BRAZILIAN EMPIRICAL STUDY

E-learning is a web-based learning ecosystem for the dissemination of information, communication, and knowledge for education and training. Understanding the impact of e-learning on society, as well as its benefits, is important to link e-learning systems to their success drivers. The aim of this study is to find the determinants of user perceived satisfaction, use, and individual impact of e-learning. This study proposes a theoretical model integrating theories of information systems' satisfaction and success in the e-learning systems. The model was empirically validated in higher education institutions and university centers in Brazil through a quantitative method of structural equation modeling. Collaboration quality, information quality, and user perceived satisfaction explain e-learning use. The drivers of user perceived satisfaction are information quality, system quality, instructor attitude toward e-learning, diversity in assessment, and learner perceived interaction with others. System quality, use, and user perceived satisfaction explain individual impact.

3.1. Introduction

E-learning is a web-based learning ecosystem integrating several stakeholders with technology and processes. With the popularization and expansion of access to the World Wide Web and greater access to devices to access the Internet, such as smartphones, laptops, tablets, and computers, learning using e-learning practices has expanded rapidly all around the world. The main examples of global e-learning systems are Coursera, EDX, Udacity, and Khan Academy among others, which are also known as Massive Open Online Courses (MOOCs) (Alraimi, Zo, & Ciganek, 2015; Chauhan, 2014).

Studies of Zhang & Nunamaker (Zhang & Nunamaker, 2003) approached the impact of e-learning in the new millennium. The new economy is characterized by industrial change, globalization, the rise of intensive competition, sharing and transferring knowledge, the revolution of information technology, the reinvention of the classroom, and the lack of meeting new needs of the new learning world and of life. Learning is changing its center point, from teacher to student.

At the same time, it offers previously unimagined possibilities of interaction and access to knowledge, virtually anywhere in the world (Felice, 2009; Yanaze, 2006). Brazil is a large country characterized by varying degrees of access to the digital world. It still encounters considerable difficulties concerning

digital inclusion (Haddad & Oliveira, 2017; Haddad, Oliveira, & Cardoso, 2016). Studies point out that the "Telecentros", a public digital "meeting point", are important for digital inclusion of those who are poor and excluded from the traditional educational system. In Brazil from 2005 to 2010 a new policy of distance learning was launched, named Brazilian Open University System, involving various stakeholders, such as public universities, municipalities, and the federal government.

This program intended from the outset to address the opportunity to provide supplementary educational programs to adults (Duran & Costa, 2016). E-learning provides people with a flexible and personalized way to learn; allowing learning on demand and reducing the cost of learning. A variety of core technologies that can facilitate the design and implementation of e-learning systems are emerging, and therefore a far-reaching impact on learning is achieved in the new millennium.

To date, several studies have used the original version of the classic model, the DeLone & McLean (D&M) IS Success Model (DeLone & McLean, 1992; 2003) to measure and evaluate the success of e-learning systems (Holsapple & Lee-Post, 2006; H.-F. Lin, 2007; H.-F. Lin & Lee, 2006). However, as far as we know, one of the first studies that was conducted to understand and modulate the e-learning Brazilian reality was Machado da Silva, Meireles, Filenga, & Brugnolo Filho (2014). In that study the authors found that information quality, service quality, and system quality had direct impact on e-learning systems use and satisfaction. Despite these results, these authors point out that future studies should be conducted, mainly to understand the perceived impacts of e-learning systems in Brazil, such as net benefits, which result from the individual and organizational impacts. Other studies referring to e-learning systems use in Brazil are scarce. Some authors that study e-learning in Brazil study learners' satisfaction and use, not measuring the individual performance (individual impacts) (Dias, 2008; George et al., 2014; Machado da Silva et al., 2014; Moreno Jr. & Zaroni, 2015).

The purpose of this article is to achieve a better understanding of satisfaction, use, and success of e-learning in the Brazilian context. Several surveys of e-learning have been conducted, but none of these studies makes use of DeLone & McLean (DeLone & McLean, 1992), but instead integrate models of Sun, Tsai, Finger, Chen, & Yeh (Sun et al., 2008), and Urbach, Smolnik & Riempp (Urbach et al., 2010), and consider that further studies are needed to better understand the reality (Al-Samarraie, Teng, Alzahrani, & Alalwan, 2017). As main contributions of this study, we outline the integration of information systems success theory D&M with e-learning satisfaction theory. Another feature of the study is that it was conducted in several organizational environments of a developing country, in which technology may help to decrease the educational, digital, and geographical divide.

The next section describes the theoretical foundations of e-learning and provides a review of the literature on use, as well as satisfaction and success of e-learning. In the following section, we explain how the theoretical model was developed, and the characteristics of the constructs and case studies. The section describes the method of the approach to the creation of the constructs and empirical data collection. In the section of analysis and results, the measurement model and evaluation of the model is addressed through structural equation modelling. The discussion section presents the study results and outlines the implications of the research, its limitations, and contributions.

3.2. Theoretical foundation

E-learning is the use of information technology to share information and knowledge for education and training; e-learning emerges as a paradigm of modern education. E-learning comprises the use of the web to access information and knowledge, disregarding time and space (Aparicio et al., 2014b; Aparicio, Bacao, & Oliveira, 2014a). E-learning is changing in the way it is used through several devices, according to Liu & Hwang (G.-Z. Liu & Hwang, 2010). Access to courses through computer networks (e-learning), mobile devices, wireless communications (m-learning) (Amasha & AbdElrazek, 2016), the mobile sensor technologies, and wireless communications is changing the e-

learning paradigm. A new system architecture of the learning environment is in progress: context-awareness and ubiquitous learning (u-learning).

3.2.1. E-learning systems studies

The use of virtual learning environments in addition to classroom study (blended learning), were surveyed by Stricker, Weibel, & Wissmath (2011). These authors compared two groups of students: a group of students with the support of virtual learning environment (VLE), and a group of students without contact with the VLE. The students' performance of the VLE support had better results than those having only face to face learning. The research of Sorgenfrei, Borschbach, & Smolnik (2013) points out three major drivers that guide the process of education through e-learning tools: technical and design size, individual motivation and finally environment characteristics. According to the authors, each of these drivers will affect the willingness of students to take other e-learning courses. E-learning acceptance predictors were studied by Cheng (2011), who concluded that perceived usefulness, ease of use, perceived enjoyment, network externality factor, system factor, individual factors and social factors are considered the main determinants of acceptance of the e-learning systems. Recent studies found that the encouragement of a higher social ability affects positively the intention to continue using e-learning, by motivating a greater use of communication tools during courses, allowing their learners to increase social participation among students (Brahmasrene & Lee, 2012).

Appendix A of the current study, outlines some of the satisfaction and e-learning success studies. Satisfaction factors identified by Frankola (2001) explain the low rates of satisfaction with the learning: students do not have enough time, there is failure in supervision or management of e-learning structure, the lack of motivation, problems with the technology chosen, erratic support to the student, preference for traditional learning, poor graphic design adopted by the platform, and instructor deficiency (lack of knowledge and/or ability to deliver). A study on student satisfaction of e-learning (Wang, 2003), highlighted important determinants such as student interface, learning community,

content, and customization. Selim (2003) found that the ease of use of web courses is the main determinant of acceptance as an effective and efficient technology for learning. Research shows that attitude of students and instructors toward e-learning can determine success (S.-S. Liaw, Huang, & Chen, 2007). Their study posed a three-tier technology use model (3-TUM). Selim (2007) described the critical success factors of e-learning as grouped into four categories: trainer, student, information technology, and university support. From literature it is known that students' dimension, teachers, courses, technology, design, and environment determine e-learning success (Sun et al., 2008). Figure 3.1 depicts the evolution of e-learning systems based on the studies in Appendix A. In general, at first studies focused more on technology itself and on content, but the latest studies reflect that students' attitude and interaction also play an important role in e-learning success.

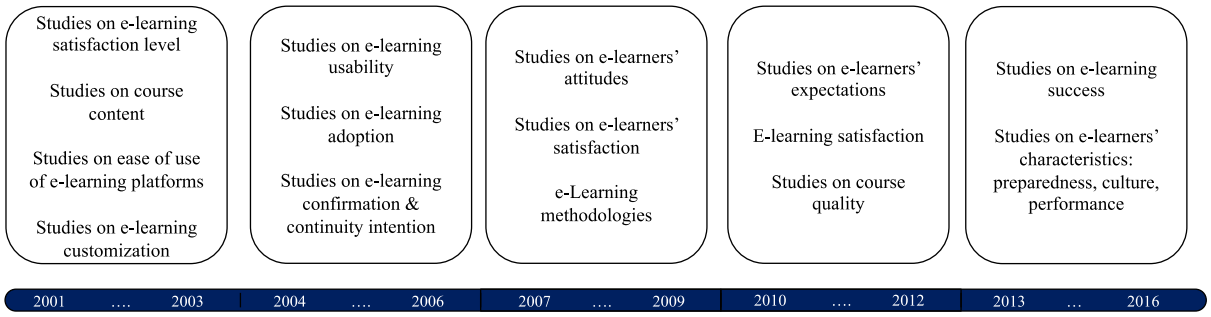


Figure 3.1 - E-learning studies timeline

These studies confirm that the research trend (from 2001 to 2003), began with a focus on course contents and customization. Then, from 2004 to 2006, the research focus was on usability of e-learning platforms, and on adoption and confirmation to continuity intention. Later, from 2007 to 2009, studies focused more on students' satisfaction level and e-learning methodologies. In the interval of 2010 to 2012, we found studies on e-learners' expectations and satisfaction. Recently, from 2013 to 2016, studies are more focused on the overall success of e-learning and on how students' characteristics affect e-learning.

3.2.2. Information system (IS) success

Information systems success has been studied regarding the end-user computing satisfaction (EUCS) developed by Doll & Torkzadeh (1988). DeLone & McLean (1992) proposed one of the most tested IS success models. The 1992 D&M model is composed of six theoretical constructs: system quality, information quality, use, user satisfaction, individual impact, and organizational impact. Afterwards, in 2003, the D&M success model was updated and found theoretical evidence that service quality is also a success determinant regarding positive influence on the use and user satisfaction (DeLone & McLean, 2003). In this model a new construct called net benefits, was included as a result of merging the individual impacts and organizational impacts constructs. According to these authors (DeLone & McLean, 2003), system quality corresponds to the technological characteristics, performance, and usability of the system itself. Information quality corresponds to the system's accuracy, validity, and currency regarding the system contents. Service quality relates to the responsiveness and perceived competence of the technological staff. Use is one of the literature success measures, and corresponds to the effective use of a system, therefore full adoption, the first phase of success. User satisfaction is the perceived level of agreeableness toward the entire system. It is measured by the appropriateness and effectiveness. Net benefits are the perceived individual and organizational impacts on tasks/job performance and efficiency.

3.3. Theoretical model

This study modulates the e-learning success in the Brazilian context. The proposed model is based on the previous theory of e-learning satisfaction and IS success theory. The proposed research model, Figure 3.2, integrates two theories, e-learning satisfaction and IS success (DeLone & McLean, 2003; Sun et al., 2008; Urbach et al., 2010). These theories have been validated by several empirical studies and are therefore models with solid foundations (Bento, Costa, & Aparicio, 2017).

3.3.1. Constructs

The proposed research model comprises 11 theoretical constructs: collaboration quality (CQ), service quality (SerQ), information quality (IQ), system quality (SysQ), learner computer anxiety (LCA), instructor attitude toward learning (IATL), diversity assessment (DA), learner perceived interaction with others (LPIO), user satisfaction (US), use, and individual impacts (II). Collaboration quality corresponds to the web environment features, digital culture and the universal use of the web on various platforms such as smartphones, tablets, and computers (Benbya et al., 2004; Detlor, 2000; Urbach et al., 2010; Wang, 2003). Service quality is the e-learning system requirements for efficient service support, which can be measured by points responsiveness, empathy, trust, and security (Urbach et al., 2010). Information quality: for the quality of information of an e-learning system, some items are needed, such as applicability, comprehensiveness, and reliability. System quality of an e-learning system comprehends functionality, usability, navigability, and the accessibility that users perceive from the usage of an e-learning platform during the course. Learner computer anxiety: anxiety is an internal personal characteristic, stable and durable, as a result of the external environment (Spielberger & Anton, 1976). Instructor attitude toward e-learning is measured by the student perception of the usefulness pointed out by the teacher during the course, compared to face-to-face learning (Sun et al., 2008). Diversity in assessment is the presence of various assessment methods in the course. Learner-perceived interactions with others comprehend three types of interaction, students with teachers, students with course materials, and students with students (Moore, 1989). User satisfaction is one success measure of the overall level of fulfilment of learners' expectations (Sun et al., 2008). Use measures the actual use of e-learning system by the students to perform their learning tasks, for example, retrieve and publish information and communicate with others. The individual impact is the degree of benefit perceived by students when using an e-learning system.

3.3.2. Hypotheses

Based on the findings of (Urbach et al., 2010) collaboration quality emerged as a significant determinant on the system usage and also on the user satisfaction. Thus, it creates possibilities for co-creation, communities of practice and collaborative knowledge (Benbya et al., 2004; Detlor, 2000; Urbach et al., 2010; Y.-S. Wang, 2003). The efficiency of different collaborative features, such as ease of use, efficiency and willingness for collaborate, facilitating communication and information sharing on multi platforms (e.g.: LMS, networks, and social media), are essential for supporting collaborating tasks. Therefore, the current research hypothesizes that:

H1a - Collaboration quality has a positive influence on the individual impact of e-learning systems.

H1b - Collaboration quality has a positive influence on the use of e-learning systems.

H1c - Collaboration quality has a positive influence on the user satisfaction of e-learning systems.

Service quality of e-learning systems requires responsiveness, empathy, trust, and security of the supporting staff. According to earlier studies, service quality is essential to satisfaction and use (Chang & King, 2005; Pitt, Watson, & Kavan, 1995; M. Uppal, Gulliver, & Ali, 2017), and in e-learning context service quality impacts positively e-learning usage and students' satisfaction (Aparicio, Bacao, & Oliveira, 2017; Machado da Silva et al., 2014). Our proposal is that service quality has an impact not only on use, and on satisfaction, but also on individual performance. Therefore, the current research hypothesizes that:

H2a - Service quality has a positive influence on the individual impact of e-learning systems.

H2b - Service quality has a positive influence on the use of e-learning systems.

H2c - Service quality has a positive influence on the user satisfaction of e-learning systems.

Rich content provides quality of the information regarding its usefulness, understandability, and reliability (DeLone & McLean, 1992). Several studies have found that information quality has a

positive impact on the use and satisfaction (Lin & Lee, 2006; Machado da Silva et al., 2014; McKinney et al., 2002; Urbach et al., 2010; Yang, Cai, Zhou, & Zhou, 2005). Information quality can also have a direct impact on individual performance (DeLone & McLean, 2002). Therefore, the current research hypothesizes that:

H3a - Information quality has a positive influence on the individual impact of e-learning systems.

H3b - Information quality has a positive influence on the use of e-learning systems.

H3c - Information quality has a positive influence on the user satisfaction of e-learning systems.

System quality of an e-learning system is critical to a good user experience of e-learning (Ahn, Ryu, & Han, 2004). It is also identified as having an impact on performance characteristics, functionality, and usability, among others (McKinney et al., 2002). System quality is the level of ease of use and carrying out of tasks (Elkaseh, Wong, & Fung, 2016; Schaupp, Weiguo Fan, & Belanger, 2006). Studies by Urbach et al. (2010) also demonstrate the importance of navigability, accessibility, structure, visual logic, and stability of e-learning systems to ensure a good user experience and learning (Butzke & Alberton, 2017; Tarhini, Hone, Liu, & Tarhini, 2017). Studies demonstrate that system quality has a positive impact on use and satisfaction (Aparicio et al., 2017; Urbach et al., 2010). DeLone & McLean (2002) hypothesize that system quality has a direct and positive impact on individual performance. Therefore, the current research hypothesizes that:

H4a - System quality has a positive influence on the individual impact of e-learning systems.

H4b - System quality has a positive influence on the use of e-learning systems.

H4c - System quality has a positive influence on the user satisfaction of e-learning systems.

Student's anxiety toward computers is different from attitude. On one hand, computer anxiety represents beliefs and feelings about computers (Heinssen, Glass, & Knight, 1987). However, learners' anxiety has a negative impact on satisfaction, preventing e-learning success (Sun et al., 2008). These

authors found that the greater the anxiety is, the smaller the task performance will be (Kanfer & Heggestad, 1997). The attitudes of individuals who are well-adjusted to technology would be more positive and will lower anxiety levels (Barbeite & Weiss, 2004). Therefore, the current research hypothesizes that:

H5 - The learner computer anxiety has a negative influence on the user perceived satisfaction of e-learning user.

Instructor attitude toward e-learning corresponds to teachers' reactions about students' problems (Soon, Sook, Jung, & Im, 2000). In an online course, instructor assistance encourages students to continue their studies. Consequently, if a teacher can handle the e-learning activities and responds to students' needs and problems promptly, the satisfaction of learning will improve (Levy & Ramim, 2017). Studies support the impact of this variable on satisfaction (Webster & Hackley, 1997). Therefore, the current research hypothesizes that:

H6 - The instructor attitude toward e-learning influences user perceived satisfaction of the e-learning user.

Diversity in assessment comprises the appropriate feedback evaluation methods and mechanisms. These mechanisms are essential for e-learning users, which allows the follow-up of learning. According to some studies, this considerably influences students' satisfaction (Thurmond, Wambach, Connors, & Frey, 2002). Therefore, if an e-learning system provides more assessment tools and diverse methods, the level of user satisfaction will be greater. Therefore, the current research hypothesizes that:

H7 - The diversity in assessment has a positive influence on the user perceived satisfaction of e-learning user.

In a virtual learning environment, the electronic interactions between students and other students or course materials can help to solve problems and improve the frequency and quality of the learning process. Arbaugh's (Arbaugh, 2002) study suggests that when students realize there is greater interaction with others, there is an increase of user satisfaction. Therefore, the current research hypothesizes that:

H8 - The learner perceived interaction with others has a positive influence on the user perceived satisfaction of e-learning user.

User perceived satisfaction toward an information system influences the actual usage of a system (DeLone & McLean, 2003). This relationship between satisfaction and use of an information system is sustained by several studies (Costa, Ferreira, Bento, & Aparicio, 2016; Seddon, 1997; Sun et al., 2008; Urbach et al., 2010). Some studies on e-learning success also support that the more satisfied the students are the more they will use e-learning systems (Aparicio et al., 2016b, 2017; Wang & Chiu, 2011). Therefore, the current research hypothesizes that:

H9 - The user perceived satisfaction has a positive influence on the use of e-learning user.

Information systems usage is positively related to individual performance (Aparicio et al., 2016b; DeLone & McLean, 2002; Tam & Oliveira, 2016; Urbach et al., 2010). If e-learners' usage perception is aligned with their needs, students can accomplish their tasks in a more effective way. The more students use e-learning systems, the more they perceive positive individual impacts (Aparicio et al., 2016b). Therefore, the current research hypothesizes that:

H10 - The use has a positive influence on the individual impact of e-learning user.

The greater the user satisfaction, the greater the individual impact (DeLone & McLean, 1992; Tam & Oliveira, 2016; Urbach et al., 2010). Studies on e-learning success report that user satisfaction has a significant impact on value (Alsabawy, Cater-Steel, & Soar, 2011), and has a positive impact on

individual performance (Aparicio et al., 2016b, 2017; Piccoli et al., 2001). Therefore, the current research hypothesizes that:

H11 - The user perceived satisfaction has a positive influence on the individual impact of e-learning user.

Figure 3.2 presents the research model proposal based on the above hypotheses. The most often studied dimension of e-learning systems success is users' satisfaction (Aparicio et al., 2016b; George et al., 2014). Satisfaction has a positive impact on usage, and on individual impacts (DeLone & McLean, 2003). For this reason, we included another theory validated for e-learning systems (Sun et al., 2008), as other dimensions, such as learners attitude toward technology, instructor attitude, assessment, and interaction between learners' satisfaction of e-learning. We included individual aspects of learners to better understand their role in success. We also included collaboration quality in the model (Urbach et al., 2010) because online students tend to be in different physical locations, and that can affect their individual performance.

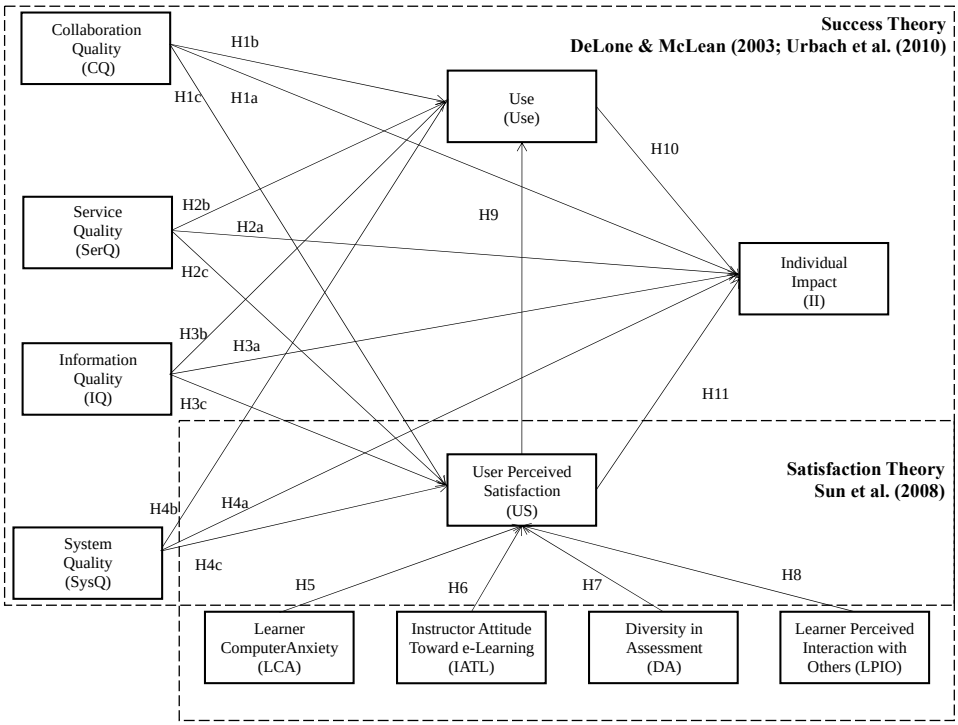


Figure 3.2 - E-learning systems' success research model proposal

3.4. Methodological approach

As the theoretical model has qualitative approaches to generalization, the quantitative method was chosen, as it was deemed more suitable (Johnson & Duberley, 2013). The survey collected 301 valid responses. An online survey was carried out with students (undergraduate and graduate) to collect data for the empirical evaluation of our theoretical model. The research design is in line with most studies and best practices.

3.4.1. Construct operationalization

The research model constructs' operationalization is composed of tested scales of several studies, of both information systems success theory and e-learning systems theory (Appendix A). Each construct of the conceptual model made use of tested and proven measures in order to increase the validity of this study. The latent variables, collaboration quality (CQ), service quality (SerQ), information quality (IQ), use, user satisfaction (US), and individual impacts (II), are operationalized according to items adaptation of Urbach et al., (2010). As for learner computer anxiety (LCA), instructor attitude toward e-learning (IATL), diversity assessment (DA), learner perceived interaction with others (LPIO), these are according to the items of Sun et al. (2008).

3.4.2. Survey environment & data collection strategy

The data collection instrument was initially developed in English, according to validated literature scales (Appendix B). Then, the final version was translated into Portuguese, by a professional translator, and then back into English by a different translator to ensure conversion correspondence (Brislin, 1970). The questionnaire was pre-tested by a group of 20, non-distance learners, to ensure that it was well interpreted by university students. The sampling strategy undertaken consisted of directly contacting 24 organizations, of higher education institutions all over Brazil, requesting collaboration to carry out the online survey among their students. A hyperlink was provided by email to the coordinators so they could pass it on to the students, asking them to forward the e-mail to all or

a subset of students. Course coordinators (graduate and undergraduate) in Brazil were contacted. Participation was encouraged by offering higher education institutions the survey results. When necessary, telephone contact with the course coordinators (and in some cases with principals) was made to clarify the objectives of the study and discuss of new procedures. The data collection process followed a strict path. The research is approved by the university committee, and from an ethical point of view, the universities involved did not oppose the study. The study is anonymous and private, and all the questions concern the study context. At the outset of the questionnaire, all respondents were informed about the academic research purpose of the survey, in which they voluntarily agreed to participate. The questionnaire was totally anonymized, no personal information was asked for from respondents, and no tracking systems were employed. As a delimitation, the study was addressed only to higher education/institutions, such as colleges, universities, and university centers either public or private. To minimize bias and obtain respondents, it was emphasized that all the data would be treated with total confidentiality and that the identity of the respondent could not be inferred.

From January of 2015 to June of 2015, 381 responses to the survey were obtained, although due to incomplete answers only 301 were considered valid and complete for analysis. Only the questionnaires were considered for further analysis. Respondent students included both the classroom mode with e-learning as support (blended learning) and 100% e-learning. Learners' answered on a seven-point scale, from 1 point - strongly disagree, to 7 points - strongly agree. The questionnaire also included queries about general respondents' characteristics, such as, gender, age, which e-learning platform they use and general comments (Table 3.1). The survey is balanced in terms of male (50%) and female (50%) respondents. The university students are respectively 49% male and 53% female (INEP, 2016; OECD Digital Economy Outlook, 2015). Most learners in the sample learners are at a university level. There is no statistically significant difference ($p > 0.10$) between the gender of our sample and the university student population.

Table 3.1 - Sample characterization

Characteristic	N	%
Gender		
Female	150	50%
Male	151	50%
Total	301	100%
Instruction level		
Undergraduate	4	1%
2 Year College Degree	83	28%
4 Year College Degree	92	30%
Master Degree	93	31%
Doctoral Degree	21	7%
Professional Degree	8	3%
Total	301	100%
E-learning systems used		
Moodle	89	30%
Blackboard	139	46%
Other or University Proprietary System	73	24%
Total	301	100%
Purpose of the e-learning course		
University Course	280	93%
Training	21	7%
Total	301	100%
MOOCs' Platforms students use		
Coursera	45	15%
edX	8	3%
Khan Academy	31	10%
Other	63	21%
Do not use MOOCs	154	51%
Total	301	100%

3.5. Analysis and results

For data analysis we used the structural equation model (SEM) method. Using the empirical survey data, the measurement properties were evaluated, and the hypotheses were tested using the approach of partial least squares (PLS) (Chin, 1998; Wold, 2006). PLS was chosen for data analysis due to its advantages, even if compared to approaches based on the covariance. When the search model is complex, it has a large number of constructs, and the measures are thus not well established (Chin & Newsted, 1999; Fornell & Bookstein, 1982). Furthermore, PLS software may be more suitable because it has less stringent requirements on the distributions (Fornell & Bookstein, 1982; Gefen, Straub, & Boudreau, 2000). Finally, the approach by the PLS is the most suitable for management problems focused on forecasts (Fornell & Bookstein, 1982; Huber, Herrmann, Meyer, Vogel, & Vollhardt, 2007). The software used was Smart PLS version 3.2.8 (Ringle et al., 2015) for statistical calculations.

3.5.1. Measurement model evaluation

Reflective indicators were used to establish the constructs. Following the validation guidelines proposed by Lewis, Templeton, & Byrd, 2005; D. Straub, Boudreau, & Gefen (2004), models of reflective measurement for one-dimensionality, internal consistency, indicator reliability, convergent validity, and discriminant validity were tested by applying standard decision rules. The traditional criterion to assess the internal consistency is Cronbach's Alpha (CA). All the CA are above 0.700, indicating internal consistency, and the scores of all items of the constructs have the same scope and meaning as defined by Cronbach (1951). An alternative measure for CA is composite reliability (CR) (Werts, Linn, & Jöreskog, 1974). The CR is recommended by Chin (1998) as the preferred measure, as it overcomes some of the deficiencies of the CA. The CA and CR values of all constructs in our model are as shown in Table 3.2, above the minimum recommended 0.700 (Nunnally & Bernstein, 1994). The model measures the CR above 0.800 meeting the criteria established by Peter (1979).

We evaluated the indicator reliability verifying the criteria that the loadings should be greater than 0.70 (Henseler, 2010; Henseler, Ringle, & Sinkovics, 2009). As reported in Table 3.2, loadings are greater than 0.7, except for two items (Use1 and Use 5), which are lower than 0.7 but greater than 0.4. Hence, no items in the table were eliminated. The measuring instrument presented good indicator reliability. Convergent validity relates to the level at which individual items are reflected in the construct and converge compared to items that measure different constructs. A commonly applied convergent validity criterion is the average variance extracted (AVE) proposed by Fornell & Larcker (1981). As shown in Table 3.2, all model constructs have indicators above 0.500, indicating that the variance of the construct is greater than the variation caused by the respective measurement errors and thus indicating that all constructs have adequate validity (Segars, 1997).

Table 3.2 - Measurement model results

Constructs	Items	Loadings	Composite Reliability (CR)	Cronbach's Alpha (CA)	Average Variance Extracted (AVE)	Discriminant Validity
Collaboration Quality (CQ)	CQ1	0.917	0.952	0.933	0.831	Yes
	CQ2	0.944				
	CQ3	0.859				
	CQ4	0.925				
Service Quality (SerQ)	SerQ1	0.931	0.946	0.923	0.814	Yes
	SerQ2	0.872				
	SerQ3	0.942				
	SerQ4	0.861				
Information Quality (IQ)	IQ1	0.930	0.934	0.906	0.781	Yes
	IQ2	0.884				
	IQ3	0.902				
	IQ4	0.816				
System Quality (SysQ)	SysQ1	0.922	0.956	0.939	0.845	Yes
	SysQ2	0.929				
	SysQ3	0.922				
	SysQ4	0.904				
Learner Computer Anxiety (LCA)	LCA1	0.905	0.952	0.925	0.870	Yes
	LCA2	0.959				
	LCA3	0.933				

Constructs	Items	Loadings	Composite Reliability (CR)	Cronbach's Alpha (CA)	Average Variance Extracted (AVE)	Discriminant Validity
Instructor Attitude Toward e-Learning (IATL)	IATL1	1.000	1.000	1.000	1.000	Yes
Diversity in Assessment (DA)	DA1	1.000	1.000	1.000	1.000	Yes
Learner Perceived Interaction with Others (LPIO)	LPIO1	0.775	0.868	0.773	0.686	Yes
	LPIO2	0.845				
	LPIO3	0.862				
User Perceived Satisfaction (US)	US1	0.895	0.930	0.899	0.771	Yes
	US2	0.753				
	US3	0.936				
	US4	0.916				
Use (Use)	Use1	0.617	0.851	0.777	0.537	Yes
	Use2	0.809				
	Use3	0.808				
	Use4	0.793				
	Use5	0.604				
Individual Impact (II)	II1	0.893	0.944	0.920	0.808	Yes
	II2	0.939				
	II3	0.935				
	II4	0.824				

As all the AVEs are above 0.500, requirements are met (Barclay, Higgins, & Thompson, 1995; Fornell & Larcker, 1981; Hair, Hult, Ringle, & Sarstedt, 2014; Urbach & Ahlemann, 2010). Finally, the discriminant validity measures the level at which the scale of different constructs differs from each other. To further validate that all measures are in fact different, the AVE square root extracted for each construct was examined and presented higher than the correlation between constructs (Table 3.3). Conceptually, this test requires that each construct represents more of the variance in its indicators than it shares with other constructs (Fornell & Larcker, 1981). A second criterion was used; we compare the loadings with the cross-loadings. We can see in Appendix C that the loadings (in bold) are greater than respective cross-loadings. Consequently, for both criteria the discriminant validity was achieved.

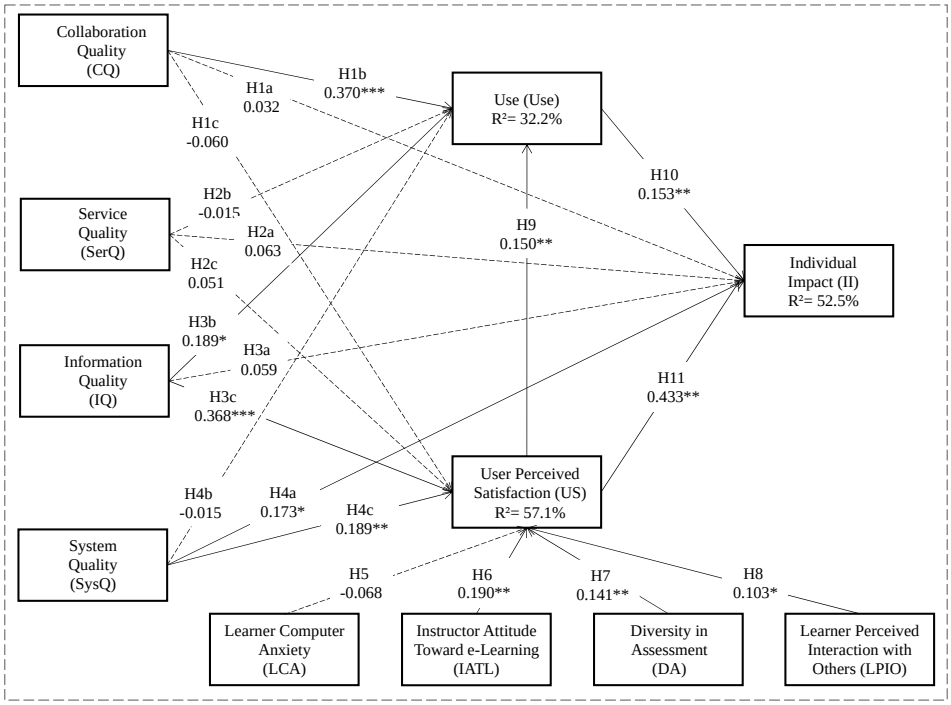
Table 3.3 - Correlation between constructs and square root of AVEs

	CQ	SerQ	IQ	SysQ	LCA	IATL	DA	LPIO	US	Use	II
CQ	**0.912**										
SerQ	0.472	**0.902**									
IQ	0.460	0.386	**0.884**								
SysQ	0.482	0.418	0.578	**0.919**							
LCA	-0.011	-0.038	-0.177	-0.218	**0.933**						
IATL	0.287	0.332	0.353	0.331	-0.109	**1.000**					
DA	0.420	0.298	0.472	0.347	-0.131	0.402	**1.000**				
LPIO	0.654	0.363	0.432	0.405	-0.052	0.364	0.472	**0.828**			
US	0.407	0.390	0.660	0.563	-0.220	0.485	0.505	0.458	**0.878**		
Use	0.503	0.285	0.443	0.350	-0.034	0.319	0.300	0.432	0.411	**0.733**	
II	0.426	0.387	0.553	0.547	-0.240	0.399	0.379	0.384	0.671	0.452	**0.899**

Note: Diagonal elements (in bold) represent the square root of the AVE

3.5.2. Assessment of the structural model

After validation of the measurement model, the structural model was studied, and the possible relationships between the constructs were tested. The results of the test conducted in the structural model are given in Figure 3.3 and Table 3.4. The test used 5,000 bootstrap resamples to determine the significance of the paths within the structural model. The quality of the model explains a considerable part of the variation of the latent variables. The model explains respectively 57.1% of the variation in user perceived satisfaction, 32.2% of the variation in use of e-learning, and 52.5% of the variation in individual impact. Since most of the constructs are explained well, we consider it a substantial model. The model explains 32.2% of the e-learning use variation. Collaboration quality ($\widehat{\beta}$ = 0.370; $p < 0.001$), information quality ($\widehat{\beta}$ = 0.189; $p < 0.050$), and user perceived satisfaction ($\widehat{\beta}$ = 0.150; $p < 0.010$) are statistically significant.



Notes: * significant at p < 0.05; ** significant at p < 0.01; *** significant at p < 0.001

Figure 3.3 - Research model results

Consequently, H1b, H3b, and H9 are confirmed. The model explains 57.1% of the user perceived satisfaction variation. Information quality ($\widehat{\beta}$ = 0.368; p < 0.001), system quality ($\widehat{\beta}$ = 0.189; p < 0.050), instructor attitude toward e-learning ($\widehat{\beta}$ = 0.190; p < 0.010), diversity in assessment ($\widehat{\beta}$ = 0.141; p < 0.010), and learner perceived interaction with others ($\widehat{\beta}$ = 0.103; p < 0.050) are statistically significant. Hence H3c, H4c, H6, H7, and H8 are confirmed. Finally, the model explains 52.5% of the individual impact variation. System quality ($\widehat{\beta}$ = 0.173; p < 0.050), use ($\widehat{\beta}$ = 0.153; p < 0.010), and user perceived satisfaction ($\widehat{\beta}$ = 0.433; p < 0.001) are statistically significant. Thus, H4a, H10, and H11 are confirmed.

Table 3.4 - Results summary of e-learning systems success hypotheses tests

Hypothesis	Variable		Variable	Findings	Support	f^2	Effect Size
H1a	Collaboration Quality (CQ)	>	Individual Impact (II)	Positively & statistically insignificant ($\widehat{\beta}$ = 0.032 NS)	No	0.001	NS
H1b	Collaboration Quality (CQ)	>	Use (Use)	Positively & statistically significant ($\widehat{\beta}$ = 0.370***)	Yes	0.131	small
H1c	Collaboration Quality (CQ)	>	User Perceived Satisfaction (US)	Negatively & statistically insignificant ($\widehat{\beta}$ = -0.060 NS)	No	0.004	NS
H2a	Service Quality (SerQ)	>	Individual Impact (II)	Positively & statistically insignificant ($\widehat{\beta}$ = 0.0625 NS)	No	0.006	NS
H2b	Service Quality (SerQ)	>	Use (Use)	Negatively & statistically insignificant ($\widehat{\beta}$ = - 0.015 NS)	No	0.000	NS
H2c	Service Quality (SerQ)	>	User Perceived Satisfaction (US)	Positively & statistically insignificant ($\widehat{\beta}$ = 0.051 NS)	No	0.004	NS
H3a	Information Quality (IQ)	>	Individual Impact (II)	Positively & statistically insignificant ($\widehat{\beta}$ = 0.059 NS)	No	0.003	NS
H3b	Information Quality (IQ)	>	Use (Use)	Positively & statistically significant ($\widehat{\beta}$ = 0.189**)	Yes	0.025	NS
H3c	Information Quality (IQ)	>	User Perceived Satisfaction (US)	Positively & statistically significant ($\widehat{\beta}$ = 0.368***)	Yes	0.175	small
H4a	System Quality (SysQ)	>	Individual Impact (II)	Positively & statistically significant ($\widehat{\beta}$ = 0.173*)	Yes	0.035	NS
H4b	System Quality (SysQ)	>	Use (Use)	Negatively & statistically insignificant ($\widehat{\beta}$ = - 0.015 NS)	No	0.000	NS
H4c	System Quality (SysQ)	>	User Perceived	Positively & statistically significant ($\widehat{\beta}$ = 0.189**)	Yes	0.047	NS

Hypothesis	Variable		Variable	Findings	Support	f^2	Effect Size
			Satisfaction (US)				
H5	Learner Computer Anxiety (LCA)	>	User Perceived Satisfaction (US)	Negatively & statistically insignificant ($\widehat{\beta}$ = - 0.068 NS)	No	0.010	NS
H6	Instructor Attitude toward e-Learning (IATL)	>	User Perceived Satisfaction (US)	Positively & statistically significant ($\widehat{\beta}$ = 0.190**)	Yes	0.063	NS
H7	Diversity In Assessment (DA)	>	User Perceived Satisfaction (US)	Positively & statistically significant ($\widehat{\beta}$ = 0.141**)	Yes	0.030	NS
H8	Learner Perceived Interaction With Others (LPIO)	>	User Perceived Satisfaction (US)	Positively & statistically significant ($\widehat{\beta}$ = 0.103*)	Yes	0.013	NS
H9	User Perceived Satisfaction (US)	>	Use (Use)	Positively & statistically significant ($\widehat{\beta}$ = 0.150**)	Yes	0.017	NS
H10	Use (Use)	>	Individual Impact (II)	Positively & statically significant ($\widehat{\beta}$ = 0.153**)	Yes	0.034	NS
H11	User Perceived Satisfaction (US)	>	Individual Impact (II)	Positively & statistically significant ($\widehat{\beta}$ = 0.433***)	Yes	0.197	small

Notes: NS = not significant; * significant at $p < 0.05$; ** significant at $p < 0.01$; *** significant at $p < 0.001$; effect Size f^2: > 0.350 large; > 0.150 and ≤0.350 medium; > 0.20 and ≤0.150 small; (Chin, 1998; Cohen, 1988)

3.6. Discussion

Most of the hypothesized relationships were verified. Use is explained by collaboration quality, information quality, and user satisfaction. Users' satisfaction is explained by information quality, e-learning system quality, instructor attitude toward e-learning, diversity in assessment, and learner interaction with others. Individual impacts on e-learning usage are determined by use of e-learning systems, user satisfaction, and system quality. Although collaboration quality does not determine user

satisfaction or individual impact, and service quality determines none of the e-learning success dimensions, either learner computer anxiety was found significant to satisfaction (Table 3.4).

The study indicates that collaboration quality positively influences e-learning systems' use (H1b), and therefore that collaboration quality of e-learning systems appears to be an important success factor. If available, collaborative features are used by the users, achieving a greater overall satisfaction with e-learning. Therefore, providing additional collaboration capabilities and improving existing ones may directly increase use and user perceived satisfaction, and hence the individual impact. Similar results were found in employee portal usage and e-learning usage (Urbach et al., 2010; Y.-S. Wang, 2003). Results indicate that service quality (H2) has no significant impact on user satisfaction, use and individual impact. This finding is consistent with the results reported by other authors (Chiu, Sun, Sun, & Ju, 2007; Choe, 1996; Urbach et al., 2010), although a study conducted in Brazil found different results (Machado da Silva et al., 2014). These authors found a statistically significant impact of service quality on use ($\widehat{\beta}$ = 0.56***) and on satisfaction ($\widehat{\beta}$ = 0.63***). This might be due to the sample differences. In our study participants were all from university programs, whereas the other study sample had learners from various levels of instruction. The results confirm hypotheses H3b and H3c, that information quality has a positive impact on use and on user satisfaction, corroborating similar results on e-learning systems success (Aparicio et al., 2017; Machado da Silva et al., 2014; Ramírez-Correa, Rondan-Cataluña, Arenas-Gaitán, & Alfaro-Perez, 2017). Another study also found that the access to resource contents predicted success (Bandeira, dos Santos, Ribeiro, & Gavião Neto, 2016). The hypotheses H4a and H4c are validated; system quality is positive and statistically significant on user perceived satisfaction, and on individual impacts. Similar results were found in e-learning studies, and in employee portal in ERP usage satisfaction. In these studies system quality also had a positive impact on user satisfaction, and system quality was not significant in these systems' use (Aparicio et al., 2017; Costa et al., 2016; T. J. McGill & Klobas, 2005; Urbach et al., 2010). Machado da Silva et

al., (2014) found no significant impact of system quality on use, or on satisfaction. The impact of learner computer anxiety on satisfaction (H5) was not found significant, which is at odds with Sun et al., (2008) findings. One reason for that is that students today might not feel so anxious toward technology usage. It is likely that the lastest generations are more familiar with digital platforms, or because 99% of the respondents had at least a two-year college degree.

Instructor attitude toward e-learning, diversity assessment, and learner perceived interaction with others have a positive impact e-learner satisfaction (H6, H7, and H8). These findings corroborate Sun et al.'s (Sun et al., 2008) results. A variety of assessment methods allow the instructors to establish the effects of learning and different aspects of education which can be more effective. As for the students, diversified rating methods are motivational factors, as evidenced by the efforts of students, engaging them in e-learning activities. Communication functionalities may also allow instructors to engage more students, and students themselves can interact more easily with their peers. Results show evidence that user satisfaction has a positive impact on e-learning systems use (H9). Similar results were reported in other studies (Urbach et al., 2010; Wu & Wang, 2006). E-learning systems use and user satisfaction have a positive impact on individual performance (H10, H11), and these findings are consistent with various studies (Aparicio et al., 2017; Urbach et al., 2010; Wu & Wang, 2006). The significant impact of user perceived satisfaction on individual impacts supports the suggestion that user perceived satisfaction can serve as a valid substitute for individual impact (Iivari, 2005; Piccoli et al., 2001). Our study demonstrates that collaboration, and information and system quality are determinant factors of e-learning systems success, and that instructor attitude, diversity in assessment, and learner interaction with others, are also success determinants for e-learning success.

3.6.1. Conclusions and implications

This article presents a theoretical background that includes IS success and e-learning systems satisfaction and success. Based upon theory a model was proposed and validated empirically in

Brazilian universities. This study demonstrates that the use and user satisfaction are interdependent, and both have a positive impact on individual performance. The hypotheses developed (information quality, system quality, instructor attitude toward e-learning, diversity in assessment, and learner perceived interaction with others) explain the user perceived satisfaction. Collaboration quality, information quality, and user perceived satisfaction are important drivers for e-learning use. Collaboration quality, service quality, information quality, system quality, user perceived satisfaction, and use explain the individual impact. This Brazilian e-learning success model explains 52% of the variation of individual impacts.

This study presents two theoretical implications, as it contributes to information systems theory. Our model combines the information systems success theory of DeLone & McLean (DeLone & McLean, 1992; 2003) with e-learning systems satisfaction theory (Sun et al., 2008) and collaboration quality (Urbach et al., 2010). As another theoretical contribution, this model validates information systems success theory for the case of e-learning systems usage in the context of Brazil.

The practical implications of this study bring insights to e-learning systems designers and providers. One such implication derived from this study is that e-learning platforms should provide technological features to enable a collaborative environment, an important aspect in e-learning systems success. According to our findings, when making decisions about, stakeholders would benefit by including collaboration modules in the platforms. As an example, technological platforms should allow the articulation of communication and collaboration between students, thus influencing use and learners' satisfaction. This study also implies that information quality has a significant impact on use and satisfaction, such as course contents. Content should be retrievable, useful, understandable, interesting, and reliable. Institutions should design various ways of self-assessment through quizzes, tests, and other ways of testing knowledge. Thus, providers would increase global success level by investing in

the contents of the course content. From this study we also learned that if e-learning systems provide a variety of ways for learning assessment, and if learners interact with each other, it will lead to an increase of satisfaction. We found from this study that the perception of individual performance is due to the learners' perceived system quality. If the system is easy to navigate and well-structured in terms of content and functionalities, it will increase satisfaction and usage of e-learning systems.

3.6.2. Limitations and future research

The results indicate that the dimensions of DeLone & McLean (2003); Sun et al. (2008); Urbach et al. (2010), are not enough to fully capture the determinants of use, satisfaction, and success of e-learning. Thus, our study contributes to the advancement of theory development and serves as a basis for future research. Future research can be carried out using universities and private colleges, and even with universities and public colleges, as they have different teaching and learning processes. These institutions might conduct comparative studies of e-learning systems success at different levels, such as comparing the learners' perceived impact with teachers' perceived impact. Other research studies can evaluate e-learning when used in blended format (classroom and e-learning) and other studies in fully online format. The components of change of paradigm in e-learning, according to Liu & Hwang (2010), are computer networks (e-learning), mobile devices and wireless communications, and device sensor technologies mobile and wireless communications (context-aware u-learning). A new system architecture of the learning environment is in progress: context-aware and u-learning. As a result, new research that takes into account such variables is recommended. Comparing the e-learning in different countries is also recommended for future studies.

CHAPTER IV . STUDENTS' LONG-TERM ORIENTATION ROLE IN E-LEARNING SUCCESS: A BRAZILIAN STUDY

E-learning can play an important role in the solution to educate a large share of the population in several countries. Studies point out that cultural characteristics can influence e-learners' performance. Our main goal is to understand the e-learning success drivers in Brazil. Our research proposes a model that analyzes students' long-term orientation role in the Brazilian e-learning context. We collected 297 answers from a survey of higher education students in nine regions. Data were analyzed through a quantitative method. Results indicate that information and collaboration quality, and e-learner satisfaction explain e-learning systems usage. Our model indicates that students' long-term orientation influences the positive relationship between e-learning systems' use and the perceived net benefits. We also found that system and information quality, and e-learning systems' use are determinants of e-learning user satisfaction. Collaboration quality and information quality are determinants of e-learning systems usage. E-learning usage and user satisfaction explain overall e-learning net benefits, and long-term orientation has a moderating effect between e-learning use and net benefits.

4.1. Introduction

Brazil is a vast country composed of several cultures, and consequently universities face great challenges when providing access to instruction for their students. Leading Brazilian universities tend to be located in the main cities and near the eastern part of the country. Brazilian telecommunications systems are scant in several locations in the interior of the country; these districts are also deeply isolated from the best universities (Duran & Costa, 2016; Stewart & Lourdes Lopes, 2015; World University Rankings, 2019). All these factors combined might explain a non-usage of online learning systems. Students tend to use several media to communicate and tend to ask questions to their peers (Stewart & Lourdes Lopes, 2015). In this setting, it is important to understand what the origins of e-learning systems usage, satisfaction, and overall success are. Tarhini et al. (2017) concluded in their study that the adoption of e-learning should focus on the cultural aspects of students. Despite being vast country, we could not find in-depth studies regarding e-learning systems usage and therefore we conclude that this aspect is not widely studied in Brazil. In recent months, due to COVID 19, these types of information systems are more critical than ever, because they play a decisive role in the learning process (Chen, Zou, Cheng, & Xie, 2020). Some authors studied Brazilian e-learning adoption and usage previously, including Okazaki & Santos (2012), by validating the technology acceptance theory. Machado da Silva et al. (2014) studied the determinants of use and satisfaction of e-learning

in Brazil. Saccol, Schlemmer, Barbosa, Reinhard, & Sarmento (2009) led a qualitative study on the ease of use and interface of a mobile-learning application. Stewart & Lourdes Lopes (2015) made a qualitative study on the different types of interaction in online learning. However, these studies do not entirely capture the e-learning success drivers in Brazil.

Brazil is a tremendously diverse country characterized by literacy gaps, economic disparities, and the coexistence of several cultural communities. Today Brazil still has the strong influence of its colonial heritage, especially Portugal in the XVI century, and later engagement by France and Netherlands in the XVII century. Brazil also has several communities formed by immigrants from other parts of the globe: Africa (Angola, Mozambique), Europe (Germany), and Asia (Japan). In Brazil, cultural aspects have always been a challenging variable for research. In this study, we address the influence of long-term (LTO) and short-term orientation (STO) on e-learning systems' success. LTO and STO are characteristics that clearly define part of the oriental and western cultures (Hofstede & Bond, 1988). Our research proposes a model grounded on the information systems success (ISS) theory (William H. DeLone, 1988; DeLone & McLean, 2003) and the cultural characteristics of LTO & STO (Confucianism) (Hofstede & Bond, 1988). We conducted a survey in eleven regions of Brazil to test our proposed model empirically; however, we obtained valid answers for analysis from nine regions.

Our study contributes to understanding the setting of Brazilian e-learning systems success, a country where e-learning plays a vital role in societal literacy. Our study outlines the main e-learning systems success determinants: system (SysQ), information (IQ), and collaboration (CQ) quality were found as the main contributors to e-learning systems adoption and students' satisfaction. Our study also contributes to understanding the role of culture, namely students' long-term orientation that affects overall e-learning success.

This paper is organized into six sections. In the first section, we introduce the context and the research objective. The second section presents the theoretical study background, followed by the Brazilian e-learning systems success model proposal (section three). We describe the methodological approach and results in the fourth and fifth sections. In the sixth section, we discuss our results and present our research conclusions.

4.2. From IS success to a culturally oriented e-learning success

The information systems (IS) success theory has been influenced by seminal studies that marked five eras of IS success studies: data processing era (in the'50s to '60s); management reporting and decision support era ('60s to '80s); strategic and personal computing (in the '80s to the '90s); enterprise system and networking ('90s to 2000); and customer-focused era (in the 2000s) (Petter, DeLone, & McLean, 2012). These five eras of IS success studies are named after the verified technological evolution and innovations. William H. DeLone & McLean (1992) proposed the first ISS model, identifying IQ, SysQ as the determinants of ISS. These two dimensions positively influenced IS usage and IS satisfaction and the subsequent explanation of individual and organizational performance. DeLone & McLean (1992) ISS model and the later model (DeLone & McLean, 2003) have been studied and verified in several contexts since then; e.g., in the usage of employees portal (Urbach et al., 2010); e-banking (Koo, Wati, & Chung, 2013; Tam & Oliveira, 2016); e-commerce systems (Chong, Cates, & Rauniar, 2010); e-government systems (Khayun, Ractham, & Firpo, 2012); e-learning systems (Machado da Silva et al., 2014). IS success defines systems usage as a success measure, as well as the satisfaction of users towards the system. IS success defines the perceived positive impact of technology usage at individual and organizational levels as dependent variables of success. The authors DeLone & McLean (2003) later merged individual impacts (II) and organizational impacts (OI) into net benefits (NB). Net benefits stand for the positive impacts on various levels of systems' usage, although the authors denominated these two impacts.

IS success theory defines that independent variables are dimensions that comprehend various types of quality (IQ, SysQ, and SerQ), as a set of desirable characteristics related to the reliability of the SysQ, the required features of the system output (information quality) and the requirable support to services (DeLone & McLean, 2003). The inner-model variables correspond to the first stage of success, measuring IS intention behavior to use, and actual IS use, as well as users' satisfaction with the system. The dependent variables, II & OI, were grouped into a new construct, net benefits.

E-learning systems are enablers of learning (Neroni, Gijselaers, Kirschner, & de Groot, 2015), as they support communication of several types of contents to be used anywhere, anytime, and on multiple devices, so these characteristics are favorable to a country like Brazil. Brazil has many people seeking to learn; however, not all people are near universities or schools as it is a vast geographically dispersed country so e-learning plays an integral part in knowledge diffusion. Most of those researches focus on the problematic of the adoption of e-learning (Machado da Silva et al., 2014; Maldonado, Khan, Moon, & Rho, 2009; Teo, 2011), but there are very few in the Brazilian context. Machado da Silva et al. (2014) shows that this country has particular challenges to face regarding infrastructure and various cultures (occidental and oriental) and different literacy levels across Brazilian society. In this research, we focus on the Brazilian context and on determining the main factors that explain e-learning systems' usage and overall success. This context draws a line we explore in this study, which is to understand the impact of LTO and STO in the success of e-learning. E-learning culture studies pointed out that culture affects how a student learns and perceives learning (Aparicio et al., 2016a). We found some studies that include one or various cultural dimensions in online learning contexts (Simmons, Simmons, Hayek, Parks, & Mbarika, 2012; Tapanes, Smith, & White, 2009; Tarhini et al., 2017; J. Yang, Kinshuk, Yu, Chen, & Huang, 2014). These studies found that cultural factors influence the way people learn and the way people interact with learning materials and peers. Tapanes et al. (2009), Simmons et al. (2012), Yang et al. (2014) and Tarhini et al. (2017) focus on the effects of the cultural

characteristics on online learning adoption and usage, such as individualism/collectivism, ambiguity tolerance level, power distance, masculinity, uncertainty avoidance, and cultural orientation. Considering these earlier studies, we found that it is relevant to study the role of LTO & STO in e-learning success. LTO & STO are cultural characteristics (Hofstede, 1984) that may impact the way people acquire knowledge and in the way they face their life, from another study we learned that when students pursue long term objectives and are persistent in their achievement, these attitudes show impact on success (Duckworth & Gross, 2014).

Hofstede & Bond (1988) focused studies on the oriental way of life, grounding in the Confucian philosophy, which they named as "Confucian dynamism." This secular philosophy proposes: (1) societal stability is based on several relationship types between people; (2) family is typically regarded as a prototype of social organizations; (3) moral behavior towards others, is considered as a way of treating others, as each person would like to be treated by others; and (4) moral with regards to anyone's tasks, is regarded as the way people try to obtain instruction and skills, working consistently and in a persevering way, regarding the sufficient resources to do that. Considering the oriental perspective, Hofstede (1991) added a fifth cultural dimension, LTO/STO, to original four as a way to incorporate the oriental view in the model. STO is coined as unfavorable or anti-ethical perspectives, the LTO, regarding Confucian dynamism theory, tend to the opposite, to the positive and ethical perspectives. According to this theory (Hofstede, 1991, 2001), the original interpretation of LTO is persistence, ordering relationships, combined with the sense of shame. The LTO/STO dichotomy is based on how the culture impacts on the way people see time passing by. In this research evolution, they tried to create a measuring scale and started the LTO concept. LTO is the cultural characteristic of incorporating time in many contexts of people's lives, respecting both past & future, instead of estimating peoples' actions only for their consequences on here/now or in their future (Bearden et al., 2006). According to Confucian dynamism theory (Hofstede & Bond, 1988; Bearden et al., 2006) and

the studies of Hofstede (1991) and Geert, Hofstede, & Minkov (2010) LTO versus STO is related with the peoples' willing to focus their behavior in the future or the present & past. These authors considered a strong relationship between LTO and ethics (Nevins, Bearden, & Money, 2007). They concluded that the more LTO the individual has, probably the more ethics component he has, and that influences the nation's culture. Considering that the DeLone & McLean Model comes from a behavioral basis, it is possible to consider that the Confucian dynamic theory, dimensions of a nation's culture can also be used to evaluate some aspects of an information system because individual aspects of behavior define the nation's culture (Figure 4.1). Leidner & Kayworth (2006) pointed out two main aspects of culture and information technology use and outcomes in their research: (1) different cultures lead to similar or different benefits and (2) cultural value is more significant to information technology success. Geert et al. (2010), correlated LTO with better school results. In the studies of A. Smith, Dunckley, French, Minocha, & Chang (2004), they concluded that there is a need to take cultural characteristics on the world wide web into consideration. The Confucian dynamic theory (Bearden et al., 2006) refers that countries with STO or LTO ratings interact with learning and work, considering: (1) While people with LTO estimate thrift, effort, and responsibility as central values, people with STO are more related to convictions and emphasize rights and values; (2) The higher LTO the person has, the more they are committed. On the other hand, individuals with STO are less committed; and (3) As a behavior, LTO people are mainly modest, whereas people with STO are mainly talkative. Some conflict can be caused by the difference between expectations and reality in people with STO. People in LTO cultures prefer to ask "what" and "how" than to ask "why." In a recent study, Figlio, Giuliano, & Özek (2017) found that LTO students attitudes' have improved results than other students, with less prominence on a delayed reward. Some studies relate LTO and STO in the learning context, indicating that several previous studies have found the impact of cultural dimensions in instructional contexts (Figlio et al., 2017; Lai, Wang, Li, & Hu, 2016; Mahomed, Mcgrath, & Yuh, 2017; Nistor, Göğüş, & Lerche, 2013) Therefore, STO and LTO would impact overall e-learning success (DeLone & McLean, 2003)

justifying the integration of IS Success Theory with Confucian dynamism theory (Bearden et al., 2006; A. Smith et al., 2004).

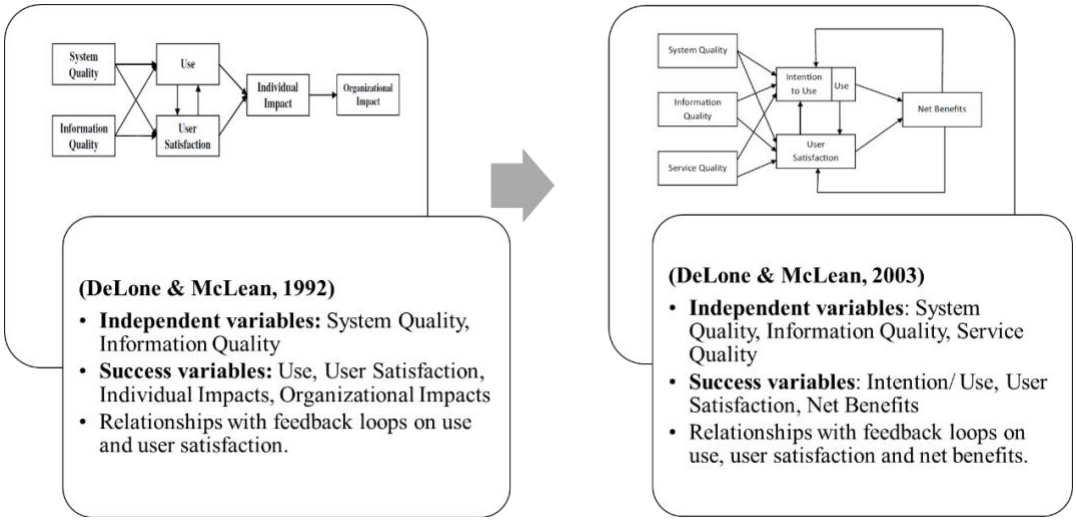


Figure 4.1 - DeLone & McLean (1992; 2003) Model's evolution

In Appendix F, we can see the summary of the main studies related to long-term orientation (LTO) or short-term orientation (STO) with e-learning, learning, and educational context. Appendix G, a summary of the main studies on e-learning culture.

4.3. Long term-oriented e-learning success model proposal

This research proposes and empirically tests a conceptual long term/ short term-oriented e-learning success model in the Brazilian context based on IS theory and Confucian dynamism theory (Bearden et al., 2006; DeLone & McLean, 1992; Hofstede & Bond, 1988). The proposed conceptual research model is illustrated in Figure 4.2, and the following sections present the theoretical justification for each of the predicted models constructs relationships. It bears in mind prior literature discoveries and begin to be validated by some empirical studies, thus gaining solid foundations.

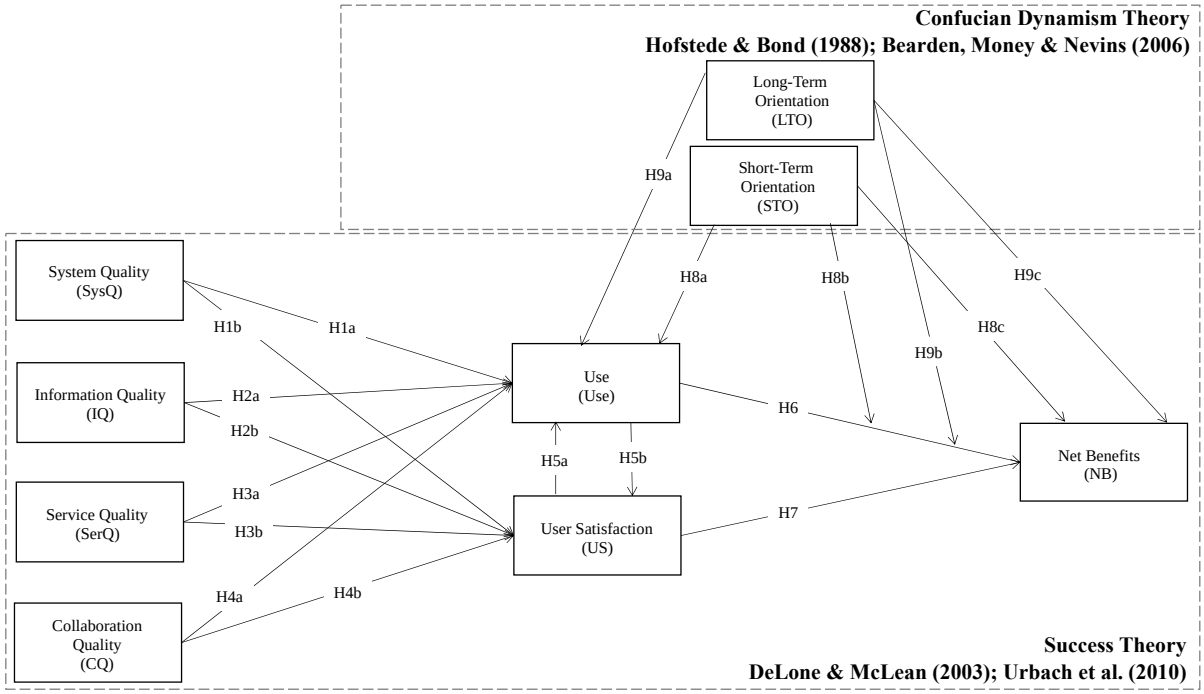


Figure 4.2 - Model proposal of LTO/STO influence on e-learning success

4.3.1. Constructs and hypotheses

Our research model (Figure 4.2) comprises nine theoretical constructs: system quality (SysQ), information quality (IQ), collaboration quality (CQ), service quality (SQ), use (U), use satisfaction (US), long-term orientation (LTO), short-term orientation (STO), and net benefits (NB). Appendix D presents the definitions of the constructs for the e-learning context. To theoretically support the relationships between the proposed model constructs, we have defined the next hypotheses (H1a; H1b; H2a; H2b; H3a; H3b; H4a; H4b; H5a; H5b; H6; H7; H8a; H8b; H8c; H9a; H9b, and H9c).

A good e-learning user experience is a result of e-learning system quality (Ahn et al., 2004). SysQ consists of the systems' ease of use, navigability, accessibility, structure and interface, among others, to support users' tasks (Elkaseh et al., 2016; McKinney et al., 2002; Schaupp et al., 2006). Some studies on e-learning also validated that user experience in the learning context is well perceived by learners (Butzke & Alberton, 2017; Tarhini et al., 2017). Machado da Silva et al. (2014) empirically

demonstrated that system quality influences e-learning usage and satisfaction. Thus, we hypothesize that system quality has a direct and positive impact on use and user satisfaction.

H1a - System quality has a positive impact on the use of e-learning systems.

H1b - System quality has a positive impact on e-learners' satisfaction.

IS content is of utmost importance for usage and satisfaction, especially when content is developed considering its usefulness, understandability, and reliability (DeLone & McLean, 2003). Previous research found that IQ has a positive impact on IS usage and users' satisfaction, as a result of using those systems (H.-F. Lin & Lee, 2006; McKinney et al., 2002; Urbach et al., 2010; Z. Yang et al., 2005). Machado da Silva et al. (2014) studied the effect of information quality on e-learning use and learners' satisfaction. Thus, we hypothesize that:

H2a - Information quality has a positive impact on the use of e-learning systems.

H2b - Information quality has a positive impact on e-learners' satisfaction.

ISS theory supports that staff responsiveness level, sympathy, confidence are characteristics of a system with quality, thus determining usage and users' satisfaction (Pitt et al., 1995; Chang & King, 2005; M. A. Uppal, Ali, & Gulliver, 2017), this was also verified in an e-learning context (Machado da Silva et al., 2014). Thus, we hypothesize that:

H3a - Service quality has a positive impact on the use of e-learning systems.

H3b - Service quality has a positive impact on e-learners' satisfaction.

Collaboration quality appeared as a positive determinant of IS usage and users' satisfaction in the employee portal success model of Urbach et al. (2010), opening the potential for developing communities that enable the sharing of practices in a work context by employees (Detlor, 2000; Y.-S. Wang, 2003; Benbya et al., 2004). The existence of a digital space that enables collaborative work

might as well constitute a favorable environment to learn as well. Facilitating interaction, communication, and knowledge sharing were studied by Stewart & Lourdes Lopes (2015) when they researched different interaction types in online learning. Thus, we hypothesize that:

H4a - Collaboration quality has a positive impact on the use of e-learning systems.

H4b - Collaboration quality has a positive impact on e-learners' satisfaction.

According to ISS theory, information systems usage influences users' level of satisfaction when they perceive the ease of use and adequacy of a system in supporting their tasks (Seddon, 1997; DeLone & McLean, 2003). H. C. Wang & Chiu (2011), in their e-learning success study, confirm that students' satisfaction level is directly related to e-learning usage. As students' satisfaction levels increase, it supports and leads to continuous e-learning usage (Al-Samarraie et al., 2017). Thus, we hypothesize that:

H5a - Use has a positive impact on e-learners' satisfaction.

H5b - E-learners' satisfaction has a positive impact on the use of e-learning systems.

The positive user experience from the learners tends to have a favorable impact on e-learners' overall performance, thus on net benefits (Piccoli et al., 2001; Al-Fraihat, Joy, Masa'deh, & Sinclair, 2020). Satisfaction can only be achieved by the use of IS, DeLone(1988) satisfaction, and use have positive effects on net benefits. From previous studies, we can infer that e-learners' usage and satisfaction levels will have a positive impact on e-learners' net benefits (Hassanzadeh, Kanaani, & Elahi, 2012; Montrieux, Vangestel, Raes, Matthys, & Schellens, 2015). Thus, we hypothesize that:

H6 - The use of e-learning systems has a positive impact on the net benefits.

H7 - E-learners' satisfaction has a positive impact on the net benefits of e-learning systems.

Culture acts as an influential factor influenced by information processing, and cognition (Earley & Ang, 2003; Tarhini et al., 2017). These authors included social, organizational and individual characteristics and investigated if those characteristics led to predicting e-learners students' behavioral intention (Tarhini et al., 2017) and e-learning usage. Some studies (Brodowsky, Granitz, & Anderson, 2008; Leonard, 2008) show that in culture, temporal orientation (e.g., STO) is an important aspect because it explains the behavior of individuals. The users' time orientation' impact on website usage also has repercussions on their attitude, as confirmed in some studies on STO/LTO and website quality perceptions (Hassan, Shiu, & Walsh, 2011; Singh, Fassott, Chao, & Hoffmann, 2006; Tsikriktsis, 2002). Therefore, it is valid to study if STO, a time-oriented dimension, has various impacts on e-learning usage, on e-learning overall performance perception, and whether STO decreases the positive relationship of usage on net benefits. Thus, we hypothesize that:

H8a - Learners' short-term orientation has a positive impact on e-learning systems usage.

H8b - Learners' short-term orientation moderates the use on net benefits.

H8c - Learners' short-term orientation has a positive impact on e-learning systems' net benefits.

Long Term Orientation was studied as a single dimension in several studies (e. g., marketing research, determinant in a new product, global brand, and other applications). As LTO is a cultural value, Rai, Maruping, & Venkatesh (2009), in their study, demonstrated that cultural characteristics impact on ISS. Joy & Kolb (2009), found that culture impacts on learning outcomes. In Hofstede's (2001) work, he found that LTO and students' mathematics' performance are significantly correlated. Therefore, LTO impacts on the learning results. Galor & Özak (2016) showed that in different geographic areas, preferences for delayed gratification are extremely stable over time, and are correlated with technology adoption, savings, and educational achievement. Tarhini et al. (2017) concluded in their study that the adoption of e-learning should focus on the cultural aspects of students. Previous studies indicate that the pursuit of long-term objectives, such as gritty students may use more e-learning systems to

undertake the learning process. These studies demonstrated a direct relationship between grit and school success, despite adversities encountered in the learning process (Aparicio et al., 2017; Duckworth & Gross, 2014). LTO can be seen as a non-cognitive trait of e-learners, and non-cognitive students' attributes showed good determinants of learning success (Duckworth et al., 2019; Porter et al., 2020). We believe that students with high LTO influences their performance in more than one way, LTO directly influences e-learning usage, and also moderates the relationship effect of e-learning use on net benefits. Thus, we hypothesize that:

H9a - Learners' long-term orientation has a positive impact on the use of e-learning systems.

H9b - Learners' long-term orientation moderates the use on net benefits.

H9c - Learners' long-term orientation has a positive impact on the net benefits of e-learning systems.

The hypothesized relationships between our model dimensions are represented in Figure 4.2.

4.4. Research methodology

This model was empirically validated using structural equation modeling (SEM)/partial least squares (PLS) in the context of Brazil's e-learning systems usage. In this country, the usage of these kinds of online learning systems is essential because of the geographically vast population distribution and the various historically cultural backgrounds. The model was operationalized using only previously validated scales to measure the constructs (please see Appendix D and Appendix E) all used items in the questionnaire were on a 7-point range scale (1-strongly disagree up to 7-strongly agree). The questionnaire contained 42 questions, five questions for sampling purposes, and 37 to operationalize the research model. The questionnaire was distributed through a commercial online survey platform.

4.4.1. Conducted survey context and data collection strategy

The data collection strategy was conducted by targeting the local adult population that studied or used e-learning in universities (public and private) all over Brazil. The survey was distributed online after

contacting leading Brazilian universities, asking them to distribute it and have students answer voluntarily. The data was collected from higher education students (e.g., colleges, universities), both public and private organizations. Students were invited to participate in this study through e-mail invitations. In order to minimize the bias of the obtained responses, e-learners' participation was entirely voluntary. Students were briefed on the study's purpose at the beginning of the questionnaire, and given the option to participate or not. In this research, no reward or incentive of any kind was offered.

4.4.2. Sample characterization

The empirical data was collected from Brazilian higher education students in the context of e-learning systems usage. Figure 4.3 shows the regions of our respondents, all of them answered the questionnaire voluntarily, and no personal data was asked for or obtained. We obtained 297 valid and complete responses for analysis of the survey. Table 4.1 presents the demographic characteristics of the respondents. Figure 4.3 illustrates the e-learners' provenience, and the 297 respondents are from nine regions: Alagoas; Goiás; Maranhão; Mato Grosso; Paraná; Rio Grande do Sul; Rio de Janeiro; Santa Catarina and São Paulo. The majority of respondents are from the regions where the most ranked Brazilian universities are located (World University Rankings, 2019). We double-checked the common method bias, firstly, to determine if any factor could emerge as a variance dominating only one single factor (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003) and the obtained results settle that none of the factors explained the majority of the variance individually. Secondly, we calculated a marker variable test (Lindell & Whitney, 2001), consisting of including a theoretically unrelated marker variable in the research model, the result was 0.021 (2.1%) as the maximum shared variance with the rest of the variables; this result is considered a low value (R. E. Johnson, Rosen, & Djurdjevic, 2011). Consequently, we found no significant common method bias.

Figure 4.3 - Regional map of the Brazilian respondents (Map build with Google Maps on August, 8, 2019)

Table 4.1 - Brazilian e-learners' characterization

Characteristics	Brazil	
	Absolut number	Percentage (%)
E-learners' gender		
Female	129	43%
Male	168	57%
Total	297	100%
E-learners' instruction level		
Undergraduate	1	1%
2 Year College Degree	100	34%
4 Year College Degree	99	33%
Master Degree	19	27%
Doctoral Degree	13	4%
Professional Degree	2	1%
Total	297	100%
Used e-learning platforms		
Moodle	49	16%
Blackboard	211	70%
University Proprietary System (in-house system)	41	13%
Other or do not know	3	1%
Total	**297**	**100%**
Context student's e-learning course		
University Course	152	51%
Training	89	30%
Other (ie: Specialization course)	56	19%

Total	**297**	**100%**
Simultaneously used MOOC platforms by e-learners		
Coursera	23	8%
edX	4	1%
Khan Academy	19	6%
Other platform	0	0
Do not use MOOCs	251	85%
Total	**297**	**100%**

Table 4.1 shows the main sample characterization, 43% of the respondents are female, and 57% are male. The large majority (98%) are university graduates, 51% say they use e-learning systems in a university program context, 30% use e-learning in a training context, and 19% use e-learning for other purposes. These numbers indicate that there are respondents that use e-learning systems for more than one objective. The great majority, 83% of the respondents, use proprietary software platforms, 16% use free software platforms, and the remainder use other platforms or do not know the system type. Only 15% of e-learners say they use massive open online courses (MOOCs), so the vast majority 85% do not use any MOOC platforms.

4.5. Data quantitative analysis and study results

We used the SEM/PLS method and applied a variance-based technique (VBSEM) to test the hypotheses empirically. This technique produces more robust results disregarding the sample, the normality data distribution, and sample size (Hair, Black, Babin, & Anderson, 2010; Hair, Sarstedt, Pieper, & Ringle, 2012). The collected data were computed with SmartPLS (version 3 software) (Ringle et al., 2015). The next subsections present the two-stage method results according to the SEM/PLS method.

4.5.1. Measurement model results

Generally accepted conditions to analyze latent variable relationships are loadings and cross-loadings, composite reliability (CR), Cronbachs' Alpha (CA), average variance extracted (AVE), and discriminant validity valuation (Hair et al., 2012). The criterion to verify variables' internal

consistency is through CA (Cronbach, 1951) and an alternative measure for CA is composite reliability (CR) (Werts et al., 1974) as recommended by Chin (1998), because it overcomes some CA deficiencies. The model measures CR above 0.800 (please see Table 4.2), indicating the criteria is met (Fornell & Larcker, 1981). AVE results also meet the rule of being above 0.500 (Barclay et al., 1995).

Table 4.2 - E-learning systems' measurement model results

Latent Variables	Item	Loadings	Composite Reliability (CR)	Cronbach's Alpha (CA)	Average Variance Extracted (AVE)	Discriminant Validity
System Quality (SysQ)	SysQ1	0.922	0.956	0.939	0.845	Yes
	SysQ2	0.932				
	SysQ3	0.924				
	SysQ4	0.900				
Information Quality (IQ)	IQ1	0.929	0.935	0.907	0.783	Yes
	IQ2	0.883				
	IQ3	0.902				
	IQ4	0.823				
Service Quality (SerQ)	SerQ1	0.929	0.946	0.924	0.815	Yes
	SerQ2	0.870				
	SerQ3	0.941				
	SerQ4	0.867				
Collaboration Quality (CQ)	CQ1	0.916	0.952	0.932	0.831	Yes
	CQ2	0.943				
	CQ3	0.861				
	CQ4	0.925				
Use (Use)	Use1	0.629	0.851	0.778	0.536	Yes
	Use2	0.805				
	Use3	0.805				
	Use4	0.788				
	Use5	0.609				
User Satisfaction (US)	US1	0.894	0.931	0.9	0.773	Yes
	US2	0.760				
	US3	0.935				
	US4	0.916				
Long-Term Orientation (LTO)	LTO1	0.908	0.897	0.772	0.814	Yes
	LTO2	0.896				
Short-Term Orientation (STO)	STO1	0.966	0.971	0.941	0.971	Yes
	STO2	0.977				
Net Benefits (NB)	NB1	0.803	0.948	0.937	0.694	Yes
	NB2	0.865				
	NB3	0.834				
	NB4	0.773				
	NB5	0.836				
	NB6	0.873				
	NB7	0.845				
	NB8	0.832				

Table 4.2 suggests that discriminant conditions are confirmed. The cross-loading (Table 4.3) shows that loadings are higher than all their cross-loadings, therefore. a second criterion is also achieved, (Henseler, Ringle, & Sarstedt, 2015) propose another approach, the heterotrait-monotrait (HTMT) ratio of correlations. If the HTMT value is below 0.90, discriminant validity has been established between two reflective constructs, thus indicating discriminant validity. All constructs in Table 4.3 have values below 0.90 for the HTMT test, so a third criterion is also achieved; therefore, we can conclude that the measurement model presents discriminant validity.

Table 4.3 - Fornell-Larcker criterion and interconstruct correlations & Heterotrait-Monotrait ratio (HTMT)

Fornel Larker										Heterotrait-Monotrait ratio (HTMT)								
	SysQ	**IQ**	**SerQ**	**CQ**	**Use**	**US**	**LTO**	**STO**	**NB**	**SysQ**	**IQ**	**SerQ**	**CQ**	**Use**	**US**	**LTO**	**STO**	**NB**
SysQ	**0.919**																	
IQ	0.623	**0.885**								0.622								
SerQ	0.451	0.423	**0.903**							0.449	0.423							
CQ	0.509	0.495	0.506	**0.912**						0.508	0.496	0.507						
Use	0.410	0.527	0.338	0.585	**0.732**					0.41	0.535	0.336	0.581					
US	0.610	0.722	0.426	0.439	0.484	**0.879**				0.609	0.722	0.428	0.439	0.487				
LTO	0.240	0.287	0.164	0.157	0.294	0.250	**0.902**			0.241	0.287	0.165	0.156	0.302	0.242			
STO	0.211	0.234	0.234	0.207	0.214	0.209	0.363	**0.985**		0.211	0.238	0.235	0.202	0.216	0.214	0.368		
NB	0.634	0.683	0.535	0.530	0.608	0.773	0.310	0.201	**0.833**	0.635	0.684	0.536	0.528	0.613	0.78	0.31	0.201	

Note: Diagonal values (in bold) are the square root of the AVE; System Quality (SysQ); Information Quality (IQ); Service Quality (SerQ); Collaboration Quality (CQ); User Satisfaction (US); Net Benefits(NB); Long-Term Orientation (LTO), and Short-Term Orientation (STO)

4.5.2. Results of Brazilian e-learning structural model

Between the two-phases SEM/PLS, all the constructs for multicolinearity were tested according to (Farrar & Glauber, 1967). We also tested the variables' variance inflation factor (VIF); results showed no multicollinearity issues. The second phase of SEM/PLS consists in testing the hypotheses, by applying a resampling technique (preferably with 5,000 subsamples extracted from the original collected sample), the bootstrapping (Henseler et al., 2009). This practice assures a more accurate result of the effects of LTO/STO on the global success of e-learning systems. For hypotheses, H5a and H5b computed the PLS two-stages tests, as we could not calculate both H5a & H5b due to recursivity.

Therefore, we tested model A, which tests use impact on user satisfaction (H5a), and model B, which calculates the user satisfaction' impact on e-learnings systems usage (H5b). Figure 4.4 illustrates both models A/B results.

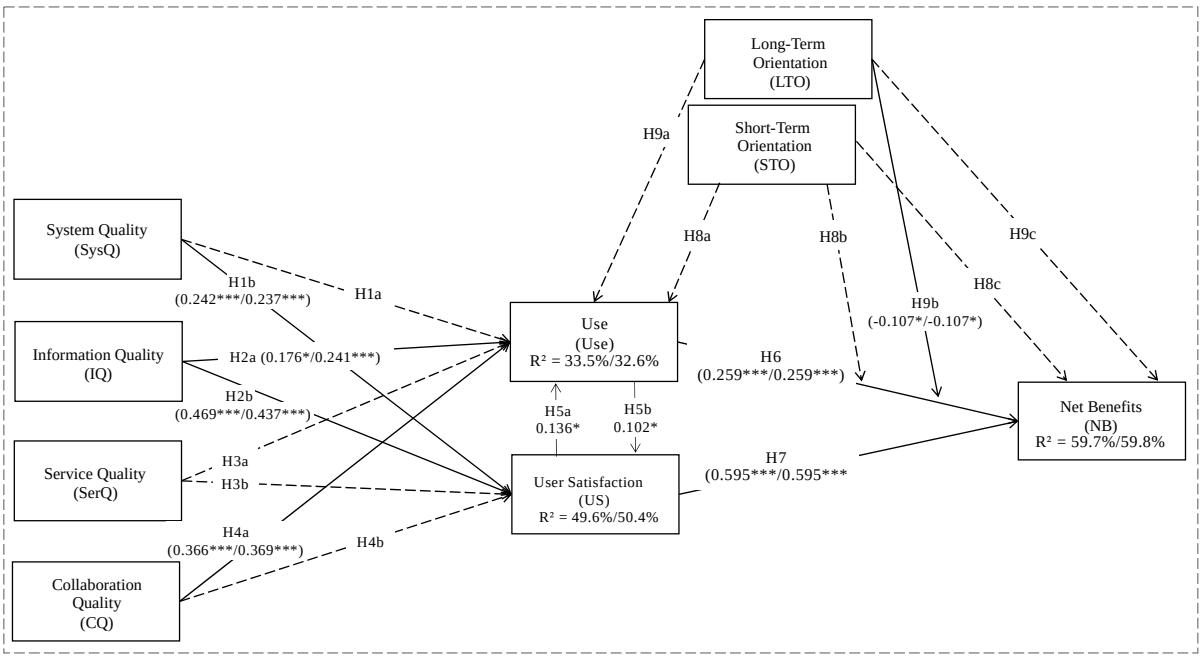


Figure 4.4 - Brazilian e-learning systems success research model results

The presented model explains 33.5%/32.6% (model A/model B) of variation in use, Information quality ($\widehat{\beta}$ = 0.176∗∗∗/0.241∗∗∗) and collaboration quality (CQ) ($\widehat{\beta}$ = 0.366∗∗∗/0.369∗∗∗) are statistically significant to explain use (Use). Long-term orientation (STO) and short-term orientation (STO) are not statistically significant on use (USE). The model explains 49.6%/50.4% of variation in user satisfaction (US). System quality (SysQ) ($\widehat{\beta}$ = 0.242∗∗∗/0.237∗∗∗) and information (IQ) ($\widehat{\beta}$ = 0.469∗∗∗/0.437∗∗∗) are statistically significant to explain user satisfaction (US). The model explains 59.7%/59.8% of the variation in net benefits (NB). Use ($\widehat{\beta}$ = 0.259∗∗∗/0.259∗∗∗) and user satisfaction (US) ($\widehat{\beta}$ = 0.595∗∗∗/0.595∗∗∗) are statistically significant to explain net benefits NB. The long-term orientation (LTO) ($\widehat{\beta}$ = -0.107∗/-0.107∗) negatively moderates use on net benefits (NB). The short-term orientation of Brazilian e-learners' does not moderate the relationship between Use and NB or

have a significant impact on NB. In summary, H1b, H2a, H2b, H4a, H5a, H5b, H6, H7, and and H9 are supported. The H1a, H3a, H3b, H4b, H8a, H8b, H8c, H9a, and H9c are not supported (Table 4.4).

Table 4.4 - Results summary of Brazilian e-learning systems success hypotheses tests

Hypothesis	Independent Variable		Dependent Variable	Moderation	Findings	Conclusion Hypothesis Validation
H1a	System Quality (SysQ)	→	Use	n. a.	$\widehat{\beta}$ = -0.020/0.012; NS	Non-significant
H1b	System Quality (SysQ)	→	User Satisfaction (US)	n. a.	$\widehat{\beta}$ = 0.242***/0.237***	Significant
H2a	Information Quality (IQ)	→	Use	n. a.	$\widehat{\beta}$ = 0.176*/0.241***	Significant
H2b	Information Quality (IQ)	→	User Satisfaction (US)	n. a.	$\widehat{\beta}$ = 0.469*/0.437***	Significant
H3a	Service Quality (SerQ)	→	Use	n. a.	$\widehat{\beta}$ = -0.018/-0.007; NS	Non-significant
H3b	Service Quality (SerQ)	→	User Satisfaction (US)	n. a.	$\widehat{\beta}$ = 0.092/0.091; NS	Non-significant
H4a	Collaboration Quality (CQ)	→	Use	n. a.	$\widehat{\beta}$ = 0.366***/0.369***	Significant
H4b	Collaboration Quality (CQ)	→	User Satisfaction (US)	n. a.	$\widehat{\beta}$ = 0.033/-0.005; NS	Non-significant
H5a	User Satisfaction (US)	→	Use	n. a.	$\widehat{\beta}$ = 0.136*/n.a	Significant
H5b	Use	→	User Satisfaction (US)	n. a.	$\widehat{\beta}$ = n.a./0.102*	Significant
H6	Use	→	Net Benefits (NB)	n. a.	$\widehat{\beta}$ = 0.259***/0.259***	Significant
H7	User Satisfaction (US)	→	Net Benefits (NB)	n. a.	$\widehat{\beta}$ = 0.595***/0.595***	Significant
H8a	Short-Term Orientation (STO)	→	Use	n. a.	$\widehat{\beta}$ = 0.023/0.024; NS	Non-significant
H8b	Use*Short-Term Orientation (STO)	→	NetBenefits (NB)	STO	$\widehat{\beta}$ = -0.020/-0.020; NS	Non-significant
H8c	Short-Term Orientation (LTO)	→	Net Benefits (NB)	n. a.	$\widehat{\beta}$ = -0.005/-0.006; NS	Non-significant
H9a	Long-Term Orientation (LTO)	→	Use	n. a.	$\widehat{\beta}$ = 0.108/0.115; NS	Non-significant
H9b	Use*Long-Term Orientation (LTO)	→	Net Benefits (NB)	LTO	$\widehat{\beta}$ = -0.107*/-0.107*	Significant
H9c	Long-Term Orientation (LTO)	→	Net Benefits (NB)	n. a.	$\widehat{\beta}$ = 0.083/0.083; NS	Non-significant

Notes: n.a.= non-applicable; NS = non-significant; * significant for $p < 0.05$; ** significant for $p < 0.01$; *** significant for $p < 0.001$**;** (Chin, 1998; Cohen, 1988)

4.6. Discussion

The empirical results of the of Brazilian e-learning systems success imply that net benefits are explained by 60% directly by the impact of e-learning use and e-learners' satisfaction, and by the negative moderation effect of students' long-term orientation from use to net benefits (please see, Figure 4.4). This finding means that if students are higher oriented in the long-term towards learning, this cultural aspect weakens the positive relationship between e-learning systems usage on the perceived net benefits (H9b). These findings were not reported before. However, Hofstede (2001) indicated in his study that LTO might predict the adoption of technology. In previous studies,

perseverance effort and consistency of interest, long-term orientation traits', do not directly influence the use of e-learning systems (Aparicio et al., 2017). This inference might mean that for higher long-term oriented e-learners, they do not perceive that their overall performance is due to the e-learning systems use, but rather their persistence towards their learning goals in the future (Hofstede & Minkov, 2010). Long-term orientation does not have a direct impact on e-learning use (H9a) and net benefits (H9c), demonstrated in Figure 4.5.

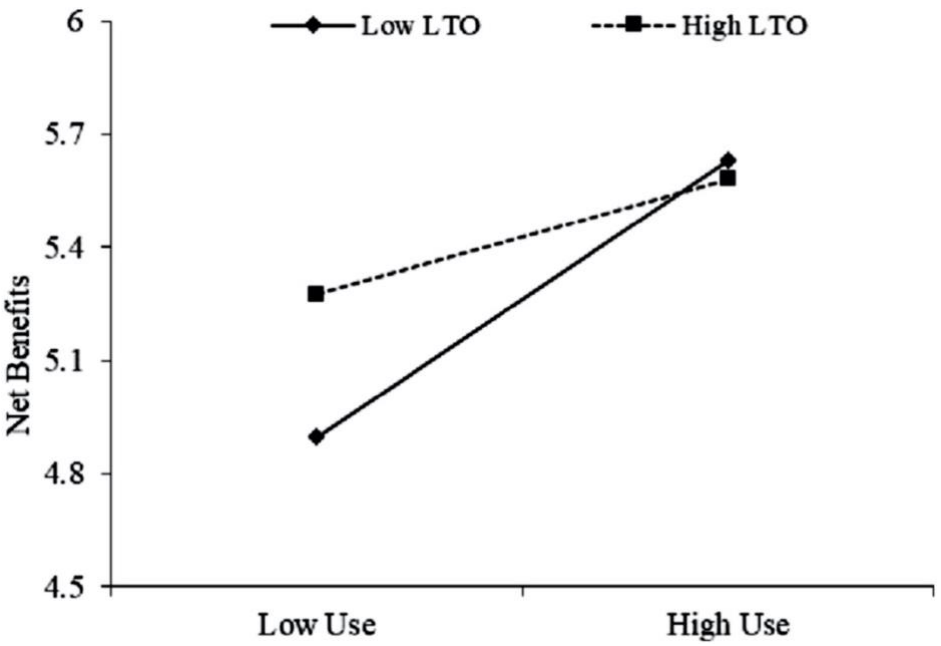


Figure 4.5 - Moderation effect of the LTO

Short-term orientation impact on e-learning systems' use (H8a), on net benefits (H8c) and indirect effect on the relationship between use and net benefits (H8b), are not supported in this study, probably indicating that when students are short-term oriented they attribute their success or failure to luck (Hofstede, 2011), instead of the e-learning systems platforms usage. A possible reason that might explain these results can lie in previous findings that indicate that non-cognitive attributes of the students are determinants to their success (Aparicio et al., 2017; Duckworth et al., 2019; Porter et al., 2020). The long-term orientation of the students can be considered as a non-cognitive attribute of students (Duckworth & Gross, 2014; Duckworth et al., 2019), and previous studies show that students'

success is derived from those traits. In our study, we found that students with high LTO might perceive success and net benefits as a result of their study and learning capabilities rather than a result of using an e-learning platform. Our study also indicates that net benefits of e-learners are positively influenced by the usage of e-learning (H6) and by e-learners' satisfaction on using those systems as a means to achieve and support the learning process (H7), as discussed by Petter et al. (2012). Similar results were achieved in a study on e-government systems (Stefanovic, Marjanovic, Delić, Culibrk, & Lalic, 2016). E-learning systems' use has a positive impact on the level of e-learners' satisfaction (H5b), and student's satisfaction level impacts positively on e-learning systems usage level (H5a), similar to the study by Stefanovic et al. (2016). E-learning systems usage is also positively influenced by information quality (H2a) and by collaboration quality (H4a), meaning that e-learners adopt these systems derived from the importance and adequacy of the contents, also derived from the collaboration with their colleagues and the overall satisfaction, similar results were found in other studies (Machado da Silva et al., 2014). Results do not show that system quality (H1a) and service quality (H3a) have any influence on the use of e-learning systems. This finding might indicate that students adopted the e-learning systems because their universities made the platforms' adoption decisions. Students' satisfaction is directly and positively influenced by e-learning systems usage (H5b), by the system quality (H1b) and by information quality (H2b), meaning that if students perceive the platforms have good quality in terms ease of use and if the contents are understandable, useful students become more satisfied, these results are similar to previous studies (Machado da Silva et al., 2014). However, the positive impact of service quality on e-learners' satisfaction (H3b) was not found similar to the Urbach et al. (2010) study. Neither was a direct relationship between collaboration quality on student satisfaction (H4b) found similar to previous results in the employee portal success' context Urbach et al. (2010). These results can be explained by a possible high quality of the systems in a way that students did not face problems with the e-learning platforms staff or because they perceive that e-learning platforms' are not the primary communication channel for interact with their peers.

4.7. Conclusions and implications

Our study presents a Brazilian e-learning systems success model supported by information systems success theory combined with the cultural characteristics of e-learners. We tested the model in real usage in the Brazilian higher education context. In this research, we can conclude that e-learning systems' quality, information quality, and use are determinant to students' satisfaction. We also found that information, collaboration quality, and learners' satisfaction are determinants of e-learning systems usage. From our study, we can further conclude that use and user satisfaction impact positively on the net benefits of students and that for a high-level long-term-oriented students, the cultural aspect can play a weakening role in the positive impact of e-learning systems usage on their overall performance.

The main theoretical implication of our study is that students' cultural aspects play a significant role in Brazilian e-learning systems success, in a way that high-level long-term-oriented students might not attribute their success to the usage of e-learning systems, but rather to the overall satisfaction level they feel when using higher education e-learning systems. This study clearly indicates that the quality of e-learning systems and information quality have a positive impact in learners' satisfaction. It also indicates that information quality and collaboration quality have a positive impact on e-learning systems' usage. From these we can draw the following practical implications derived from this study: higher education institutions should consider higher importance to e-learning content in terms of adequacy, because it influences e-learning acceptance and learners' satisfaction, besides providing easiness of navigation in the online learning environment, providing support to their students' collaboration. The collaboration features of these platforms have a substantial impact on its usage, enabling accessible, adequate, and comfortable communication among students, especially in the current times, that students are even more isolated due to COVID 19. Higher education institutions should also pay special attention to higher long-term-oriented students because of the positive

influence of the use of these kinds of platforms might be compromised in terms of the perceived students' overall success.

The present model supported information systems success in e-learning theory, and one cultural aspect does not fully capture e-learning systems success in Brazil, therefore in future studies, the question of whether other cultural factors can influence e-learning systems usage success should be understood deeper. In future studies, the perceived e-learning success through the teacher's point of view could also be captured, and the resultant comparisons be drawn.

CHAPTER V . DETERMINANTS OF E-LEARNING SUCCESS: CROSS-COUNTRY COMPARISON (BRAZIL *VS* PORTUGAL)

The present study evaluates perceived success factors in a cross-country e-learning systems study, comparing Brazil vs. Portugal e-learners' perceptions. To achieve such a comparison we adopted the information systems success theory and tested it in these two contexts. We use an empirical quantitative approach to conduct this study. A total of 582 students, 297 from Brazil, and 285 from Portugal participated in the survey. The outcomes of this study revealed that online-learning use and e-learners' satisfaction are significant determinants of individual and organizational impact of e-learning success to Brazilian and Portuguese students. In both countries, information quality impacts positively on online-learning use and students' satisfaction. Brazilian and Portuguese students evaluated the effect of system quality on use and service quality on e-learning use differently. The study leads to the conclusion that Brazilian and Portuguese students have different behaviors regarding system and service quality variables. However, in both nations, information quality, use, and satisfaction show similar patterns, resulting in similarities in individual and organizational influence on e-learning performance.

5.1. Introduction

Portugal and Brazil share centuries of history (Saraiva, 2000). Although the two countries are geographically distant, they still have culture, language, traditions, and even architecture in common. At present, a significant number of Brazilian students attend schools and higher education in Portugal. In the year 2019/2020 there were 22,961 Bazilian students (DGEECC, 2021) enrolled in Portuguese higher education. Courses in both countries are taught mainly in the Portuguese language, but in some cases in English language. Since the beginning of the pandemic of COVID 19, e-learning platforms have been intensively used to ensure safe physical distancing around the world. As a result, it is estimated that e-learning industry revenues have grown 900% since 2000 (Bouchrika, 2020), which is the time frame cited in literature as the initial stage of the adoption of these systems. Today, e-learning platforms play an essential role in the education and communication industries of those two countries. In 2020, they had a combined total of more than 9,001,435 students in higher education: 396,909 in Portugal (Pordata, 2021) and 8,604,526 in Brazil (MEC, 2021).

We conducted an exploratory bibliometric study (Aparicio et al., 2014b) in March 2021 on Elsevier (2015) to identify e-learning multi-group studies. The search resulted in 21 multi-group studies. From the results obtained we found that multi-group e-learning studies cover adoption models, multigroup analysis, cultural backgrounds, information systems, satisfaction, perceived ease of use, gender, and developing countries. From an analysis conducted in all the keywords of those studies, and based on the similarities of the titles, keywords and abstracts we identified the connection between those 21 studies as shown in Figure 5.1. From those relationships we identified a strong similarity between studies on higher education studies, particularly regarding the adoption of structural equation models. There were five different clusters, shown in Figure 5.1 with different colors. The five clusters are related to the method used in the study. The red cluster showed the satisfaction models; the green cluster was related with the multi-group analysis and mobile learning in higher education; the blue cluster showed studies focused on adoption models and theoretical framework; the yellow cluster showed studies related with behavioral intention of e-learners, and finally, the purple cluster showed studies on technology acceptance in developing countries. From the results, we can observe that most of those studies are from Hong Kong, Chile, Malaysia, Saudi Arabia, United Kingdom (UK), and United States of America (USA). From Figure 5.1 we can observe that there are studies which strongly relate authors from USA, UK, Hong Kong, Chile, and the rest of the countries. From this analysis it is clear that there are no e-learning cross-country studies including Brazil or Portugal. The bibliometric study indicates there is still need for better understanding the success determinants of e-learning systems. This exploratory study indicates that are few multi-group studies which compare different countries, particularly countries that have centuries of historical connections, such as Brazil and Portugal.

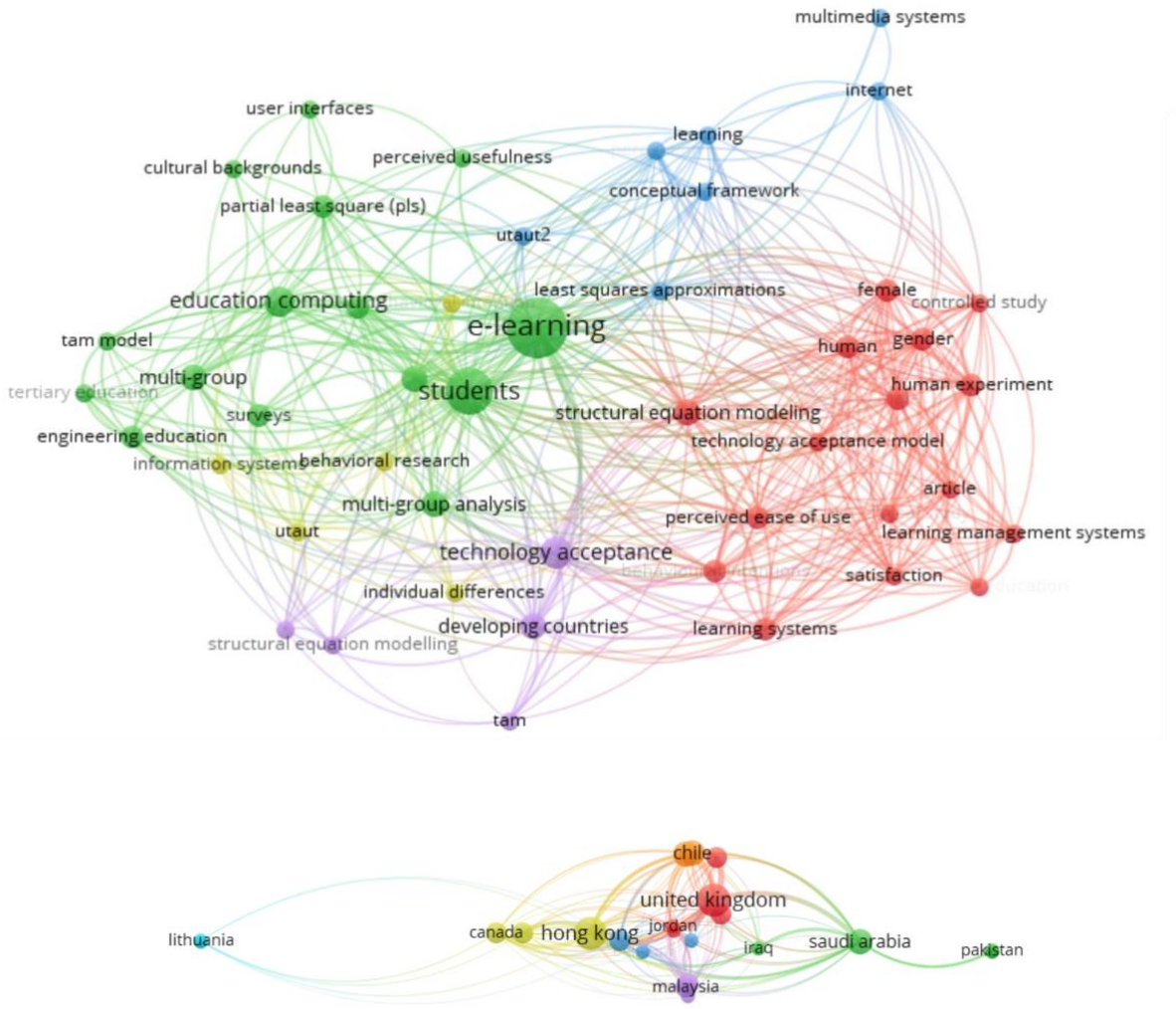


Figure 5.1 - Exploratory bibliometric results on e-learning multi-group studies (keywords, abstracts & countries)

From the exploratory bibliometric analysis, we state that few studies deeply explore e-learning systems usage and their learners' perception in a cross-country comparison study. The goal of this research is to learn more about the determinants of success in e-learning by comparing and contrasting the educational reality of Brazil and Portugal. Our study validates empirically the information systems success theory model (DeLone & McLean, 2003) for e-learning and the concepts that compose it: system quality (SysQ); service quality (SerQ); information quality (IQ); use (Use); satisfaction of students' (US); individual and organizational impacts (II & OI), empirically. The research study

provides an empirical analysis of the differences between Portugal and Brazil: (a) how higher education students perceive their performance when using e-learning systems and (b) a cross-country validation of information systems success theory in an e-learning context. Results confirm that Brazilian and Portuguese students have different perceptions in terms of system quality and service quality but are similar in terms of online-learning systems' use, satisfaction of learners', individual and organizational impact of e-learning. Due to the similarities between Brazil and Portugal, it is relevant to identify the differences between the two countries so as to gain insights into the determinants of success in e-learning.

Next, we present the literature on online learning systems based on the success theory, and e-learning cross-country studies. The third section describes the conceptual model we tested, its constructs and hypotheses which state the relationships between the constructs. The fourth section discusses the empirical and sampling procedures. The fifth section shows the results of the data analysis and presents a structure for interpreting the data and discussion. In the last section, we present the study conclusions and research implications.

5.2. Theoretical background

5.2.1. E-learning systems background

Systems for e-learning are information systems used to support all phases of the distance learning process, usually also mentioned in literature as online learning systems. As e-learning systems are massive and global technologies, they must take into account users who act in a variety of local and national contexts (Teo, 2010; Aparicio et al., 2019). There are some studies on the determinants of success (Wang et al., 2007; Lee & Lee, 2008; Alsabawy et al., 2011; Aparicio et al., 2016a; 2016b; Aparicio et al., 2017, 2019; Bento et al., 2017) highlighted the importance of students' relationships for self-regulatory efficacy, which impacts academic performance, other that refer to gamifiaction as

adriver to e-learning success. Similarly, information systems models are essential factors in order to assess WebCT's success at the University of Botswana, according to Tella & Mutula (2010). Upon assessing an index of online teachers and an organizational e-readiness level (Pereira et al., 2017), the results indicate that in the University of West Indies, the success score in terms of e-learning systems was high (Gay & Dringus, 2012) and it was also high in professional training contexts (Costa & Aparicio, 2011). Machado da Silva and colleagues (2014) conducted a study in Brazil and validated part of the impacts in the DeLone & McLean (1992) model (D&MM). E-learning studies discuss the implementation of educational technologies and digital teaching methodologies. Web learning is a technological solution and a cognitive socio-technical process (Bandura, 1977; Cidral, 2020). Besides, the fact that e-learning is influenced by many different factors (Miranda et al., 2017), including organizational factors (Sun & Zhang, 2006), factors related to developing e-learning resources (Liaw, 2008), behavioral and cultural factors (Joy & Kolb, 2009) and social factors (Tarhini et al., 2013b; Teo, 2010) must be taken into account. The literature has generally used the original version of the classic D&MM (1992) model to understand and modulate the success factors of learning through online systems. According to this model, satisfaction and use explain individual impacts. In turn, individual impacts explain organizational impacts.

5.2.2. E-learning cross-country studies

Some e-learning studies focus on cross-country applications of the technology (Cyr, 2008; Teo, 2011; Yang et al., 2014; Tarhini et al., 2015). They found that teaching quality, the usefulness of the content, and conditions that facilitate learning, were essential dimensions. They were able to validate the original 3-factor solution for a model known as the acceptance measure model for e-learning (Teo, 2011). The studies of Tarhini et al. (2013a) have demonstrated that factors affecting students validate an extended model of technology acceptance. The main conclusion of Tarhini et al. (2015) evaluating cross-country education was that individual, organizational, and social factors are essential and should

be considered when explain students' intention and usage of e-learning. When discussing students' intentions and use of e-learning, there are several elements to consider. For instance, the study of Tarhini et al. (2017) shows that the one of the key factors to consider for e-learning adoption is quality of working life. Also, they conclude that social and cultural values have straight connections with e-learning tools adoption, with significant moderating effects observed.

5.2.3. IS Success theory

IS success theory was proposed and developed by several authors (DeLone, 1988; DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon et al., 1999; Larsen, 2003; Lee et al., 2007; Lee & Lee, 2008). The updated model D&MM proposes that service, system and information quality have a positive influence on satisfaction and use, consequently producing a perception of IS net benefits. In other words, the D&MM can be employed from the moment of inception of an information system by studying the way students either use or intend to use a system. It is applied as a possible way of understanding if these systems can be used as an effective way to teach and learn.

5.3. Conceptual model

The revised DeLone & McLean Information System Model (2003) became a standard used for more than ten years in different applications. It was used as a basis for information systems acceptance models (Davis, 1989; Ajzen, 1991; Venkatesh et al., 2003; Sun et al., 2008). Given these applications of the DeLone & McLean (2003) IS Success Model, we can conclude it has been exhaustively tested and constitutes a useful tool to evaluate e-learning systems satisfaction.

5.3.1. Constructs

Supported by IS success theory constructs, we identified the definitions set out in the Table 5.1.

Table 5.1 - Dimensions and items

Dimension	Items	Authors
System Quality (SysQ)	Functionality, navigation, ease of use of IS, reliability, performance, flexibility, data quality, searchability, portability, structure, integration, accessibility, usability, availability, adaptability, currency, response time, shift time, data accuracy, completeness, and system flexibility	Ahn et al. (2004); DeLone, (1988); DeLone & McLean, (1992); DeLone & McLean, (2003); Emery (1971); Hamilton & Chervany, (1981); McKinney et al. (2002); Urbach et al. (2010); Cidral, Aparicio, & Oliveira (2020)
Information Quality (IQ)	Information accuracy, timeliness, relevance, usefulness, completeness, consistency of information system output, productivity timeliness, trustworthiness, precision, currency, aggregation, and formatting	Ahituv (1980); Iivari & Koskela (1987); DeLone (1988); DeLone & McLean, (1992); McKinney et al. (2002); DeLone & McLean (2003); Yang et al. (2005); Lin & Lee (2006); and Cidral et al. (2020)
Service Quality (SerQ)	Staff's reliability, responsiveness and assurance and empathy, and competence of the service personnel in charge	Pitt et al. (1995); Chang & King (2005); Sun et al. (2008); Wang & Liao, (2008); Wang & Wang (2009); Urbach et al. (2010); and Cidral et al. (2020)
Use (Use)	Corresponds to the actual use of the IS according to the users' previous experience of the system and also indicates the resolution to continue to use the system	Davis, Bagozzi, & Warshaw (1992); DeLone & McLean (1992); H. Sun & Zhang (2006)
User Satisfaction (US)	Corresponds to the IS adequacy and the general level of efficiency, effectiveness, and overall satisfaction with the online learning system	Igersheim (1976); Lucas (1978); Doll & Torkzadeh (1988); DeLone & McLean (1992); Saarinen (1996); Tojib, Sugianto, & Sendjaya (2006); Sun et al. (2008)
Individual Impact (II)	Job performance, usefulness, task performance, work effectiveness, task simplification, decision-making, and management control.	DeLone & McLean (1992); (Davis, 1989)
Organizational Impact (OI)	Cost reduction, improvement of operations, quality enhancement of coordination and collaboration of the teams' members, as well as the overall success, workgroups, personal relationship, inter-organizational, industry aspects, consumer, and society	Goodhue & Thompson (1995); Gelderman (1998); (Sabherwal, 1999); DeLone & McLean (1992)

5.3.2. Hypotheses

Following DeLone & McLean (1992), in which the quality of service and information are connected to use and satisfaction of employing an e-learning system, it can be perceived that these equally influence customer success through individual and organizational impact constructs likewise, as demonstrated below. System quality measures information system processing and technical success. If businesses are expected to employ an enterprise information system, system quality is an important issue. According to several studies, system quality determines the intensity of use and learners' satisfaction in an online learning context (Tella & Mutula, 2010; Gay & Dringus, 2012; Machado da Silva et al., 2014; Bauk et al., 2014). Particularly regarding web content, a high-quality system should provide the user with the following features: personalization, completeness, relevance, ease of use, and security (Mansell & Ang, 2015). Therefore, we formulate the hypothesis:

H1a - System quality has a positive effect on use of e-learning systems.

H1b - System quality has a positive effect on user satisfaction of e-learning systems.

The quality of learning content and the resources of the platform, provide students with the valuable means to enable learning activities. Here, a systems model evaluates the quality of information resources which the system contains. It measures information system output as well as the quality of the system performance. Iivari (1987) and Iivari & Koskela (1987) included the concept of informativeness: that is, comprehensiveness, and relevance. Consequently, it may be assumed that information quality plays a key role in e-learning usage. Similarly, the literature indicates that information quality has a positive effect on use and satisfaction (Wang et al., 2007; Gay & Dringus, 2012; Bauk et al., 2014; Cidral et al., 2018, 2020; Aparicio et al., 2019). Therefore, we hypothesize the following:

H2a - Information quality has a positive effect on the use of e-learning systems.

H2b - Information quality has a positive effect on the user satisfaction of e-learning systems.

Commensurate with what takes place in any other service provided, the service quality of a system is not only linked to the support delivered to the client but also the competence of the service personnel in charge. This dimension assesses the service provided based on the system, organization, or outsourced service provider. Service quality refers to user support by training units (Petter & McLean, 2009), and whether it is adequate assistance for system users (Wang & Wang, 2009). The service quality is linked to service supplied by educators and educational organization according to the e-learning system's satisfaction model of Sun et al. (2008). It also can include an instructor dimension. Therefore, we formulate the following hypothesis:

H3a - Service quality has a positive effect on the use of e-learning.

H3b - Service quality has a positive effect on the user satisfaction of e-learning.

Use correlates to the use rate of an online learning system to achieve learning activities. Use is the way learners act while interacting with the information system. As DeLone & McLean (1992) explained, "the use of the system and its information products impacts or influences the individual user in the conduct of his or her work." Also, "perceived ease of use" is users' perception of the ease of adopting a system" (Sun & Zhang, 2006), and it is strictly related to use. This hypothesis of interplay between use upon user satisfaction and individual impact (or net benefits) is supported by several studies (Wang et al., 2007; Tella & Mutula, 2010; Hassanzadeh et al., 2012; Cidral et al., 2018, 2020; Aparicio et al., 2019). Therefore, we hypothesize that:

H4a - E-learning use has a positive effect on user satisfaction.

H4b - E-learning use has a positive effect on individual impact.

The literature indicates that one of the most essential aspects to consider in IS success is users' satisfaction. With this indicator, it may be known directly from the user his or her opinion of an IS. User satisfaction is a reaction to the output of an information system. Studies support the influence

that user satisfaction has on the individual impact or net benefits dimensions (Bauk et al., 2014; Cidral 2018). They maintain the viewpoint that performance quality is related to higher levels of use and an increase in system utilization, thus enhancing user satisfaction. Therefore, we hypothesize that:

H5 - e-Learner's satisfaction has a positive effect on the perceived individual impact.

Individual impact corresponds to the users' performance while interacting with information systems (IS). Although use and user satisfaction are inter-reliant categories, together, they play a key role in individual impact. This involved perceived individual benefits and overall usefulness (Davis, 1989), work environment, and job effectiveness. These are measures of the final dependent variable (organizational impact) in our e-learning success model. Organizational impact is related to the response of the organization to the evaluation categories. The organizational response happens based mainly on individual impact because organizations are comprised of people. One of the most critical issues resulting from the organizational impact is the collaborative features of an e-learning system and the developers' speed of response to users' needs. However, Gelderman (1998) and Goodhue & Thompson (1995) point out the challenge of measuring the organizational impact of individual IS initiatives. Studies also found a strong relationship between individual impact, organizational impact (Aparicio et al., 2016b; 2019), and the context of the IS Heo & Han (2003) and Gorla et al. (2010) therefore confirming previous findings. Overall, organizational impact grows in the same way as other performance categories of the D&M IS Success Model. Thus, we hypothesize that:

H6 - Individual impact has a positive effect on the organizational impact of e-learning systems.

These hypotheses were supported directly by the D&M IS success model (DeLone & McLean, 1992). We now present the proposed research model for e-learning success, which we tested in two different countries (Figure 5.2).

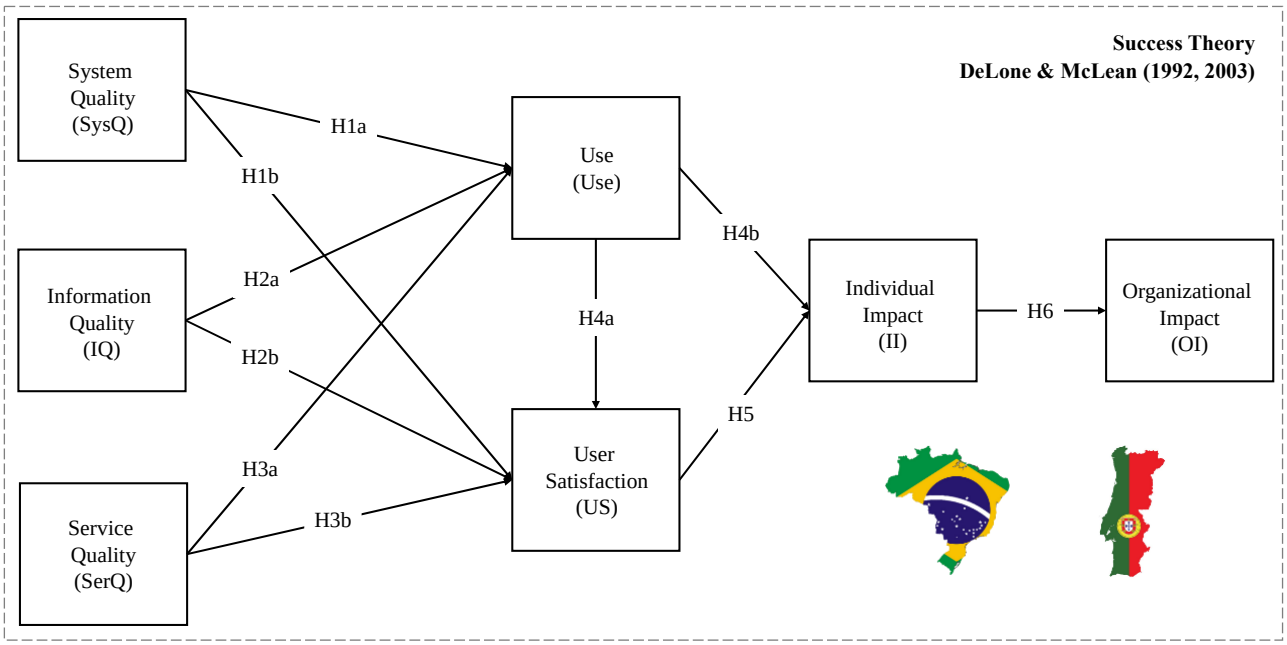


Figure 5.2 - Research on D&M IS Success Model (DeLone & McLean, 1992; 2003)

5.4. Methodology

5.4.1. Procedure

The data was collected from Brazilian and Portuguese students attending higher education institutions. Participants from thirty-four universities in Brazil and eleven in Portugal were surveyed. These students participated voluntarily, after being informed of the study objectives. No financial incentive or reward of any kind was offered. All these measures aimed to minimize bias and increase participation.

5.4.2. Sampling approach

According to previous empirical studies in the e-learning systems context (Aparicio et al., 2017) our study was based on a random sampling method, which enabled researchers to collect data based on participants' availability. Empirical data was collected in Brazil and Portugal using a self-administrated questionnaire containing 35 questions. Those constructs were operationalized using the measurement observable items from previous studies in e-learning (Costa et al., 2016; Cidral et al., 2018, 2020; Aparicio et al., 2019). The survey was sent to various universities in both countries.

The survey sample is composed of students in Brazil and Portugal who uses e-learning systems, including both face-to-face classes, b-learning, hybrid learning and 100% e-learning. Students from universities in Brazil and Portugal who took part in the study were either graduate or undergraduate students. In Brazil, 381 responses to the survey were obtained, although only 297 were validated and complete for analysis due to incomplete answers. In Portugal, 371 answers to the survey were obtained, although only 285 complete responses were analyzed, due to incomplete answers. Table 3 presents the sample characteristics for both countries.

Table 5.2 - E-learners' sample characterization

Characteristics	Brazil Sample		Portugal Sample		Full Sample	
	N	%	N	%	N	%
Gender						
Female	150	50.5%	129	45.3%	279	47.9%
Male	147	49.5%	156	54.7%	303	52.1%
Total	**297**	**100.0%**	**285**	**100.0%**	**582**	**100.0%**
Age (years)						
Mean	38.8	-	29.4	-	32.4	-
Standard Deviation	10.1	-	11.7	-	11.2	-
Instruction level						
Undergraduate	4	1.3%	0	0%	4	0.7%
Two-Year degree	83	27.9%	93	32.6%	176	30.2%
Four-Year degree	92	31.0%	95	33.3%	187	32.1%
Masters' degree	90	30.3%	55	19.3%	145	24.9%
Doctoral degree	20	6.7%	32	11.2%	52	8.9%
Professional degree	8	2.8%	10	3.6%	18	3.2%
Total	**297**	**100.0%**	**285**	**100.0%**	**582**	**100.0%**

5.5. Data analysis and results

Researchers often employ structural equation modeling (SEM) because this method assesses the relationships between latent variables. In our study, we used the variance-based technique to conduct the statistical tests for the empirical part of the study. Partial least squares (PLS), the path modeling method, is considered adequate, because not all variables data are distributed normally, according to results from a Kolmogorov-Smirnov test. The Smart PLS 3.2.8 software was used to carry out the present SEM research modeling (Ringle et al., 2015). In a first stage of the analysis, we computed the reliability and validity of data. After that, a structural model was examined.

5.5.1. Results of the measurement model

The data was evaluated using construct's and indicator reliability. Validity and consistency tests were successfully made, and results are reported in Table 5.3. Cronbach's Alpha is above 0.7 for all latent variables (Cronbach, 1951), indicating internal consistency (Straub, 1989). Convergent validity was assessed (Gefen et al., 2000). The criteria for indicator reliability was that the loadings should be higher than 0.7 (Nunnally & Bernstein, 1994). Only Use1 shows 0.634 loadings, but all other loadings are statistically significant at 0.01. Table 5.3 shows these results. As a whole, the measurement model presents good indicator reliability. To achieve the criterion of convergent validity, the AVE should be more than 0.5, meaning that the latent variable can explain more than half of the variation in its indicators (Fornell & Larcker, 1981; Hair et al., 2014). Finally, to evaluate the discriminant validity of the constructs, both the Fornell-Larcker criterion and the cross-loadings criterion were used. The Fornell-Larcker criterion is also met for all constructs (Chin, 1998). Each loading indication should be greater than all cross-loadings, according to the cross-loadings criterion (Appendix I) (Fornell & Larcker, 1981). Results from the measurement tests indicate discriminant validity of the scales for different constructs that are different from each other.

Table 5.3 - Measurement model results (full sample)

Model latent variable	Observable variable	Item Loading	Composite Reliability	Cronbach's Alpha	AVE	Discriminant Validity
System Quality (SysQ)	SysQ1	0.931	0.965	0.952	0.872	Yes
	SysQ2	0.943				
	SysQ3	0.934				
	SysQ4	0.928				
Information Quality (IQ)	IQ1	0.935	0.951	0.931	0.829	Yes
	IQ2	0.910				
	IQ3	0.922				
	IQ4	0.874				
Service Quality (SerQ)	SerQ1	0.944	0.958	0.941	0.851	Yes
	SerQ2	0.897				
	SerQ3	0.952				
	SerQ4	0.896				
Use (Use)	Use1	0.634	0.861	0.799	0.555	Yes
	Use2	0.775				
	Use3	0.787				
	Use4	0.795				
	Use5	0.720				
User Satisfaction (US)	US1	0.882	0.933	0.904	0.778	Yes
	US2	0.795				
	US3	0.923				
	US4	0.921				
Individual Impact (II)	II1	0.916	0.954	0.935	0.839	Yes
	II2	0.940				
	II3	0.940				
	II4	0.864				
Organizational Impact (OI)	OI1	0.916	0.963	0.948	0.865	Yes
	OI2	0.940				
	OI3	0.942				
	OI4	0.922				

Table 5.4 - Fornell-Larcker criterion: matrix of correlation constructs and square root of AVE (full sample)

	SysQ	IQ	SerQ	Use	US	II	OI
SysQ	**0.934**						
IQ	0.670	**0.910**					
SerQ	0.482	0.508	**0.922**				
Use	0.449	0.540	0.385	**0.745**			
US	0.616	0.696	0.482	0.491	**0.882**		
II	0.590	0.631	0.469	0.588	0.709	**0.916**	
OI	0.605	0.656	0.542	0.567	0.684	0.742	**0.930**

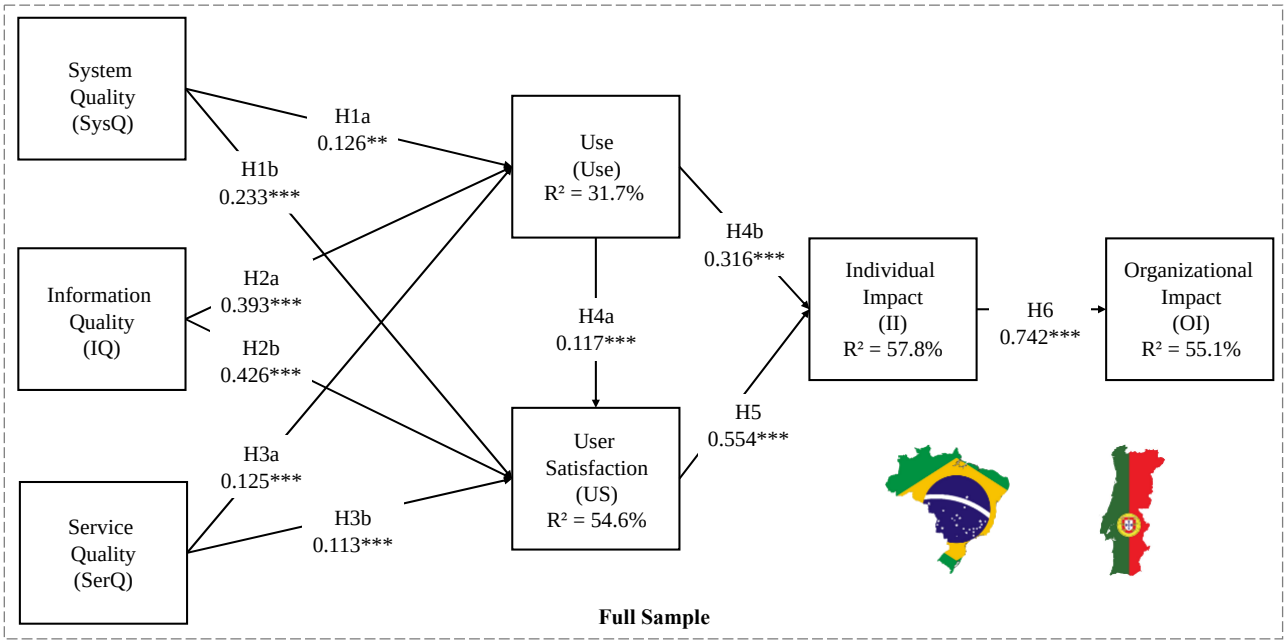
Note: The diagonal values (in bold) represent the square root of the AVE. System Quality (SysQ); Information Quality (IQ); Service Quality (SerQ); Use (Use); User Satisfaction (US); Individual Impact (II); and Organizational Impact (OI)

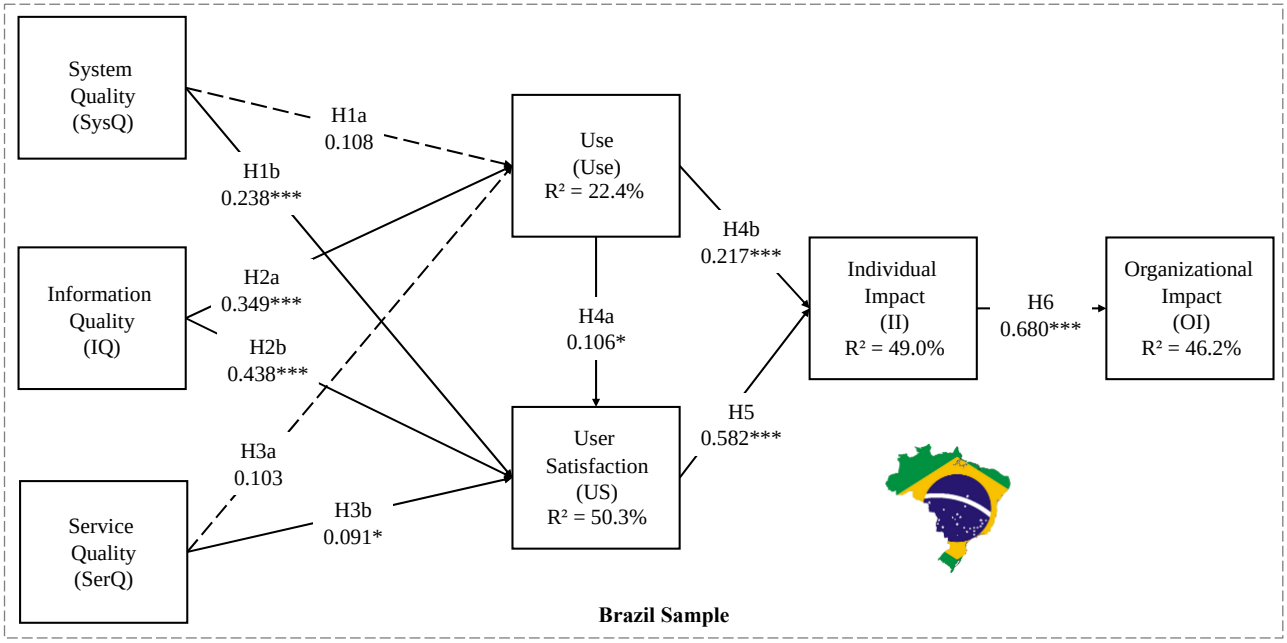
5.5.2. Structural model

A key output of the analysis, the coefficient of determination (R^2) (Chin, 1998) evaluated the structural model quality. Figure 5.3 shows the structural model results. In the full sample that includes both Brazil and Portugal cases, the model explains 31.7% of the variation in use, 54.6% of the variation in user satisfaction construct, 57.8% of the variation in individual impact, and 55.1% of the variation in organizational impact for e-learning success.

In the Brazil sample, the model explains 49.0% of the variation in individual impact and 46.2% of the variation in organizational impact. In the Portugal sample, the model explains 67.3% of the variation in individual impact and 65.6% of the variation in organizational impact. The only construct that was not fully explained by the data was use in the Brazilian sample, where the model only explained 22.4% of the variance. For the structural model in the Portuguese sample, we find support for the hypotheses tested. In the Brazilian sample, we find support for eight of the ten hypotheses. In the results from the full sample (Brazil and Portugal together), all hypotheses were supported. Among the constructs in the full sample, some are significant in explaining e-learning success. These are individual impact on organizational impact ($\widehat{\beta}$ = 0.742***), followed by user satisfaction on individual impact ($\widehat{\beta}$ = 0.554***). In the Brazil sample, two hypotheses are significant: individual impact on organizational impact ($\widehat{\beta}$ = 0.680***; p = <0.000), followed by user satisfaction on individual impact ($\widehat{\beta}$ = 0.582***; p < 0.000). In Portuguese sample, individual impact on organizational impact ($\widehat{\beta}$ = 0.810***; p < 0.000), followed by user satisfaction on individual impact ($\widehat{\beta}$ = 0.531***; p < 0.000). Figure 2 and Table 6 present standardized coefficient paths among the latent variables in the model for the full sample. Regarding the Portugal sample, all hypothesized relationships are supported (p < 0.001). Use ($\widehat{\beta}$ = 0.389***; p < 0.000), has a significant positive impact on individual impact ($\widehat{\beta}$ = 0.810***; p<=

0.000) which was found to have a substantial beneficial influence on organizational impact.





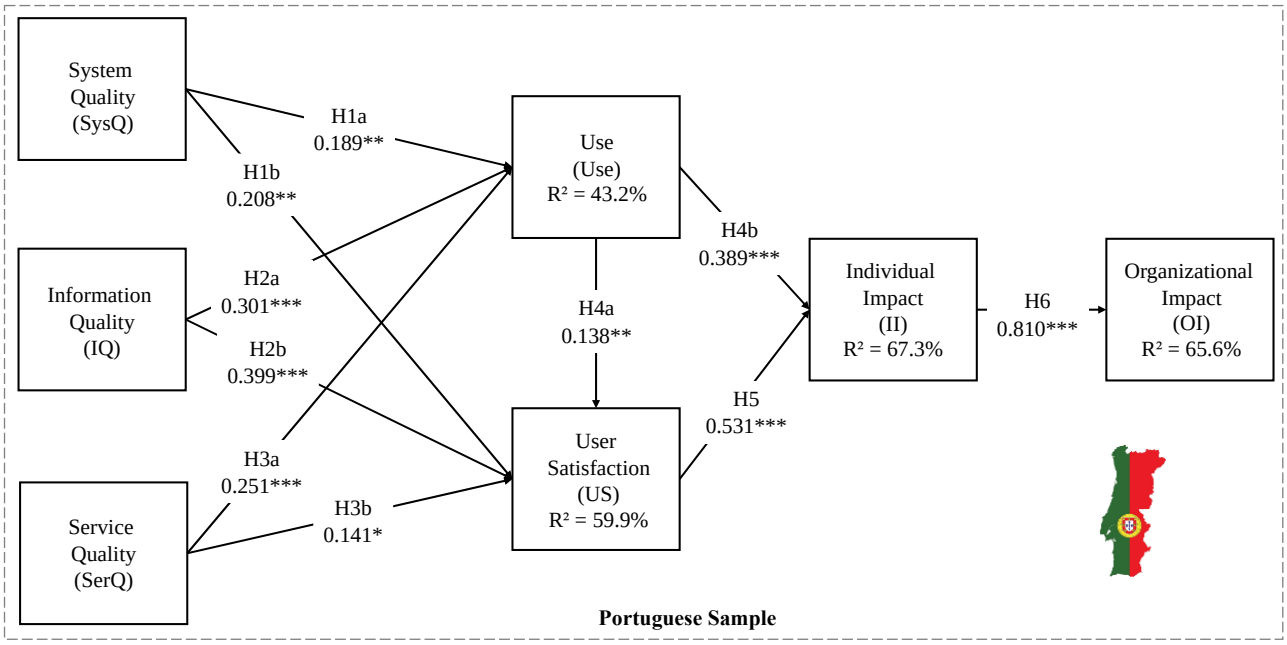


Figure 5.3 - Research models results (full sample: Brazil sample and Portugal sample)

Interestingly, the construct system quality on use hypothesis (H1a), is not supported ($\widehat{\beta}$ = 0.108; p = 0.138) in the Brazil sample. However, in the Portugal sample, the results suggest a relationship as they reject a null hypothesis that no difference exists, ($\widehat{\beta}$ = 0.189**; p = 0.029). The same situation occurs with the construct service quality on use in the Brazil sample. Hypothesis (H3a) is not supported ($\widehat{\beta}$ = 0.103; p = 0.105). However, in the Portugal sample, the results suggest a significant difference ($\widehat{\beta}$ = 0.251***; p = 0.001).

Table 5.5 - Results of hypotheses tests of full sample (Brazil and Portugal)

Hypotheses	Sample	Findings	p-Value	Support
H1a **System Quality (SysQ) → Use (Use)**	Brazil	Not significant ($\hat{\beta}$ = 0.108 NS)	0.138	No
	Portugal	Positive impact & statistically significant ($\hat{\beta}$ = 0.189**)	0.029	Yes
	Full	Positive impact & statistically significant ($\hat{\beta}$ = 0.126**)	0.236	Yes
H1b **System Quality (SysQ) → User Satisfaction (US)**	Brazil	Positive impact & statistically significant ($\hat{\beta}$ = 0.238***)	0.000	Yes
	Portugal	Positive impact & statistically significant ($\hat{\beta}$ = 0.208**)	0.007	Yes
	Full	Positive impact & statistically significant ($\hat{\beta}$ = 0.233***)	0.618	Yes
H2a **Information Quality (IQ) → Use (Use)**	Brazil	Positive impact & statistically significant ($\hat{\beta}$ = 0.349***)	0.000	Yes
	Portugal	Positive impact & statistically significant ($\hat{\beta}$ = 0.301***)	0.001	Yes
	Full	Positive impact & statistically significant ($\hat{\beta}$ = 0.393***)	0.662	Yes
H2b **Information Quality (IQ) → User Satisfaction (US)**	Brazil	Positive impact & statistically significant ($\hat{\beta}$ = 0.438***)	0.000	Yes
	Portugal	Positive impact & statistically significant ($\hat{\beta}$ = 0.399***)	0.000	Yes
	Full	Positive impact & statistically significant ($\hat{\beta}$ = 0.426***)	0.645	Yes
H3a **Service Quality (SerQ) → Use (Use)**	Brazil	Not significant ($\hat{\beta}$ = 0.103 NS)	0.105	No
	Portugal	Positive impact & statistically significant ($\hat{\beta}$ = 0.251***)	0.001	Yes
	Full	Positive impact & statistically significant ($\hat{\beta}$ = 0.125***)	0.068	Yes
H3b **Service Quality**	Brazil	Positive impact & statistically significant ($\hat{\beta}$ = 0.091*)	0.048	Yes

Hypotheses	Sample	Findings	p-Value	Support
(SerQ) → User Satisfaction (US)	Portugal	Positive impact & statistically significant ($\hat{\beta}$ = 0.141*)	0.025	Yes
	Full	Positive impact & statistically significant ($\hat{\beta}$ = 0.113***)	0.261	Yes
H4a Use (Use) → User Satisfaction (US)	Brazil	Positive impact & statistically significant ($\hat{\beta}$ = 0.106*)	0.025	Yes
	Portugal	Positive impact & statistically significant ($\hat{\beta}$ = 0.138**)	0.002	Yes
	Full	Positive impact & statistically significant ($\hat{\beta}$ = 0.117***)	0.306	Yes
H4b Use (Use) → Individual Impact (II)	Brazil	Positive impact & statistically significant ($\hat{\beta}$ = 0.217***)	0.000	Yes
	Portugal	Positive impact & statistically significant ($\hat{\beta}$ = 0.389***)	0.000	Yes
	Full	Positive impact & statistically significant ($\hat{\beta}$ = 0.316***)	0.011	Yes
H5 User Satisfaction (US) → Individual Impact (II)	Brazil	Positive impact & statistically significant ($\hat{\beta}$ = 0.582***)	0.000	Yes
	Portugal	Positive impact & statistically significant ($\hat{\beta}$ = 0.531***)	0.000	Yes
	Full	Positive impact & statistically significant ($\hat{\beta}$ = 0.554***)	0.751	Yes
H6 Individual Impact (II) → Organizational Impact (OI)	Brazil	Positive impact & statistically significant ($\hat{\beta}$ = 0.680***)	0.000	Yes
	Portugal	Positive impact & statistically significant ($\hat{\beta}$ = 0.810***)	0.000	Yes
	Full	Positive impact & statistically significant ($\hat{\beta}$ = 0.742***)	0.003	Yes

Notes: NS = not significant; * significant at $p < 0.05$; ** significant at $p < 0.01$; *** significant at $p < 0.001$

5.5.3. Discussion

The results from the present research study indicate that D&MM fits the data well for both samples (Brazil and Portugal) and thus can be used to measure e-learning success. Similar to earlier studies (Aparicio et al., 2016; Cidral et al., 2018, 2020), our findings corroborate empirical findings of earlier studies in e-learning success, in which usage was explained by the quality of information, collaboration and satisfaction but not by systems and service quality for the Brazil case (Cidral.et al., 2018; Machado Da Silva et al., 2014). For another Portuguese study (Aparicio et al., 2017) it was reported that usage is explained by information and by service quality. The current study, however, has a greater explanation power as it explains 55% of the individual students' performance in general.

The two major differences between Brazil and Portugal are that in the Brazil case, neither the system quality nor the service quality has a significant impact on use. As for the Portugal context, all the independent variables have an impact on use and on learners' satisfaction. The dependent latent variables, individual and organizational impact, are strongly and significantly influenced by e-learning usage and e-learners satisfaction level for both countries. These two constructs of the structural model indicate that e-learning success is the same for Brazilian and Portuguese learners: user satisfaction on individual impact and individual impact on organizational impact.

This study offers new paths to conduct research between these two countries because it demonstrates the need of conducting deeper studies including variables that previous literature has shown to be relevant for further studies. We suggest that new research be conducted to better understand success in e-learning better, taking into account new and more current items, such as net promoter score (NPS), return on investment (ROI), and transfer and application of learning with others. To the extent that there is only learning when there is behavioral change, not all customer success can be measured in terms of individual and organizational impact, which is a limitation of our study. Other studies in

literature also found differences between two different countries that share history, culture and trade, particularly in adoption drivers such as hedonic motivation differ between those countries (Al-Azawei & Alowayr, 2020). Other cross-countries studies refer to the cultural differences affecting e-learning usage (Tarhini et al., 2017) or to digital skills attainments between the samples (Ramírez-Correa et al., 2017).

5.6. Conclusions and implications

The present study presented a cross-country empirical study based on the information systems success theory. It was found that the following variables in the Brazilian samples, system quality on use and service quality on use are not significant ($p > 0.05$). In the Portuguese sample, the results are the opposite: system quality and service quality are significant ($p < 0.001$) and their slope $\hat{\beta}$ is strong and positive. This finding indicates that there are probably other intervening factors in the e-learning process (Brazil *vs* Portugal). The ten hypotheses in the Portuguese sample and eight hypotheses in the Brazilian sample were supported, and all hypotheses in the full sample were supported. As most of the structural model constructs obtained high coefficients of determination and path coefficients, we conclude that the model captured the concept of success in e-learning systems.

We believe that adequate implementation of educational technologies has a significant influence on learning and consequently, higher education leaders should focus on this as they consider the structure, content, and personnel of e-learning systems. Effective learning must be adapted to the process context in which it takes place. This cross-country study demonstrates that some differences exist between Brazilian and Portuguese learners, who have different behaviors regarding system quality (SysQ) and service quality (SerQ) variables with use of e-learning. As for the variables information quality (IQ), use (Use) and user satisfaction (US), Brazilian and Portuguese learners have similar behaviors, and these lead to similarity regarding individual impact (II) and organizational impact (OI) of e-learning.

As for practical implications, this study seems to indicate that for Portuguese students find the quality of the infrastructure upon which the systems are supported (SysQ) as being very relevant to their success in their course when compared to Brazilian students, as well as the perceived support from the helpdesk services (SerQ) which is also perceived differently in terms of its contribution to success. In the Brazilian market these two factors only contribute to the perception of satisfaction not to the usage of such systems. In both countries e-learners' satisfaction explains more the students' perceived performance and success than use does. Based on the theoretical model, the results from this study suggested a high variance explanation, particularly regarding factors related the impact of students's satisfaction on performance (II & OI), which demonstrates the usefulness of the study framework for decision-makers, researchers and practitioners. As a result, we urge that these actors give the proposed factors more thought in order to provide greater instructional enrichment in higher education institutions.

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CHAPTER VI . CONCLUSIONS

The e-learning ecosystem has been developing rapidly worldwide, providing increasingly broader content, experiences, services, and also promoting knowledge sharing. Technology is transforming the way of learning, by impacting not only people but also corporations and society. Information technology has dramatically impacted our education, and new generations (digital natives) learn differently. Besides, there is often no separation between the online and offline world, which blends and crystallizes into new behaviors and educational experiences. Our summary of findings, limitations and future studies are presented below.

6.1. Summary of findings

Our work is supported by the fact that it is of utmost importance to understand the most critical determinants of the success of e-learning. Four studies were developed and presented in the previous chapters; three empirical studies and one meta study. The complete list of the most significant determinants, as found in the empirical studies (Chapters III, IV, and V), meta study (Chapter II), and the list of the essential relationships, as seen in the remaining chapters, are presented in Table 6.1.

Table 6.1 - List of significant determinants relationships

Independent	**Dependent**	**Chapter**		
		III	**IV**	**V**
		Individual Impact (II)	Net Benefits (NB)	Individual Impact (II) Organizational Impact (OI)
Collaboration Quality (CQ)	Use (Use)	√	√	
Service Quality (SerQ)		√	√	√
Information Quality (IQ)		√	√	√
System Quality (SysQ)		√	√	√
Collaboration Quality (CQ)	User Perceived Satisfaction (US)	√		
Service Quality (SerQ)		√		
Information Quality (IQ)		√		
System Quality (SysQ)		√		
Learner Computer Anxiety (LCA)		√		
Instructor Attitude Toward e-Learning (IATL)		√		
Diversity in Assessment (DA)		√		
Learner Perceived Interaction with Others (LPIO)		√		
Collaboration Quality (CQ)	User Satisfaction (US)		√	
Service Quality (SerQ)			√	√
Information Quality (IQ)			√	√
System Quality (SysQ)			√	√
Short-Term Orientattion (STO)	Use (Use)		√	
Long-Term Orientattion (LTO)			√	

From Table 6.1, we can identify the relationships that have been found to be significant in most studies. In relation to use: service quality, information quality, and system quality were significant in three studies. In relation to user satisfaction: service quality, information quality, and system quality were found in to be significant in two studies. Results from all the main studies are presented as follows.

We started in Chapter II with the e-learning success literature review and meta studies. The best determinants of e-learning success found in the literature were: (1) use, (2) user perceived satisfaction, (3) information quality, (4) system quality, (5) service quality, (6) collaboration quality, (7) learner computer anxiety, (8) instructor attitude toward e-learning, (9) diversity in assessment, (10) learner perceived interaction with others, (11) short-term orientation, and (12) long-term orientation. The e-learning concepts ecosystem presents very similar terms: e-learning, on-learning, b-learning, u-learning, and d-learning. In digital libraries, there is a growth trend for all terms; a highlight of demand and growth for online learning and e-learning; and Google Trends signals development for online course (voice of society for learning solutions) and a decreased tendency to the use of online learning and e-learning (academic trends focusing on research).

We present in Chapter III a theoretical model to evaluate the impact of satisfaction on e-learning success. The model is based on literature on information systems' success and satisfaction. The research model was empirically tested and validated with university students from Brazil. Our model explains more than 52% of the variation of the individual impact as due to the e-learning systems use, and user perceived satisfaction. The study demonstrates that satisfaction theory is an important determinant of e-learning success. This means that students with a stronger satisfaction play a central role in assessing individual impact. Collaboration, information, and system quality are success determinants. User satisfaction dimensions are success determinants, and user satisfaction, both directly and indirectly, affects learners' individual impact.

Chapter IV presents a theoretical model with a cultural dimension of learners' e-learning success. First, students' long-term orientation influences the positive relationship between e-learning systems' use and perceived net benefits. Also, system and information quality and e-learning systems' use are determinants of e-learning user satisfaction. Additionally, collaboration quality and information quality are determinants of e-learning systems usage. Our model explains more than 59% of the variation of the net benefits as due to the e-learning systems use and user satisfaction. The study demonstrates that Confucian dynamism theory regarding a long-term orientation and short-term orientation have a low impact on the use and net benefits.

In Chapter V, we analyzed the success of e-learning in two different countries, namely Brazil and Portugal, based on the information success model of DeLone & McLean. Brazilian and Portuguese students evaluated the effect of system quality on use and service quality on e-learning differently. The cross-country comparison confirms that information quality and user satisfaction have similar behaviors. These lead to similarities regarding the individual impact and organizational impact in the success of e-learning. It is shown that D&M model explains more than 57% of the variation of individual impact, and more than 55% of the variation of organizational impact in the full sample (Brazil and Portugal samples).

6.2. Limitations and future studies

This thesis contains some limitations. First, the third and the fourth empirical studies were based on university students' opinions in Brazil. The model's validation could be increased if the data were collected in more regions, considering the large Brazilian territorial extension. These would enable analyzing and contrasting research, thus enabling new insights. Unfortunately, in Brazil, empirical studies in e-learning are scarce. Second, the empirical studies were directed to higher education institutions such as colleges, university centers, and universities, regardless of whether e-learning is used 100% online, as blended learning, or as support for face-to-face learning. This limitation did not

jeopardize the research, so future studies may broaden the understanding of e-learning according to the methodology adopted.

For future research, we suggest studies integrating structural equation modeling (SEM) and decision tree (machine learning). Other studies could employ random forest (machine learning) integrated with structural equation modeling (SEM).

The year 2020 was very unusual. The Corona Virus Disease 2019 (COVID 19) affected business models as it resulted in the emergence of new habits and behaviors. In this context, optimal education is not only a competitive advantage but has also become a corporate prerequisite. E-learning as a whole has been dramatically impacted, and the process of adopting technology has been heavily accelerated. Therefore, news studies about blended learning, hybrid learning and e-learning are essential.

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Appendix A - Summary table of main studies related to the use, satisfaction, and success of e-learning (Chapter III)

Authors	Study / Context	Conclusions / Results / Contributions
Frankola (2001)	Low satisfaction rates with e-learning	. Students do not have enough time . Failure in supervision or management of e-learning structure . Lack motivation . Problems
Wang (2003)	Model for measuring satisfaction of asynchronous e-learning student	Highlighted important variables such as: . Student interface . Learning community . Content . Customization
Selim (2003)	Evaluate the acceptance of the courses on the web by students, based on the technology acceptance model (TAM), and formulated the course website acceptance model (CWAM)	The ease of use of the courses on the web is the main determinant as to acceptance as an effective and efficient learning technology
Chiu, S.-Y. Sun, P.-C. Sun, & Ju (2007)	Integrates the concept of subjective task value and fairness theory to construct a model for investigating the motivations behind learners' intention to continue using web-based learning	Usability, quality, value, and the decision to continue the e-learning were highlighted
J.-K. Lee & J.-H. Lee (2005)	Study on the effectiveness of e-learning system for courses and modules	Flow theory to the hypothesis of a theoretical model to explain and predict the intentions of users to continue to use e-learning
Roca, Chiu, & Martínez (2006)	The perceived performance component is decomposed in perceived quality and perceived usability. Study based on the expectancy disconfirmation theory (EDT), and proposed a decomposed technology acceptance model	The intention of continuity is determined together: . Perceived usefulness . Information quality . Confirmation . Service quality . Quality of the system . Perceived ease of use . Cognitive absorption
Liaw, Huang, & Chen (2007)	Study of the students' and instructor's attitudes in connection to e-learning. Developing the three-tier use model (3-TUM)	Conclusions in levels: . Level 1 / layer of individual experience and quality system . Level 2 / affective and cognitive layer . Level 3 / behavioral intention layer

Authors	Study / Context	Conclusions / Results / Contributions
Selim (2007)	Study of the critical factors of success in e-learning	Four categories: . (1) Instructor . (2) Student . (3) Information technology . (4) Support from university
Levy (2007)	Compared the dropouts and persistent e-learning students, and raised two constructs: (1) academic locus of control, and (2) student satisfaction with e-learning	The results demonstrated that student satisfaction with e-learning is a key indicator in the decision to abandon the course of e-learning
Shee & Wang (2008)	With the web-based e-learning system (WELS) growth, users are recognized as essential as satisfaction influences the adoption of systems	Development of methodology based on student satisfaction and their applications in multi-criteria evaluation of web-based e-learning system
Roca & Gagné (2008)	Study for understanding the intention of continuity of e-learning in the workplace were based on self determination theory (SDT), and the study expanded the TAM with the e-learning services	In the proposed model perceived usefulness, perceived playfulness and perceived ease of use are expected to be influenced by the perceived autonomy support, perceived competence, and relational perception. The study also helped to examine the effects of motivational factors affecting the constructs TAM
Sun et al. (2008)	Study on the satisfaction level of using e-learning systems	Developed an integrated model with six dimensions: students, teachers, courses, technology, design, and environment. The research investigated the critical factors that affect student satisfaction in e-learning
Johnson, Hornik, & Salas (2008)	Development of a model of evaluation of the factors that contribute to the creation of e-learning success environments, taking into account the presence and social factors, and other variables, such as application-specific computer self-efficacy (AS-CSE), perceived usefulness, interaction in the course, and the effectiveness of e-learning	The results indicate that AS-CSE and perceived usefulness were related to course performance, satisfaction and instrumentality of the course, as well as interaction and social presence.

Authors	Study / Context	Conclusions / Results / Contributions
Ozkan & Koseler (2009)	Proposed the hexagonal e-learning assessment model (HELAM) for the LMS	Designed six dimensions in this multi-dimensional approach to evaluation: . (1) System quality . (2) Service quality . (3) Content quality . (4) Learner perspective . (5) Instructor attitudes . (6) Supportive issues
Lee (2010)	Synthesized expectation-confirmation model (ECM), TAM, theory of planned behavior (TPB), and the flow theory to the possibility of a theoretical model to explain and predict the intentions of the users and the continuous use of e-learning	New variables that impact the intention of continuity of e-learning users, such as: satisfaction, usefulness, attitude, concentration, subjective norm, and perceived behavioral control
Paechter, Maier, & Macher (2010)	Expectations and experiences of students in e-learning, related learning objectives and satisfaction of the course	Showed 5 important factors in the learning process: . (1) Instructional design, learning materials, and friendly electronic environment . (2) Availability of interaction between students and students with instructors/teachers . (3) Possibility of exchanging and sharing among students . (4) Encouragement of individual learning . (5) Improvements based on the analysis of the cognitive and emotional outcomes involved in learning
Lin & Bhattacherjee (2010)	Based on the theory of rational action and theory confirmation of expectation generated model	The model features six constructs: . (1) Frequency of negative critical incidents . (2) Quality accumulative satisfaction attributes . (3) Perceived ease of use . (4) Perceived usefulness . (5) Attitude . (6) Intention to continue
Aggelidis & Chatzoglou (2012)	Study on the satisfaction of e-learning system for courses and modules	Build on existing body of knowledge, testing past models and suggesting new conceptual perspectives on how the EUCS is formed among the users of the hospital information system

Appendixes

Authors	Study / Context	Conclusions / Results / Contributions
Okazaki & Santos (2012)	The study examined factors influencing e-learning adoption and the moderating role of gender in Brazil. This study extends the TAM by adding attitude and social interaction	Unlike the original TAM, perceived usefulness is not a direct driver of intention. In terms of moderation, gender affects three relationships: (1) ease of use –› perceived usefulness; (2) perceived usefulness –› attitude, and (3) intention –› actual behavior
Chow & Shi (2014)	Study on the level of satisfaction of using e-learning systems	Understanding students' satisfaction of the background and intention to continue the e-learning based on the ECM
Parkes, Stein, & Reading (2015)	University context	Students' preparedness influences results on e-learning university courses
Pereira et al. (2015)	Investigate the constructs of technology readiness index (TRI) and the decomposed expectancy disconfirmation theory (DEDT) as determinants of satisfaction and continuous use intention in e-learning services applied in public organizations	Quality, quality disconfirmation, value and value disconfirmation positively impact on satisfaction, as well as disconfirmation usability, innovativeness and optimism. Likewise, satisfaction proved to be decisive for the purpose of continuous use intention. In addition, technoogical readiness and performance are strongly related

Appendix B - Measurement items (Chapter III)

Constructs	Code	Indicators	Theoretical Support
Using a seven-point scale 1, strongly disagree; 7, strongly agree, the variables are to be measured by asking students to rate their perception on e-learning systems. Strongly disagree 1 - 2 - 3 - 4 - 5 - 6 - 7 Strongly agree			
Collaboration Quality	**CQ1**	Our e-learning system enables an easy and comfortable communication with my colleagues.	Urbach et al., (2010)
	CQ2	Our e-learning system supports an effective and efficient sharing of information with my colleagues.	
	CQ3	Our e-learning system enables a comfortable storing and sharing of documents with my colleagues.	
	CQ4	Our e-learning system allows me to easily and quickly locate my colleagues' contact information.	
Service Quality	**SerQ1**	The responsible service personnel are always highly willing to help whenever I need support with the e-learning system.	DeLone & McLean (2003)
	SerQ2	The responsible service personnel provide personal attention when I experience problems with the e-learning system.	
	SerQ3	The responsible service personnel provide services related to the e-learning system at the promised time.	
	SerQ4	The responsible service personnel have sufficient knowledge to answer my questions in respect to the e-learning system.	
Information Quality	**IQ1**	Examples are retrievable documents, course news, process descriptions, and course-specific information. 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.	
System Quality	**SysQ1**	Please assess the system quality of the e-learning platform. The e-learning system is easy to navigate.	
	SysQ2	The e-learning system allows me to easily find the information I am looking for.	
	SysQ3	The e-learning system is well structured.	
	SysQ4	The e-learning system is easy to use.	
Use	**Use1**	Please indicate the extent to which you use the e-learning system to perform the following tasks: Retrieve information.	
	Use2	Publish information.	
	Use3	Communicate with colleagues and teachers.	
	Use4	Store and share documents.	
	Use5	Execute course work.	
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.	
Learner Computer Anxiety	**LCA1**	Working with a computer would make me very nervous	Sun et al. (2008)
	LCA2	Computers make me feel uncomfortable	
	LCA3	Computers make me feel uneasy and confused	
Instructor Attitude Toward e-learning	**IATL1**	Compared to traditional classrooms, you feel that your instructor considers useful a web-based learning technology.	
Diversity in Assessment	**DA1**	The e-learning offers a variety of ways to assess my learning (quizzes, written work, oral presentation, etc.)	
Learner Perceived Interaction with Others	**LPIO1**	I learned more from my fellow students in this e-learning system than in other courses	
	LPIO2	The instructor frequently attempted to elicit student interaction	
	LPIO3	It was easy to follow class discussions	
User Perceived Satisfaction	**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?	
	US5	Execute course work.	

Appendix C - Item cross-loadings (Chapter III)

	CQ	SerQ	IQ	SysQ	LCA	IATL	DA	LPIO	US	Use	II
CQ1	**0.917**	0.459	0.461	0.451	-0.002	0.312	0.446	0.662	0.437	0.496	0.436
CQ2	**0.944**	0.449	0.428	0.471	0.000	0.269	0.400	0.606	0.390	0.460	0.424
CQ3	**0.859**	0.380	0.378	0.368	-0.013	0.218	0.291	0.536	0.282	0.408	0.291
CQ4	**0.925**	0.425	0.401	0.457	-0.027	0.233	0.374	0.569	0.352	0.463	0.382
SerQ1	0.452	**0.931**	0.344	0.387	-0.067	0.315	0.286	0.350	0.362	0.247	0.372
SerQ2	0.424	**0.873**	0.316	0.335	-0.018	0.289	0.268	0.312	0.321	0.244	0.339
SerQ3	0.446	**0.942**	0.354	0.398	-0.013	0.316	0.249	0.318	0.370	0.254	0.378
SerQ4	0.380	**0.861**	0.379	0.387	-0.039	0.277	0.275	0.331	0.351	0.283	0.307
IQ1	0.426	0.369	**0.930**	0.539	-0.148	0.349	0.444	0.382	0.607	0.427	0.521
IQ2	0.489	0.343	**0.884**	0.587	-0.207	0.319	0.454	0.464	0.589	0.367	0.490
IQ3	0.370	0.358	**0.902**	0.501	-0.181	0.347	0.435	0.391	0.615	0.375	0.519
IQ4	0.338	0.291	**0.816**	0.408	-0.083	0.223	0.330	0.284	0.519	0.400	0.417
SysQ1	0.424	0.345	0.483	**0.922**	-0.279	0.250	0.287	0.362	0.475	0.286	0.462
SysQ2	0.482	0.413	0.570	**0.929**	-0.162	0.338	0.357	0.405	0.549	0.364	0.503
SysQ3	0.451	0.420	0.556	**0.922**	-0.156	0.311	0.344	0.359	0.555	0.328	0.500
SysQ4	0.412	0.354	0.509	**0.904**	-0.216	0.311	0.281	0.360	0.485	0.304	0.542
LCA1	0.010	-0.012	-0.158	-0.144	**0.905**	-0.081	-0.103	-0.056	-0.191	0.000	-0.170
LCA2	-0.017	-0.060	-0.157	-0.214	**0.959**	-0.120	-0.125	-0.064	-0.210	-0.062	-0.254
LCA3	-0.021	-0.033	-0.179	-0.247	**0.933**	-0.103	-0.136	-0.028	-0.215	-0.029	-0.242
IATL	0.287	0.332	0.353	0.331	-0.109	**1.000**	0.402	0.364	0.485	0.319	0.399
DA1	0.420	0.298	0.472	0.347	-0.131	0.402	**1.000**	0.472	0.505	0.300	0.379
LPIO1	0.425	0.208	0.271	0.226	0.036	0.251	0.346	**0.775**	0.304	0.312	0.232
LPIO2	0.578	0.372	0.373	0.329	0.007	0.360	0.432	**0.845**	0.394	0.362	0.375
LPIO3	0.599	0.306	0.411	0.424	-0.147	0.288	0.391	**0.862**	0.424	0.391	0.332
US1	0.328	0.347	0.600	0.520	-0.202	0.522	0.469	0.386	**0.895**	0.364	0.585
US2	0.307	0.276	0.414	0.359	-0.131	0.311	0.335	0.283	**0.758**	0.251	0.542
US3	0.368	0.323	0.668	0.517	-0.224	0.442	0.495	0.449	**0.936**	0.410	0.630
US4	0.421	0.415	0.607	0.559	-0.205	0.410	0.457	0.467	**0.916**	0.396	0.598
Use1	0.230	0.145	0.378	0.269	-0.113	0.247	0.194	0.225	0.316	**0.617**	0.313
Use2	0.379	0.155	0.312	0.219	-0.011	0.225	0.271	0.382	0.296	**0.809**	0.351
Use3	0.510	0.291	0.317	0.317	0.053	0.271	0.281	0.454	0.308	**0.808**	0.306
Use4	0.438	0.300	0.298	0.282	0.048	0.227	0.254	0.328	0.275	**0.793**	0.309
Use5	0.248	0.132	0.327	0.188	-0.125	0.193	0.081	0.158	0.311	**0.604**	0.379
II1	0.394	0.354	0.480	0.442	-0.230	0.416	0.309	0.314	0.568	0.396	**0.894**
II2	0.405	0.379	0.494	0.507	-0.208	0.425	0.364	0.394	0.660	0.445	**0.939**
II3	0.389	0.366	0.481	0.492	-0.201	0.355	0.340	0.351	0.601	0.394	**0.935**
II4	0.342	0.291	0.532	0.523	-0.225	0.234	0.345	0.317	0.576	0.387	**0.824**

Appendix D - Model constructs definitions (Chapter IV)

Constructs	Definition	Authors
System Quality (SysQ)	E-learning systems quality refer to the overall system performance, according to usability aspects, like the ease of use, performance, flexibility, integration, interaction, navigation, time-response and reliability of the e-learning system itself.	DeLone & McLean (2003); Urbach et al., (2010)
Information Quality (IQ)	E-learning information quality has to do with the content accuracy, availability, usefulness, relevance of the information provided within the e-learning platform.	
Service Quality (SerQ)	The service quality in e-learning systems are due to the staff provided support to the various stakeholders, in terms of assurance, empathy, responsiveness, and reliability.	
Collaboration Quality (CQ)	Collaboration quality corresponds to the effectiveness of communication between students and teachers, as well as between peers for learning purposes.	
Use (Use)	Use is the level of adoption in terms of frequency and purpose of utilization, e.g., the nature of the actual usage of the e-learning system.	
User Satisfaction (US)	User satisfaction is the level of fulfillment as a result of the e-learning system usage.	
Net Benefits (NB)	E-learning systems' net benefits correspond to the performance at the student's individual level, in terms of productivity, learnability, learning tasks simplification, usefulness, among other, and the performance at an organizational level, as the e-learning system improves the overall success level of the university, and increased the capacity enhancement of coordination.	
Long-Term Orientation (LTO)	Refers to the learner's effort being focused towards the achievement of results in the future with perseverance.	Hofstede & Bond (1988); Bearden et al. (2006)
Short-Term Orientation (STO)	Corresponds to the immediacy of present results from learning, this construct is also related to the focus on the past orientation of student, rather than the future.	

Appendix E - Measurement items of questionnaire (Chapter IV)

Constructs		Code	Indicators	Theoretical Support
Using a seven-point scale, 1 strongly disagree, and 7 strongly agree, the variables are to be measured by asking students to rate their perception of e-learning systems				
System Quality		**SysQ1**	The e-learning system is easy to navigate.	DeLone & McLean (2003)
		SysQ2	The e-learning system allows me to find the information I am looking for easily.	
		SysQ3	The e-learning system is well structured.	
		SysQ4	The e-learning system is easy to use.	
Information Quality		**IQ1**	The information provided by the e-learning system is useful.	
		IQ2	The information provided by the e-learning system understandable.	
		IQ3	The information provided by the e-learning system is interesting.	
		IQ4	The information provided by the e-learning system is reliable.	
Service Quality		**SerQ1**	The responsible service personnel are always highly willing to help whenever I need support with the e-learning system.	
		SerQ2	The responsible service personnel provide personal attention when I experience problems with the e-learning system.	
		SerQ3	The responsible service personnel provide services related to the e-learning system at the promised time.	
		SerQ4	The responsible service personnel have sufficient knowledge to answer my questions in respect of the e-learning system.	
Collaboration Quality		**CQ1**	Our e-learning system enables easy and comfortable communication with my colleagues.	Urbach et al. (2010)
		CQ2	Our e-learning system supports an effective and efficient sharing of information with my colleagues.	
		CQ3	Our e-learning system enables a comfortable storing and sharing of documents with my colleagues.	
		CQ4	Our e-learning system allows me to easily and quickly locate my colleagues' contact information.	
Use		**Use1**	Retrieve information.	DeLone & McLean (2003)
		Use2	Publish information.	
		Use3	Communicate with colleagues and teachers.	
		Use4	Store and share documents.	
		Use5	Execute courses work.	
User Satisfaction		**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?	
Net Benefits		**NB1**	The e-learning system enables me to accomplish tasks more quickly.	
		NB2	The e-learning system increases my productivity.	
		NB3	The e-learning system makes it easier to accomplish tasks.	
		NB4	The e-learning system is useful for my job.	
		NB5	The e-learning system has helped my university improve the efficiency of internal operations.	
		NB6	The e-learning system has helped my university improve the quality of working results.	
		NB7	The e-learning system has helped my university enhance and improve coordination within the university.	
		NB8	The e-learning system has helped my university make itself an overall success.	
Confucianism	**Short-Term Orientation**	**STO1**	Respect for tradition is important to me.	Hofstede & Bond (1988); Bearden et al. (2006)
		STO2	Traditional values are important to me.	
	Long-Term Orientation	**LTO**	I work hard for success in the future.	
		LTO	I plan for the long-term.	

Appendix F - Summary of the main studies related to long-term orientation (LTO) or short-term orientation (STO) with e-learning, learning, and education context (Chapter IV)

Authors Study Field	Methodology	Model Constructs	Theoretical Model and Stage	Results
Tsikriktsis (2002) Study the link between culture and website quality (WebQual) expectations from web-banking	Survey: collected from MBA students from many cultures N=171 (45=North America, 21=South America, 38=Western Europe, 13=Eastern Europe, 17=Southern Europe and 37=Australia)	WebQual . Age . Gender . Nation . Power distance . Individualism . Uncertainty avoidance . Long-term orientation	- Confucian Dynamism Theory	The analysis reveals that two cultural dimensions (masculinity and long-term orientation) are associated with higher website quality expectations. The findings have important managerial implications for globalization of e-services
Hassan, Shiu, & Walsh (2011) The study replicated and extended the work of Bearden et al., (2006) examining the psychometric properties and generalization of the scale across countries of the European Union (EU)	Survey: based on data collected from respondents across 10 (ten) EU Member States via an internet questionnaire N=3.491 (EU)	. Long-term orientation scale (tradition / planning)	- Confucian Dynamism Theory	The LTO scale is found to possess adequate dimensional properties in the majority of country samples. Discriminant validity between the two LTO dimensions is not evidenced across four country samples. Significant association is found between LTO and individualistic orientation among respondents in nine of the ten countries with few significant associations found between LTO and

Authors Study Field	Methodology	Model Constructs	Theoretical Model and Stage	Results
				uncertainty avoidance
Nistor, Göğüş, & Lerche (2013) The study researched new platforms and environments for technology-enhanced learning	Survey: with educational technology users N=4.589 (1.849=Germany, 1.017=Romania and 1.723=Turkey)	- Power distance - Individualism - Masculinity - Uncertainty avoidance - Long-term orientation - Performance expectancy - Effort expectancy - Social influence - Facilitating conditions - Computer anxiety - Use intention - Use behavior	- Confucian Dynamism Theory - UTAUT Acceptance and use	. Makes headway in the integration of culture (sensu Hofstede) in the UTAUT, and proposes a major ETA Model (educational technology acceptance) . The cultural sample diversity allows the verification of correlations between acceptance and culture
Ruhi & Al-Mohsen (2015) Study explored sociological and technological factors that affect the use of enterprise 2.0 (E2.0) technologies for knowledge management (KM)	Survey: employees of various organizations in different countries and industries. Exploratory factor analyses and structural equation modeling techniques N=176 (43=Canada, 48=USA, and 85=Saudi Arabia)	. Power distance . Long-term orientation . Perceived ease of use . Perceived usefulness . Enterprise 2.0 richness . Enterprise 2.0 sophistication . Knowledge management environment . Personal information behavior . Organizational information behavior . Intention of use of system	- Confucian Dynamism Theory - TAM Adoption and use	Results indicate that national culture traits and corporate KM culture play an important role in influencing personal and organizational information behavior, as well as the use of enterprise 2.0 technologies for KM
Lai, Wang, Li, & Hu (2016)	Survey: undergraduate students studying	. Long-term orientation . Collectivism	- Confucian Dynamism Theory	. Strong direct effects but weak

Appendixes

Authors Study Field	Methodology	Model Constructs	Theoretical Model and Stage	Results
Study examined the influence of individual cultural values exposition on self-directed use of technology for language learning beyond the classroom	a variety of foreign languages including English, French, Chinese, German, Japanese, Korean, Spanish and Russian. Around 48% of the participants self- rated themselves as of beginning proficiency level N=661 (182=Hong Kong, 221=USA and 258=China)	. Power distance . Uncertainty avoidance . Performance expectancy . Effort expectancy . Facilitating conditions . Social influence . Hedonic motivation . Intention to use . Technology use	- UTAUT Acceptance and use	moderating effects of cultural values . Performance expectancy and hedonic motivation influence technology use . Long-term orientation is critical to technology adoption in informal language learning . Uncertainty avoidance is critical to technology adoption in informal language learning
Figlio, Giuliano, & Özek (2017) The study addressed the role of LTO on educational performance of immigrant students living in the United States; used population-level administrative data from Florida's birth and education records	Survey: students (K-12) level data coming from the Program for International Student Assessment (PISA). The sample of second-generation immigrants (the restricted version) consists of 396.330 unique students identified based on the foreign-born status of the mother. For our extended definition of second-generation students,	Variables and search results . Test scores in mathematics and reading . Probability of being retained . Absence rates . Disciplinary incidents . High school graduation . Enrollment in advanced classes . Fraction of advanced classes in scientific subjects . School choice . Gifted students	- Confucian Dynamism Theory	. Students from countries with long-term oriented attitudes perform better than students from cultures with less emphasis on the importance of delayed gratification . These students perform better in third grade reading and math tests, have larger test score gains over time, have fewer absences and disciplinary incidents, are less likely to repeat grades, and are more likely to graduate from high

Authors Study Field	Methodology	Model Constructs	Theoretical Model and Stage	Results
	additional 269.487 unique students were included, identified using the language spoken at home N=665.817 (93 countries)			school in four years
Mahomed, Mcgrath, & Yuh (2017) Study investigated the role of national culture on email usage	Survey: non-academic staff in public universities N=217 (Malaysian)	- Power distance (PD) - Uncertainty avoidance (UA) - Collectivism (C) - Masculinity (M) - Long-term orientation (LT) - Indulgence (I) - Perceived ease of use (PEOU) - Perceived usefulness (PU)	- Confucian Dynamism Theory - TAM Acceptance and use	Malaysian public universities perceive that emails become more useful when they are easy to be utilized and that individual long-term orientation and indulgence of work affect this thought

Appendix G - Summary of the main studies related to e-learning culture (Chapter IV)

Authors Study field	Methodology	Model Constructs Theoretical Model and Stage Results		
McLoughlin & Oliver (1999) Argues for cultural localization, which means incorporating the values, styles of learning and cognitive preferences of the target population	Survey: tracing the design processes involved in the development of an online unit for indigenous Australian learners preparing to enter university	The design of web-based instruction is not culturally neutral, but instead is based on the particular epistemologies, learning theories and goal orientations of the designers themselves		
Misko, Choi, Hong, & Lee (2004) This study compares e-learning in two countries, where, despite different policy frameworks and institutional arrangements, there has been a rapid expansion (by international standards) in the uptake of information and communication technology, and especially in education and training	Survey: case studies, review policies and strategies adopted to developing e-learning, and statistics on the uptake of information and communication in Australia and Korea	. Similar information and communication technology (ICT) uptake (e.g. computer usage and internet access) . Korea has not as widely developed a distance learning system as Australia . Common pedagogical issues . Government strategies and evolutionary forces drive e-learning . Advances and affordability of new technology . Concerns for access and equity . Preference for a blended approach to learning . Transparent learner management systems . The expansion of e-learning . Difficulties in developing e-learning content . Copyright issues and concerns . Practical realities		
Li & Kirkup (2007) Gender and cultural differences in internet and computers use	Survey: semi-structured questionnaire, Chinese and British students	- Gender - Internet skills . Send an e-mail . Use a search engine to find information . Create my own Web pages	Adoption and use	Continued significance of gender in students' attitudes, and use of computers, within different cultural contexts

Authors Study field	Methodology	Model Constructs Theoretical Model and Stage Results		
	N= 465 (245 England and 220 China)	. Keep records of websites . Understanding navigation buttons and keys		
Tapanes, Smith, & White (2009) Analyze the effects that Hofstede's individualism / collectivism and ambiguity (in)tolerance cultural dimensions exert on online courses offered from an individualist / ambiguity tolerant perspective	Survey: instructors teaching in 2 universities (undergraduate and postgraduate students) N=201 (USA: 100 instructors and 101 students)	- Individualism - Collectivism - Ambiguity intolerant - Ambiguity tolerant	- Hofstede Model Adoption	The cultural differences affect how students perceive the online classroom
Maldonado, Khan, Moon, & Rho (2009) Validate a modified UTAUT model, by adding e-learning motivation; try to determine the role of e-learning motivation in the use and adoption of e-learning systems and conversely the effect of technology on students' e-learning motivation; and to test region and gender as moderators in the model	Survey: data analysis from 47 secondary schools N= 150 (Peru)	- E-learning motivation - Social influence - Facilitation condition - Region - Gender - E-learning portal behavioral intention - E-learning portal use behavior	- UTAUT Adoption and use	E-learning motivation and social influence had a positive influence on behavioral intention, while facilitating condition had no effect on e-learning portal use

Authors Study field	Methodology	Model Constructs Theoretical Model and Stage Results		
Swierczek & Bechter (2010) Cultural features of e-learning	Survey: qualitative and quantitative study; . 22 classes at Universitas 21 Global (participants from South and East Asia) . 6 classes at Euro*MBA (participants from European Union) . 12 classes at Asian Institute of Technology (AIT) (participants from East Asia) N=1.500 (many countries)	E-learning behaviors (quantitative) - Discussion board (posted; read) - Course content - Organizer - Mail (read; sent) - Chat - Session Insights (qualitative) - Discussions: peer support and coffee (not graded) - Discussions: topic related (graded) - Team discussions: graded indirectly by students via peer assessment	Adoption and use	European participants tend to be individualistic, achievement oriented, and emphasize learning by induction. South Asians reveal high power distance and also an achievement orientation. East Asians also demonstrate high power distance as indicated by a teacher-centric focus. East Asians tend to prefer theory as the starting point for analysis
Teo (2011) Cross-cultural validation of the e-learning acceptance measure (ElAM)	Survey: university students from 3 public universities N= 377 (Thailand)	- Tutor quality (TQ) - Perceived usefulness (PU) - Facilitating conditions (FC)	- ElAM Adoption	The original 3-factor ElAM was not supported. However, the data in this study supported a correlated two-factor model (TQ and FC)
Teo, Wong, Thammetar, & Chattiwat (2011) Assess e-learning acceptance by students	Survey: using the ElAM (Teo, 2010) with university students from 3 public universities N= 377 (Thailand)	- Tutor quality (TQ) - Perceived usefulness (PU) - Facilitating conditions (FC) * MIMIC model (Multiple indicators, multiple causes) . Gender . Age . Perceived competence	- ElAM Adoption	University students in Thailand have an above average level of e-learning acceptance (mean=111.36 out of 147). Among the user domains, age and perceived competence correlated significantly with the factors in ElAM. Using

Authors Study field	Methodology	Model Constructs Theoretical Model and Stage Results		
		. Years of computer use		MIMIC modelling, students' e-learning acceptance was found to be significantly different by age and perceived competence
L. Simmons, C. Simmons, Hayek, Parks, & Mbarika (2012) Tested a model of learning comparing trust and satisfaction, between American and Latin American countries	Survey: undergraduate students N=211 (96=Ecuador and 115=USA)	- Trusting beliefs (TB) - Institutional trust (IT) - Perceived ease of use (PEOU) - Media richness (MR) - Learning satisfaction (LS) - Perceived learning outcome (PLO) - Power distance index (PDI) - Individualism (IDV) - Masculinity (MAS) - Uncertainty avoidance index (UAI)	- Hofstede Model - UTAUT Acceptance and use	. Culture has direct and significant impact on trust in learning technologies . Presentation that e-learning students can develop trusting beliefs in learning technologies and that trust leads students to feel satisfied with their learning and perceive that they will have a positive learning outcome
Tarhini, Hone, & Liu (2013a) Factors affecting students validate an extended TAM, to include SN and QWL constructs, in the Lebanese context	Survey: cross-sectional undergraduate and postgraduate students N= 569 (Lebanon)	- Perceived usefulness (PU) - Perceived ease of use (PEOU) - Social norms (SN) - Quality of work life (QWL) - Behavioral intention (BI) - Actual use (AU)	- TAM Adoption	PU, PEOU, SN and QWL, to be significant determinants of students' BI
Tarhini, Hone, & Liu (2013b) TAM is extended to include social, institutional and individual factors in the general structural model to empirically investigate and	Survey: cross-sectional in Brunel University N= 604 (England)	- Perceived ease of use (PEOU) - Perceived usefulness (PU) - Social norms (SN) - Quality of work life (QWL) - Computer self-f efficacy (SE) - Facilitating conditions (FC)	- TAM Adoption and use	Policy makers should take into account that e-learning implementation is not simply a technological solution, but they should also address individual differences by

Authors Study field	Methodology	Model Constructs Theoretical Model and Stage Results		
study whether students are willing to adopt and use e-learning systems		- Behavioral intention (BI) - Actual usage (AC)		considering a set of critical success factors such as social, institutional and individual factors
Tarhini, Hone, & Liu (2013c) Extend TAM to include 2 other constructs (social norms and quality of work life) in order to better suit developing countries	Survey: cross-sectional undergraduate and postgraduate students N= 569 (Lebanon)	- Perceived ease of use (PEOU) - Perceived usefulness (PU) - Social norms (SN) - Quality of work life (QWL) - Behavioral intention (BI) - Actual usage (AC)	- TAM Adoption and use	Support for the applicability of the extended TAM in the Lebanese context. E-learning is not just a technological solution, but should also consider social and cultural factors
Yang, Kinshuk, Yu, Chen, & Huang (2014) Elicit strategies for smooth and effective cross-cultural online collaborative learning through a pilot study	Survey: a mixed method research approach using questionnaire, interview and content analysis was used, between the West and the East. Students of a Chinese University and an American University took part in the study N= 62 (28 China and 34 USA)	- Group division . Homogeneous between groups . Heterogeneous in group - Collaborative process . Social lounge . Cultural orientation . Technology integration - Evaluation methods . Cultural identity . Affect . Participation	- Collaborative learning (Johnson & Johnson, 1999) - Model of community of inquiry (Garrison, Anderson, & Archer, 2001) - Evaluation methods for cross-cultural collaboration (Lai-Chong Law & Vu Nguyen-Ngoc, 2010) Adoption	Social interaction played an important role, and students preferred to have more prior knowledge of each other's cultures and backgrounds. They were also inclined towards more in-depth individual conversations
Atabekova, Gorbatenko, &	Survey: individual questionnaires	- Metropolitan and regional universities - Family income	- Willis (2007)	Research findings lead to the conclusion that it is

Authors Study field	Methodology	Model Constructs Theoretical Model and Stage Results		
Chilingaryan (2015) Russian students with different social background view the cloud-based foreign language learning	and in-depth interviews of students from 7 universities (metropolitan / regional location) N= 358 (Russian)	- Ethnic and religious affiliation	- Wong (2006) Adoption	the students' family background in terms of metropolitan or remote region origin and income level that most affect their positive/negative attitude and also the degree of aptitude to cloud-based learning
Tarhini, Hone, & Liu (2015) Examines the social, organizational and individual factors that may affect students' acceptance of e-learning systems in higher education in a cross-cultural context	Survey: university students; 2 private universities in Lebanon and 1 university in England N= 1.173 (604 England and 596 Lebanon)	- Perceived ease of use (PEOU) - Perceived usefulness (PU) - Social norms (SN) - Quality of work life (QWL) - Self-efficacy (SE) - Facilitating conditions (FC) - Behavioral intention (BI) - Actual usage (AU)	- TAM Adoption	Individual, social and organizational factors are important to consider in explaining students' BI and usage of e-learning environment
A. Tarhini, Teo, & T. Tarhini (2016) Validate the ElAM (Teo, 2010) across two cultures, one is from a European country: England, and the other from Asia: Lebanon	Survey: university students; 2 private universities in Lebanon and 1 university in England N= 461 (252 England and 209 Lebanon)	- Tutor quality (TQ) - Perceived usefulness (PU) - Facilitating conditions (FC)	- TAM Adoption	The original 3-factor solution for ElAM was supported and found to be adequate for the British sample, whereas the results revealed a bad fit for the Lebanese sample
Aparicio, Bacao, & Oliveira (2016b) Provides a deeper understanding of	Survey: national and international students, education level (lower than bachelor,	- User satisfaction (US) - Use (Use) - Individual impact (II)	- D&M - Hofstede Model Success	Students influenced by collective culture perceive more individual and organizational impacts than

Authors Study field	Methodology	Model Constructs Theoretical Model and Stage Results		
the impact of students' cultural characteristics, for individualism / collectivism, on the perceived outcomes of e-learning systems use and success	bachelor and master or higher) N= 323 (Portugal and other countries)	- Organizational impact (OI) - Individualism / collectivism (IC)		individualistic culture students. Individualism / collectivism also moderates the users' perceived satisfaction on individual impact, and from individual impacts to organizational impacts
Tarhini, Hone, Liu, & Tarhini (2017) Examine the moderating effects of individual-level culture on the adoption and acceptance of e-learning tools by students	Survey: web-based learning users, studying full or part time for masters or undergraduate degrees, at 2 universities located in Beirut N= 569 (Lebanon)	- Perceived ease of use (PEOU) - Perceived usefulness (PU) - Subjective norms (SN) - Quality of work life (QWL) - Self-efficacy (SE) - Facilitating conditions (FC) - Behavioral intention (BI) - Actual usage (AU) - Power distance (PD) - Masculinity/femininity (MF) - Uncertainty avoidance (UA) - Individualism/collectivism (IC)	- TAM - Hofstede Model Adoption	PU, PEOU, SN and QWL to be significant determinants of students' BI towards e-learning. The relationship between SN and BI was particularly sensitive to differences in individual- cultural values, with significant moderating effects observed for all four of the cultural dimensions studied

Appendix H - Measurement items of questionnaire (Chapter V)

Constructs	Code	Indicators	References
Using a seven-point scale, 1 strongly disagree, and 7 strongly agree, the variables are to be measured by asking students to rate their perception of e-learning systems			
System Quality	**SysQ1**	The e-learning system is easy to navigate.	DeLone & McLean (1992, 2003); Costa et al. (2016); Cidral et al. 2018, 2020; Aparicio et al. (2019)
	SysQ2	The e-learning system allows me to find the information I am looking for easily.	
	SysQ3	The e-learning system is well structured.	
	SysQ4	The e-learning system is easy to use.	
Information Quality	**IQ1**	The information provided by the e-learning system is useful.	
	IQ2	The information provided by the e-learning system understandable.	
	IQ3	The information provided by the e-learning system is interesting.	
	IQ4	The information provided by the e-learning system is reliable.	
Service Quality	**SerQ1**	The responsible service personnel are always highly willing to help whenever I need support with the e-learning system.	
	SerQ2	The responsible service personnel provide personal attention when I experience problems with the e-learning system.	
	SerQ3	The responsible service personnel provide services related to the e-learning system at the promised time.	
	SerQ4	The responsible service personnel have sufficient knowledge to answer my questions in respect of the e-learning system.	
Use	**Use1**	Retrieve information.	
	Use2	Publish information.	
	Use3	Communicate with colleagues and teachers.	
	Use4	Store and share documents.	
	Use5	Execute courses work.	
User Satisfaction	**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?	
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.	
Organizational Impact	**OI1**	The e-learning system has helped my university improve the efficiency of internal operations.	
	OI2	The e-learning system has helped my university improve the quality of working results.	
	OI3	The e-learning system has helped my university enhance and improve coordination within the university.	
	OI4	The e-learning system has helped my university make itself an overall success.	

Appendix I - Loadings and cross-loadings (Chapter V)

	SysQ	IQ	SerQ	Use	US	II	OI
SysQ1	**0.931**	0.590	0.414	0.409	0.544	0.529	0.560
SysQ2	**0.943**	0.642	0.466	0.432	0.590	0.545	0.576
SysQ3	**0.934**	0.652	0.484	0.421	0.610	0.558	0.565
SysQ4	**0.928**	0.617	0.433	0.414	0.554	0.570	0.559
IQ1	0.609	**0.935**	0.465	0.519	0.632	0.581	0.611
IQ2	0.668	**0.910**	0.474	0.450	0.640	0.563	0.592
IQ3	0.604	**0.922**	0.484	0.518	0.656	0.622	0.606
IQ4	0.561	**0.874**	0.425	0.477	0.606	0.527	0.578
SerQ1	0.455	0.468	**0.944**	0.349	0.448	0.442	0.517
SerQ2	0.409	0.431	**0.897**	0.319	0.425	0.405	0.486
SerQ3	0.462	0.477	**0.952**	0.352	0.463	0.462	0.503
SerQ4	0.449	0.495	**0.896**	0.396	0.442	0.419	0.495
Use1	0.390	0.474	0.259	**0.634**	0.418	0.450	0.507
Use2	0.275	0.323	0.250	**0.775**	0.317	0.414	0.357
Use3	0.303	0.319	0.333	**0.787**	0.317	0.378	0.380
Use4	0.318	0.344	0.334	**0.795**	0.316	0.392	0.363
Use5	0.349	0.485	0.257	**0.720**	0.411	0.504	0.450
US1	0.568	0.644	0.432	0.451	**0.882**	0.615	0.620
US2	0.428	0.471	0.359	0.302	**0.795**	0.563	0.510
US3	0.556	0.655	0.415	0.482	**0.923**	0.666	0.617
US4	0.604	0.665	0.487	0.474	**0.921**	0.651	0.654
II1	0.509	0.557	0.433	0.543	0.623	**0.916**	0.662
II2	0.551	0.575	0.465	0.555	0.694	**0.940**	0.702
II3	0.543	0.569	0.423	0.519	0.642	**0.940**	0.677
II4	0.556	0.608	0.394	0.535	0.634	**0.864**	0.675
OI1	0.584	0.607	0.504	0.500	0.631	0.663	**0.916**
OI2	0.571	0.609	0.507	0.559	0.649	0.720	**0.940**
OI3	0.555	0.615	0.532	0.515	0.628	0.679	**0.942**
OI4	0.543	0.609	0.477	0.532	0.635	0.696	**0.922**

Note: System Quality (SysQ); Information Quality (IQ); Service Quality (SerQ); Use (Use); User Satisfaction (US); Individual Impact (II); and Organizational Impact (OI)

Appendix J - Summary of the main studies related to the success of e-learning

Authors Study Field	Methodology	Model Constructs	Results
Baker, Boggs, & Arabasz (2003) Perspectives on e-learning support. Focus on the evolving needs of faculty and students	Survey: nearly 300 institutions participated in quantitative surveys, qualitative interviews or case study N= 258 (USA)	- Institutional policies encouraging technology integration with instruction - Importance of communications methods used to support faculty e-learning activities - Categorization of student and instructor computer skill levels - Significant technology support challenges for students - Significant technology support challenges for instructors	- Use incentives to encourage faculty to pursue e-learning development and experimentation - Help facilitate faculty and student preferences in communication methods during e-learning training and support - Understand faculty and student experiences with e-learning technology and promptly address the challenges those groups face - Help faculty members understand and employ effective practices for e-learning
Newman (2003) The study describes the strategic considerations and key institutional competencies necessary to foster online success, and identifies the principal organizational models in use today	Survey: selected case studies / 2 institutions with notable online learning programs: Pennsylvania State University and the University of Central Florida (UCF) and structured interviews	- Student-related outcomes - Faculty-related outcomes - Institutional outcomes	Process essential to program success: assessment and evaluation
Y.-S. Wang, H.-Y. Wang, & Shee (2007) Development of scale and validation of a	Survey: 8 international or local organizations that have implemented enterprise e-learning systems	- Information quality - System quality - Service quality - System use - User satisfaction - Net benefit	Presents evidence of the scales factor structure, reliability, content validity, criterion related validity, convergent

measurement to e-learning systems success (ELSS)	N= 206 (Taiwan)		validity, and discriminant validity
J.-K. Lee & Lee (2008) A research model which is based on an e-learning success model as well as the relationship of the e-learner's self-regulatory efficacy	Survey: students from Daegu University and students enrolled in e-learning systems N= 225 (Korea)	- Academic performance (AP) - Learning environmental satisfaction (SA) - Perceived usefulness on LMS (PU) - Perceived ease of use on LMS (PEOU) - Information contextual quality (ICQ) - Information representational quality (IRQ) - Service quality on interaction (SQ) - Self-regulatory efficacy (SRE)	- A new model of information system success (ISS) and SRE: one of human services to e-leaner - Quality of system depends on LMS and quality of assessment of interaction information and system - Confirmation that SRE's higher learner has high self-study and perceived learning strategy
Artino (2009) Explored the extent to which students' thoughts, feelings, and actions are associated with the nature of an online course and how that course relates to them personally	Survey: undergraduates (sophomores and juniors) from the U.S. Naval Academy N= 481 (USA)	- Personal factors: . Motivational beliefs (self-efficacy and task value beliefs) . Achievement emotions (positive emotions and negative emotions) - Personal behaviors: . Self-regulated learning strategies (cognitive strategies and metacognition) - Academic outcomes: . Achievement, satisfaction and continuing motivation	Results from a logistic regression analysis revealed that students who said they were planning to become aviators upon graduation were more likely to report greater perceptions of task value and greater use of metacognitive control strategies than their non-aviator counterparts
McGill & Klobas (2009) The study described the use of technology-to-performance chain as a framework to address the question of how	Survey: students from an Australian university who were using a web-based plataform (WebCT) in their studies N= 267 (Australia)	. Precursors of utilization: - Expected consequences of LMS use - Attitude towards LMS use - Social norms - Instructor norms - Facilitating conditions - Task technology fit	The results provide strong support for the importance of task–technology fit, which influenced perceived impact on learning both directly and indirectly via level of utilization. Whilst task–technology fit had a strong influence on perceived

task–technology fit influences the performance impacts of LMS's		- LMS utilization - Perceived impact on learning - Student grades	impact of the LMS on learning it only had a weak impact on outcomes in terms of student grades
Means, Toyama, Murphy, Bakia, & Jones (2010) Analysts screened these studies to find those that: (a) contrasted an online to a face-to-face condition, (b) measured student learning outcomes, (c) used a rigorous research design, and (d) provided adequate information to calculate an effect size	Survey: a systematic search of the research literature from 1996 through July 2008 identified more than a thousand empirical studies of online learning	- Learning experience dimension: . Expository . Active . Interactive - Synchronicity: . Synchronous . Asynchronous - Face-to-face alternative - Face-to-face enhancement	As a result of this screening, 51 independent effects were identified that could be subjected to meta-analysis. The meta-analysis found that, on average, students in online learning conditions performed better than those receiving face-to-face instruction
Tella & Mutula (2010) Based on a prevalent information systems success model, the study proposes and describes a revised model for evaluating WebCT systems success in educational settings	Survey: qualitative and quantitative study, from students of University of Botswana N= 503 (Botswana)	- System quality - Content quality - Support service quality - Teaching and learning quality - Students' self-regulated learning - Intention to use/use - User satisfaction - Net benefits	The study findings suggest that content quality, system quality, support service quality, teaching and learning quality, self-regulated learning, intention to use/use, user satisfaction and net benefits are important factors for evaluating the success of WebCT (Course Content Management System)
Gay & Dringus (2012) Evaluated an index of e-readiness score of online instructors	Survey: online instructors, from 144 online courses offered of the University of West Indies	- System quality - Service quality - Information quality - System use - User satisfaction - Net benefits	Results revealed that the e-learning systems success score of the university was 4.07 out of 5 or 81.4%. The e-readiness score of

and of the institutional level	N= 113 (USA)		online instructors was 4.53 or 90.6%
Bhuasiri, Xaymoungkhoun, Zo, Rho, & Ciganek (2012) Study identified the critical success factors (CSF) that influence the acceptance of e-learning systems in developing countries	Survey: 76 usable responses were collected using Delphi method and analytic hierarchy process (AHP) N1= 43 (information and communications technology ICT experts) N2= 39 (learners, faculty, administrative and technical staff, and employers) N= 76 (many countries)	- Personal dimensions: . Learners' characteristics . Instructors' characteristics . Extrinsic motivation - Environmental dimensions: . e-learning environment - System dimensions: . Infrastructure and system quality . Course and information quality . Institution and service quality	The results reveal 6 dimensions and 20 CSF for e-learning systems in developing countries. Findings illustrate the importance of curriculum design for learning performance. Technology awareness, motivation and changing learners' behavior are prerequisites for successful e-learning implementations
Hassanzadeh, Kanaani, & Elahi (2012) Present a model for measuring success of e-learning systems in universities	Survey: was done in 5 universities (1) e-learning experts that have knowledge and experience (N= 33) (2) e-learning system users (N= 2.858 students; N= 470 alumni and N= 270 instructors) N1= 33 and N2= 3598 (Iran)	- Technical system quality - Content and information quality - Service quality - User satisfaction - Intention to use - Use of the system - Loyalty to system - Benefits of using e-learning system - Goals achievement	Examined the relationships between components and finalized proposing MELSS Model (model for measuring e-learning systems success entitled)
McGill, Klobas, & Renzi (2014) Examines conditions associated with continuation of e-learning initiatives in universities. Conditions associated with institutional,	Survey: authors of 64 empirical papers describing e-learning initiatives (20 of which had not continued) published in the peer-reviewed literature the classification and explanation of the role of each condition in	- Factors associated with continuance: . Institutional factors . Developer factors . Teacher factors . Student factors . Technology factors	- Students are positive about sustainable and discontinued e-learning initiatives - E-learning initiatives generally require financial support for continuance - Technology needs to be up to date but stable for sustainable e-learning initiatives

developer, instructor, student and technology issues were identified from a review of the literature	continuation of their initiative to the time of the study, which was at least three years after all the papers were published		- Marketing' skills may help with e-learning sustainability
Pressler (2014) Studies of e-learning analytics	Survey: using the McKinsey 7S Model (Waterman, Peters, & Phillips, 1980), some cautions and suggestions were pointed out	- The McKinsey 7S Model: . Structure . Systems . Style . Staff . Skills . Strategy . Share values	The studies suggest that any organization assessing its readiness to engage in learning analytics must reflect on the status of the organization in each of the 7 areas outlined in the McKinsey 7S framework
George et al. (2014) Systematic review of the effectiveness of online e-learning to health professionals' education	Survey: 57 studies, including students (medicine, dentistry, nursing, physical therapy and pharmacy), from January 2000 to August 2013 N= 6.750 (many countries)	- Knowledge - Skills - Attitude - Satisfaction	Found that online e-learning does lead to changes in knowledge, skills, attitude and satisfaction and seems to be more effective than traditional learning in terms of knowledge and skills gained
Machado da Silva, Meireles, Filenga, & Brugnolo Filho (2014) Study on two success dimensions (use and satisfaction) of e-learning systems in Brazilian context	Survey: students from public and private institutions from several regions N= 291 (Brazil)	- System quality - Information quality - Service quality - Use of the system - User satisfaction	Information quality, system quality and service quality have positive impact on usage. Information quality and service quality have positive impact on satisfaction. Validated part of the DeLone & McLean (2003) Model in Brazilian context
Bauk, Šćepanović, & Kopp (2014) Study to understand satisfaction of students with web based learning	Survey: students of University Mediterranean (UNIM) were researched N= 63 (Montenegro)	- DeLone & McLean Model: . Information quality . System quality . Service quality . Use . User satisfaction . Net benefits	The study identified critical elements of web based learning system within blended environment using Kano (1984) (dys)functional model and DeLone and McLean generic model

system used in blended learning model		- Kano (1984) Model: . Attractive quality attribute . One-dimensional quality attribute . Must-be quality attribute . Indifferent quality attribute . Reverse quality attribute . Questionnaire quality attribute	for the information systems success, providing in such manner the recommendations for creating a better new teaching / learning system
Hachey, Wladis, & Conway (2015) This study found that general academic performance (GPA) and prior online experience both predicted online science, technology, engineering and mathematics (STEM) course outcomes	Survey: students who took a STEM course online between 2004 and 2012 at a large, urban community college N= 1.566 (USA)	- Prior outcomes: . None (no prior online experience) . Successful (all prior online courses completed successfully) . Mixed success (some prior online courses completed successfully and some unsuccessfully) . Unsuccess (no prior online courses completed successfully)	- GPA and prior online outcomes separately predict online STEM course outcomes - Past online outcomes differ even among students with the same GPA - Both prior online outcomes & GPA can identify STEM students at risk online
Cidral, Oliveira, Di Felice, & Aparicio (2018) The aim of this study is to find the determinants of user perceived satisfaction, use, and individual impact of e-learning. Proposes a theoretical model integrating theories of information systems' satisfaction and	Survey: students from public and private institutions from several regions N= 301 (Brazil)	- Collaboration quality - Service Quality - Information quality - System quality - Learner Computer Anxiety - Instructor attitude toward e-learning - Diversity in assessment - Learner perceived interaction with others - Use - User perceived satisfaction - Individual impact	- Study on e-learning systems success for Brazilian context - Model integrates information systems success theory with e-learning satisfaction theory - Collaboration, information and system quality are success determinants for Brazilian e-learning systems context - User satisfaction dimensions are success determinants in e-learning systems - User satisfaction has a direct and indirect

success in the e-learning systems			effect on learners' individual impact

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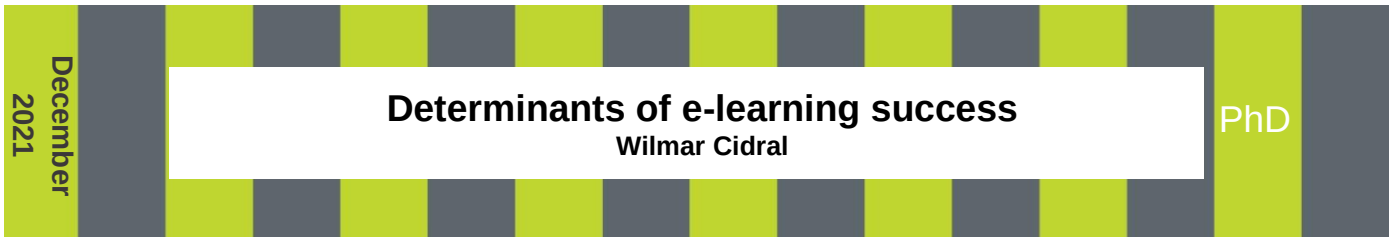
December 2021
Determinants of e-learning success
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