UNIVERSITY OF QUEBEC AT MONTREAL

# DIGITAL TRANSFORMATION IN HIGHER EDUCATION FROM A BLENDED LEARNING PERSPECTIVE

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# TRANSFORMATION NUMÉRIQUE DANS L'ENSEIGNEMENT SUPÉRIEUR À PARTIR D'UNE PERSPECTIVE D'APPRENTISSAGE MIXTE

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PAR
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JUILLET 2019

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# DEDICATION

This dissertation is dedicated to Diego, my dear husband, who continuously provided encouragement and support during this academic journey.

TABLE OF CONTENT

LIST OF FIGURES ..... xv

LIST OF TABLES ..... xvii

LIST OF ABREVIATIONS ..... xix

RÉSUMÉ ..... xxi

ABSTRACT ..... xxiii

CHAPTER I
INTRODUCTION ..... 1

1.1 Background ..... 1

1.2 Objective, rationale and research questions ..... 5

1.3 Method ..... 6

1.3.1 Research design ..... 6
1.3.2 Data collection strategy ..... 8

1.4 Structure of the thesis ..... 10

CHAPTER II
DIGITAL TECHNOLOGIES, BLENDED LEARNING, AND HIGHER EDUCATION ..... 13

2.1 Introduction ..... 14

2.2 Method ..... 20

2.2.1 Literature search strategy ..... 22
2.2.2 Study selection criteria and procedures ..... 23
2.2.3 Quality assessment ..... 24
2.2.4 Data extraction strategy ..... 25
2.2.5 Analysis and synthesis strategy ..... 27

2.3 Findings and results ..... 28
2.3.1 What digital technologies are deployed in the context of blended learning in higher education? ..... 31
2.3.2 What are the current practices and context of use of these technologies reported in selected literature? ..... 35
2.3.3 What dimensions are proposed in selected literature for mapping and measuring the trajectory of digitalization in higher education institutions? ..... 40
2.3.4 Integrating the model ..... 44
2.4 Discussion ..... 47
2.5 Limitations, contributions, and implications ..... 50
2.5.1 Limitations ..... 50
2.5.2 Implications and recommendations for future research ..... 51
2.5.3 Implications for practice and policy ..... 52
2.6 Conclusions ..... 52

CHAPTER III
BLENDED LEARNING IN HIGHER EDUCATION: TRENDS AND CAPABILITIES ..... 55
3.1 Introduction ..... 56
3.2 Conceptual framework ..... 61
3.3 Method ..... 62
3.4 Findings and results ..... 63
3.4.1 Research trends in selected literature about digital technologies in blended learning for higher education ..... 63
3.4.2 Conceptual model of educational technology capabilities ..... 71
3.4.3 Educational technology capabilities ..... 73
3.5 Discussion ..... 82
3.6 Policy implications ..... 86
3.7 Conclusions ..... 86
3.8 Limitations and future research directions ..... 88

CHAPTER IV
TRANSPARENCY IN PREVIOUS LITERATURE REVIEWS ABOUT BLENDED LEARNING IN HIGHER EDUCATION ..... 91

4.1 Abstract ..... 91
4.2 Introduction ..... 92
4.3 Background, purpose, and research questions ..... 95
4.4 Method ..... 99
4.4.1 Planning the review ..... 99
4.4.2 Search strategy ..... 100
4.4.3 Study selection ..... 103
4.4.4 Quality assessment ..... 104
4.4.5 Data extraction strategy ..... 105
4.4.6 Analysis and interpretation strategy ..... 107
4.5 Trends in standalone review types and main themes ..... 108
4.6 Level of methodological transparency and current practices ..... 113
4.6.1 Developing a review plan ..... 115
4.6.2 Searching the literature ..... 117
4.6.3 Selecting studies ..... 119
4.6.4 Assessing quality ..... 120
4.6.5 Extracting data or key aspects from included studies ..... 121
4.6.6 Synthesizing and interpreting data, and formulating conclusions ..... 121
4.7 Discussion ..... 122
4.8 Conclusions ..... 126
4.9 Contributions ..... 127
4.10 Limitations and future work ..... 128

CONCLUSIONS ..... 131
5.1 Main findings ..... 131
5.1.1 Chapter 2: Digital technologies, blended learning and higher education ... ..... 131
5.1.2 Chapter 3: Blended learning in higher education: trends and capabilities.. ..... 132
5.1.3 Chapter 4: Transparency in previous literature reviews about blended learning in higher education ..... 133
5.2 Theoretical contributions ..... 134
5.3 Empirical contributions ..... 136
5.4 Limitations ..... 137

5.5 Implications for practice ..... 139
5.6 Policy implications ..... 140
5.7 Implications for future research ..... 141

APPENDIX A PROFILE OF ARTICLES SELECTED FOR CHAPTER III ORDERED BY AUTHORS ..... 143

APPENDIX B TECHNOLOGY PORTRAIT OF BLENDED LEARNING IN HIGHER EDUCATION ..... 147

APPENDIX C LIST OF ARTICLES FOR ANALYSIS IN CHAPTER 4 ..... 149

APPENDIX D PROFILE OF ARTICLES INCLUDED IN CHAPTER 5 ..... 153

APPENDIX E LIST OF EXCLUDED STUDIES FROM CHAPTER 5 ORDERED BY REASON OF EXCLUSION AND AUTHORS ..... 159

APPENDIX F TRANSPARENCY ASSESSMENT RESULTS SHEET ..... 161

REFERENCES ..... 163

# LIST OF FIGURES


| Figure | | Page |
|---|---|---|
| 1.1 | Research process for the study | 7 |
| 2.1 | Flow diagram of the search, study selection, and quality assessment strategies. | 21 |
| 2.2 | Perspectives of analysis and implementation levels of blended learning | 30 |
| 2.3 | Driving forces and digital technologies | 32 |
| 2.4 | Dimensions for mapping and measuring the trajectory of digitalization in higher education institutions | 41 |
| 2.5 | Conceptual model for explaining the transformational potential of blended learning in higher education | 45 |
| 2.6 | Framework for mapping and measuring the transformational level of digital technologies. | 46 |
| 3.1 | Conceptual model of technology capabilities | 73 |
| 4.1 | Research process for standalone literature reviews. | 99 |
| 4.2 | Search strategy and selection of studies. | 102 |

LIST OF TABLES


| Table | | Page |
|---|---|---|
| 1.1 | Categories and keywords and search terms | 9 |
| 1.2 | Chapters and sources for data collection | 9 |
| 1.3 | Thesis chapters | 12 |
| 2.1 | Keywords. | 22 |
| 2.2 | Exclusion criteria for the study selection | 23 |
| 2.3 | Coding sheet for abstracts | 26 |
| 2.4 | Coding sheet for full-text articles. | 27 |
| 2.5 | Literature characterization ordered by total selected citations. | 29 |
| 2.6 | Criteria for specific digital technologies classification. | 31 |
| 2.7 | Educational technology enablers. | 33 |
| 2.8 | Portrait of technological enablers, digital technology categories and specific digital technologies. | 34 |
| 2.9 | Dimensions and frameworks identified from the literature for mapping the trajectory of digitalization in higher education institutions | 44 |
| 3.1 | Keywords and search terms | 62 |

3.2 Identified research trends in selected literature ..... 64

3.3 Educational technology capabilities ..... 74

4.1 Literature review typology classified by the contribution to theory..... 96

4.2 Key characteristics of standalone review types. ..... 97

4.3 Categories and keywords and search terms. ..... 101

4.4 Exclusion criteria. ..... 103

4.5 Bibliometric and methodological coding schema..... 105

4.6 Assessment form for transparency in literature reviews articles. ..... 106

4.7 Included reviews classified by type and year (2007-2017). ..... 109

4.8 Studies included by type of literature review and main themes. ..... 110

4.9 Studies included by type of literature review and quartiles..... 114

4.10 Studies fulfilling the transparency assessment items. ..... 115

4.11 Number of studies that stated their search resource type and sources..... 118

# LIST OF ABREVIATIONS

| | |
|---|---|
| AR | Augmented reality |
| ARS | Audience response system |
| BYOD | Bring your own device |
| DET | Digital educational technology |
| ETC | Educational technology capability |
| IVS | Immersive virtual simulators |
| LMS | Learning management system |
| MOOC | Massive open online courses |
| OER | Open educational resources |
| RFDI | Radio-frequency identification |
| RS | Recommender system |
| VLCS | Virtual learning companion system |
| VR | Virtual reality |

# RÉSUMÉ

L'apprentissage mixte ou hybride (blended learning) est une approche d'apprentissage fondée sur la technologie qui combine des activités en ligne et en face à face, des théories d'apprentissage et des pratiques pédagogiques intégrées dans un contexte dynamique de mise en œuvre à plusieurs niveaux (p. Ex. En classe, institutionnel, écosystème) et multidimensionnel ( à savoir les aspects pédagogiques, technologiques, organisationnels et individuels de la performance). Cette méthode peut offrir des avantages et éviter les pièges de ces approches appliquées individuellement. Malgré des recherches scientifiques approfondies sur l'apprentissage mixte, l'étude de son potentiel de transformation en est encore à ses débuts. Dans le présent travail, certaines lacunes identifiées dans la littérature constituent la base d'un triple objectif de recherche analysant l'apprentissage mixte pour l'enseignement supérieur en tant qu'approche innovante fondée sur la technologie. Cet objectif comprend la découverte du potentiel de transformation des technologies éducatives numériques ; tendances et capacités conduisant à des transformations structurelles ; et les pratiques de recherche actuelles en matière de divulgation des choix méthodologiques dans ce domaine de recherche quand les chercheurs utilisent comme méthode de recherche une approche de revue de la littérature. En utilisant des approches d'analyse de contenu et de revue de la littérature, cette étude a collecté et analysé des données issues de chapitres de livres, études primaires et articles de revue de la littérature pertinents pour répondre aux questions de recherche. Les contributions théoriques et empiriques comprennent un cadre d'analyse du potentiel de transformation des technologies éducatives numériques et des pratiques d'apprentissage mixte ; l'analyse du concept de capacités technologiques éducatives et de sa typologie associée ; et des données relatives aux pratiques de recherche actuelles dans les revues de littérature autonomes concernant la divulgation des choix méthodologiques.

Mots clés : apprentissage mixte, revue de la littérature, capacités, technologies numériques, enseignement supérieur, méthodes de recherche, évaluation de la transparence, tendances.

# ABSTRACT

Blended learning is a technology-enabled learning approach that combines online and face-to-face delivery modes, learning theories and pedagogical practices embedded in a dynamic multi-level (i.e., classroom, institutional, ecosystem) and multi-dimensional context of implementation (i.e., pedagogical, technological, organizational, and individual aspects of performance). Therefore, blended learning can have the potential to provide advantages and avoid the pitfalls of each of these approaches when applied separately. Despite the extensive scientific research on blended learning, the investigation of its transformational potential is still in an early stage. In the present study, gaps were identified in the literature that provide the basis for the three research objectives related to analyzing blended learning in higher education. These objectives include: 1) uncovering the potential for transformation of digital educational technologies; 2) identifying trends and capabilities leading to structural transformations; and 3) evaluating the current practices of researchers with regard to the disclosure of methodological choices when conducting literature reviews in this field. By using content analysis and literature review approaches, this study collected and analyzed data from relevant book chapters, primary studies, and review papers to answer the research questions. Theoretical and empirical contributions include: a framework for analyzing the potential for transformation of digital educational technologies and blended learning practices; an analysis of the concept of educational technology capabilities and its associated typology; and a compilation of data related to current research practices, specifically focusing on the disclosure of methodological choices when conducting standalone literature reviews in the field of blended learning in higher education.



Keywords: blended learning, capabilities, digital technologies, higher education, literature review, research methods, transparency assessment, trends.

# CHAPTER I

# INTRODUCTION

## 1.1 Background

The higher education system has been facing criticisms related to its high cost, its content, the quality of courses, and the degree of relevance of their graduates' competencies for industry. Despite ongoing criticisms, higher education is going through deep transformations. Along with democratization and standardization, digitization is a foremost component of these transformations.

The first tendency, democratization, is driven by the steadily growing global demand for higher education (OECD, 2014, pp. 46-47). The United Nations Educational, Scientific and Cultural Organization (UNESCO) has identified education as a main societal priority, while acknowledging serious problems still not solved, especially in developing countries. UNESCO associates access to quality education with highly positive impacts in terms of income distribution and the creation and distribution of human prosperity. UNESCO proclaimed three principles within the framework *Education 2030*. The first principle restates the right to an education as a fundamental human right, as well as an enabling right. The second principle reaffirms education as a public good. Finally, the third principle prioritizes gender equality and inclusion in education as a global initiative for future years (UNESCO, 2016). Social, economic,

political, and cultural contexts represent both barriers and enablers that go beyond technological solutions as the only transformative elements in the education system.

Despite all efforts, most societies and education systems have failed in both elements of the first principle. In this context, technology is promoted as an effective mechanism for reducing inequality in education (S. Graham, 2002, as cited in Selwyn, 2011, p. 97). Graham, S. (2002) identified three ways in which people see technology as a facilitator of inclusion and equality in education: 1) increasing the diversity of mechanisms and modes in education; 2) decreasing barriers to education as a democratization mechanism; and 3) enhancing individual control over one's own education in terms of content, delivery mode, and pace of learning. These promises have not yet been fulfilled despite massive investments in content production and educational technologies such as Open Educational Resources (OERs) and Massive Open Online Courses (MOOCs).

The second tendency, standardization, is the outcome of the internationalization of the higher education system. The increase in university exchanges, the growing student mobility, and the rise of online formal academic courses have propelled the harmonization of university programs, mostly through the process of accreditation and international agreements (e.g., The Bologna process). Currently, worldwide demand for higher education is increasing despite frequent critiques related to high costs, accessibility barriers, dropout rates, and the quality of courses (OECD, 2014, pp. 46-47). Furthermore, educational institutions often face challenges related to the overall relevance of their programs to graduates' continuing education or post-graduate employment (Christensen *et al.*, 2011); and to the actual educational credentials in the higher education system (Collins, 2011). Some of these challenges include: improving multicultural integration, reducing dropout rates, facilitating fluid transitions from educational programs to first jobs, and implementing flexible and relevant lifelong

learning processes. To confront these challenges, Redecker et al. (2013) as cited in Scott (2015), suggest that institutions require innovative structural transformations. However, these challenges must first be investigated through broader, multidisciplinary, multi-level research that addresses the social, pedagogical, economic, demographic, and financial aspects of education (Geels, 2005). In this regard, approaches such as blended learning may provide alternative opportunities for higher education institutions to deal with these challenges and respond to external pressures to effectively deploy technological innovations in the classroom.

A third major tendency, digitization, is the result of digital innovations massively applied to higher education. Digital innovations refer to a broad range of digital devices, platforms or infrastructural technologies. Olleros & Zhegu (2016, p. 6) defined digitization as:

> the full range of software-driven processes—all the way from datafication and computation to prediction, display, communication, and action—that allow increasingly smart machines to intervene in the world.

However, the history of technology and education presents "plenty of evidence to suggest that the implementation of technology in education is rarely a predictable or even a controllable process" (Selwyn, 2011, p. 60). Questioning the impact of digitization is necessary, especially in a context of high volume and velocity of educational digital innovation development. Digitization is far from being a "silver bullet" to solve the systemic problems of higher education. Often poorly embedded in complex educational contexts, digitization is showing its limits.

The scientific literature shows technology as a complex element operating in a variety of educational settings. Using different methods, researchers analyze, describe, and

explain potential transformations in the education sector from multiple perspectives (e.g., social, organizational, technological, pedagogical), employing various educational approaches (e.g., digital technologies supporting traditional instruction, online learning, blended learning).

Research about these transformations often involves performing analyses of future technological trends, which typically require different periods of time to develop a potential impact analysis (Selwyn, 2011, pp. 166-167). The short- and medium-term analyses concern a detailed state-of-the-art description, while the long-term analyses correspond more closely to speculative forecasting. In education, this type of analysis might involve specific groups of learners in the classrooms, specific institutions, or the entire educational ecosystem.

In particular, blended learning, a technology-enabled learning approach that combines both face-to-face and online learning practices, seems to represent the most promising compromise between these two extreme delivery modalities. Definitions from literature show the mix of content media and instructional delivery methods as the key elements for this educational approach (Garrison & Kanuka, 2004). These definitions also come with different labels such as hybrid courses, flexible learning, and mixed mode learning (Dzakiria *et al.*, 2012). From a more pedagogical perspective, the literature presents blended learning as a shift from teacher-content to student-experience. This shift may offer "the right balance of pedagogy and technology to the right learner in the right moment" (Oliver & Trigwell, 2005).

Researchers in this field are still developing more refined definitions of blended learning as their understanding of this phenomenon improves (Picciano, 2009; Tshabalala *et al.*, 2014). According to Fernandes *et al.* (2016), blended learning or b-learning is a:

> mixed learning model that integrates online learning with face-to-face learning theories and practices, materialized in a flexible, multimodal, and multi-linear redesign,

whereby multi-linear learning refers to a self-paced and individualized learning processes. Nevertheless, despite extensive scientific research on blended learning, the investigation of its transformational potential is still in its initial stages. However, for the purpose of this study, the author defines *blended learning* as a technology-enabled learning approach that combines online and face-to-face delivery modes, learning theories and pedagogical practices embedded in a dynamic multi-level (i.e., classroom, institutional, ecosystem) and multi-dimensional context of implementation (i.e., pedagogical, technological, organizational, and individual aspects of performance).

## 1.2 Objective, rationale and research questions

Using a standalone literature review approach, including multiple perspectives and focusing on blended learning in higher education, the present work aims at: 1) uncovering the potential for transformation of digital educational technologies; 2) identifying trends and capabilities leading to structural transformations; and 3) evaluating current practices of researchers with regard to the disclosure of methodological choices and research activities in previous standalone literature reviews. An iterative and comprehensive literature search and analysis allowed the author to identify and refine the research objective and research questions presented in chapters 2, 3, and 4. Typically, these types of knowledge syntheses are conducted as standalone literature reviews. This kind of research works are subject to criticism, in some cases, with regard to the soundness of their research process, and in particular characteristics such as systematicity, transparency, and scientific rigor (Paré *et al.*, 2016).

Chapter 2

1. What digital technologies are deployed in the context of blended learning in higher education?
2. What are the current practices and context of use of these technologies?
3. How transformative are digital technologies used in blended learning contexts for higher education?

Chapter 3

1. What are the emerging trends in blended learning implementations in higher education?
2. What are the current capabilities in the educational technology used in these blended learning implementations in higher education?
3. How are these educational technology capabilities used in blended learning implementations in higher education?

Chapter 4

1. What trends exist in these types of literature reviews, what are their main themes, and how transparent are they?
2. What practices do the selected reviews use to ensure transparency?

## 1.3 Method

### 1.3.1 Research design

The design chosen for this research work includes seven stages (**Figure 1.1**). The first stage served to explore a more specific research domain regarding digital technologies and education. After this stage, the author identified 1) blended learning in higher education as a valuable and suitable area for further development and 2) the adoption, diffusion, and innovative technology-enabled learning approach as a context with high potential impact in this research domain.

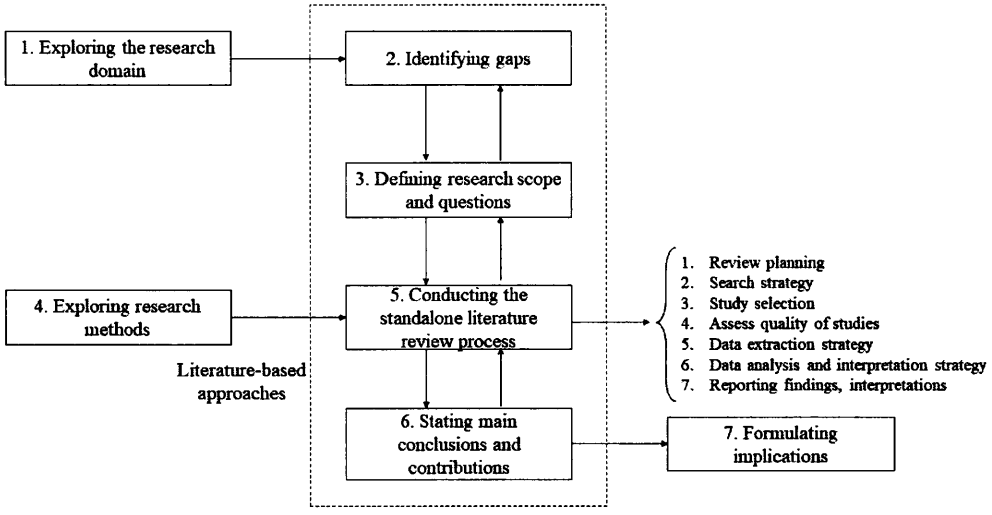


**Figure 1.1** - Research process for the study

In the second and third stages, based on a highly iterative process, the author identified gaps in previous research, defined the scope, and elaborated a set of initial research questions refined during the process. In the fourth stage, based on the research questions, the author explored potential approaches for answering the research questions. This exploration provided the author with valuable insights on the existing literature regarding primary studies (e.g., conceptual papers, quantitative studies, qualitative studies) and standalone literature reviews. As a result, the author identified the literature-based approach as the most suitable for this research process.

During the fifth stage, the author identified and selected a *theoretical review* type as the most suitable research design for chapter 2. This type of review intends to provide models, frameworks or theories to explain a particular phenomenon based on previous empirical or theoretical works (Paré *et al.*, 2015). The author draws a portrait of digital

technologies and their context of usage, and makes an analysis of how transformative blended learning practices are in higher education contexts.

From this initial work, findings and results showed some common themes in the analysis of technological implementations. These clues led the author to identify and define the concept of educational technology capabilities (ETC), and provide some explanation for the potential relationship between ETC and learning purposes in formal educational contexts. This time, the author selected a *narrative literature review* type to conduct this research and present the results in chapter 3.

Finally, while conducting these two previous stages of research, the author identified some limitations due to the lack of explicit data in the sources, mainly in literature reviews. These limitations revealed some clues about how researchers reported their work. Based on these insights, the author conducted an analysis of previous literature reviews regarding their level of transparency and current practices of reporting methodological decisions and activities for this kind of scientific work. The author selected a *descriptive review* type as being the most suitable for chapter 4.

The final stages of the research process include the analysis and interpretation of findings for stating conclusions, identifying contributions, and formulating implication for the scientific and practitioners' communities.

### 1.3.2 Data collection strategy

Since the research method selected is a literature-based approach, all data collection is based on the scientific literature. This research selected articles based on four categories of keywords and search terms as presented in **Table 1.1**.

**Table 1.1** - Categories and keywords and search terms

| Category | Keywords and search terms |
|---|---|
| Blended learning | "blended learning" OR "blended education" OR "hybrid learning" OR "mixed-mode instruction". |
| Higher education | "higher education" OR universit* OR college. |
| Innovation | adopt* OR barrier* OR challenge* OR change* OR diffusion* OR disruption* OR driver* OR factor* OR impact* OR improvement* OR innovati* OR invention* OR pattern* OR radical OR reinvention* OR sustainable OR transform*. |
| Literature review | review OR state-of-art OR "state of the art" OR "state of art" OR "meta-analysis" OR "meta analysis" OR "meta analytic study" OR "mapping stud*" OR overview. |

The author selected EBSCO, ERIC, SCOPUS, and Web of Science as the most suitable resources for the literature search. For each one of these scientific online electronic databases providers and citation indexes, the author used these keywords and search terms to build specific queries. This search resulted in three sets of peer-reviewed articles as sources for data collection as presented in **Table 1.2**.

**Table 1.2** - Chapters and sources for data collection

| | | Categories of keywords and search terms | | | | |
|---|---|---|---|---|---|---|
| Chapters | Type of review paper | Blended learning | Higher education | Innovation | Literature review | Type of peer-reviewed articles analyzed |
| 2 | Theoretical review | ✓ | ✓ | ✓ | | 1017 abstracts<br>37 journal articles |
| 3 | Narrative review | ✓ | ✓ | ✓ | | 48 journal articles & book chapters |
| 4 | Descriptive review | ✓ | ✓ | ✓ | ✓ | Review papers<br>37 journal articles<br>3 conference articles |

The data collection process comprised several steps. First, based on the research questions, the author elaborated some coding schemas for the data extraction procedure. This data was analyzed, discussed, and adjusted during the agreement sessions when required. All the gathered data was consolidated in board tables for further analysis. Additionally, the author used a note-taking process during the detailed analysis of the articles to obtain a better insight into the selected literature.

## 1.4 Structure of the thesis

Chapter 1 is the introduction and presents general aspects of the thesis. This chapter includes the background of blended learning as concept and research domain. Subsequently, it presents the objective and the research questions. It is followed by sections discussing the method, the specific contributions of this research, the structure of the thesis described chapter by chapter, and the conceptual frameworks used for this work.

Chapter 2 discusses the digitalization of higher education. Particularly, it presents a portrait of digital technologies and the context of their use, and an analysis of how transformative blended learning practices are in the higher education context. This chapter acts as an independent manuscript and it is included as originally submitted for publication. It comprises the abstract and introduction, and a definitions section. It is followed by sections describing the conceptual frameworks and the research questions, the method, and findings and results. Finally, it includes the discussion, conclusions, limitations, and future work sections.

Chapter 3 identifies some of the most promising trends in blended learning implementations in higher education, the capabilities provided by technology (e.g., datafication), and the contexts of use of these capabilities. This chapter acts as an independent manuscript and it is included as originally submitted for publication. This chapter is divided into seven sections: The first section presents concepts related to educational technologies, their capabilities, and their use in blended learning implementations. The second section presents the conceptual framework and research questions. It is followed by sections dealing with the research method and the finding and results. Finally, the chapter presents a discussion section, some policy implications

for the educational sector, conclusions, limitations of the current analysis, and suggestions for future research work.

Chapter 4 presents an assessment of previous literature review about blended learning in higher education. This assessment intends to reveal the main themes discussed, the level of transparency, and current practices in reporting methodological choices in these review papers. This chapter acts as an independent unpublished manuscript. This paper is divided into the following sections: the background; the objective and research questions; the research method; the findings and results; a discussion section; and some conclusions. Finally, the last sections present the limitations of this research and future work.

Chapter 5 presents a synthesis of the articles, the general conclusions, and the main implications for researchers and practitioners.

Finally, **Table 1.3** presents the list of chapters, the research questions, main theories and frameworks used in this research, the research method applied for each chapter, and the main contributions.

**Table 1.3** - Thesis chapters

| Chapters and research questions | Theories and frameworks | Method | Theoretical and empirical contributions |
|---|---|---|---|
| Chapter 1 - Introduction | - | - | - |
| Chapter 2 - Digital technologies, blended learning, and higher education.<br>1. What digital technologies are deployed in the context of blended learning in higher education?<br>2. What are the current practices and context of use of these technologies?<br>3. What dimensions are proposed in selected literature for mapping and measuring the trajectory of digitalization in higher education institutions? | Blended learning frameworks (Graham, C. R., 2006; Graham, Charles R. *et al.*, 2013), the multi-level perspective on sustainability transitions (Geels, 2005), drivers of digitization (Berger, 2015). | Theoretical review | - A portrait of the digital educational technologies related to blended learning in higher education.<br>- A framework for measuring the transformational level of these technologies. |
| Chapter 3 – Blended learning in higher education: trends and educational technology capabilities.<br>1. What are the emerging trends in blended learning implementations in higher education?<br>2. What are the current capabilities in the educational technology used in these blended learning implementations in higher education?<br>3. How are these educational technology capabilities used in blended learning implementations in higher education? | Blended learning frameworks (Graham, C. R., 2006; Graham, Charles R. *et al.*, 2013), the multi-level perspective on sustainability transitions (Geels, 2005), Disruptive innovation (Christensen *et al.*, 2011) | Narrative review | - The identification of the most promising trends in blended learning implementations in higher education.<br>- The development of a typology for Educational technology capabilities (e.g., datafication).<br>- The analysis of the contexts of use of these capabilities. |
| Chapter 4 – Transparency in previous literature reviews about blended learning in higher education.<br>1. What trends exist in these types of literature reviews, what are their main themes, and how transparent are they?<br>2. What practices do the selected reviews use to ensure transparency? | Standalone literature review typology (Paré *et al.*, 2015). Systematicity and transparency – A framework for conducting standalone literature reviews (Paré *et al.*, 2016). | Descriptive review | - The extension of framework to include an assessment procedure for identifying the levels of transparency.<br>- The analysis of current practices in reporting methodological decisions for providing recommendations for enhancing trustworthiness. |
| Chapter 5 - Conclusion | - | - | - |

CHAPTER II

# DIGITAL TECHNOLOGIES, BLENDED LEARNING, AND HIGHER EDUCATION

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## Abstract

Blended learning is a technology-enabled learning approach that combines online and face-to-face delivery modes, learning theories and pedagogical practices embedded in a complex context of implementation. This combination can potentially retain the individual advantages of these approaches while avoiding their respective pitfalls. Based on previous academic literature, this *theoretical review* aims to propose a framework for explaining the transformational potential of blended learning in higher education. By coding and analyzing the selected literature that comprise 1,017 abstracts and 37 journal articles, we intend to : 1) portray the digital educational technologies reported in the selected sources; 2) analyze the current practices and contexts of use of

these technologies; and 3) identify what dimensions are proposed for mapping and measuring the trajectory of digital technologies in higher education institutions. Our findings show that the technological choice is not enough to create successful transformations of the teaching-learning process. Instead, a multi-level and multi-dimensional perspectives that aligns the pedagogical, motivational, technological, and institutional dimensions of these implementations are necessary. This integrated model may provide practitioners and policy-makers conceptual support and better insights for understanding the complexity associated to blended learning to improve their implementations and policy-making process. For researchers, this model may offer some clues for further exploration of blended learning as a dynamic and integrated technology-enabled learning approach not constrained only by classroom settings and organizational decisions.

**Keywords:** blended learning, digital technology, higher education, innovation, theoretical literature review.

## 2.1 Introduction

The first pillar of this study relates to the concept of blended learning. Blended learning is a multidimensional concept and, therefore, difficult to encompass fully within one definition. Nevertheless, for the purpose of this study, the authors define *blended learning* as a technology-enabled learning approach that combines online and face-to-face delivery modes, learning theories and pedagogical practices embedded in a complex context of implementation. Previous academic literature have used "hybrid courses," "flexible learning", and "mixed-mode learning" as synonyms for blended learning (Dzakiria *et al.*, 2012). This proliferation of denominations has contributed to the ambiguity of blended learning as a concept (Picciano, 2009; Tshabalala *et al.*, 2014). Despite this definition issue, researchers have produced abundant and insightful

academic literature in this field. In this scenario, current academic literature has analyzed blended learning from multiple perspectives such as pedagogical (Francis & Shannon, 2013; Hutchings & Quinney, 2015), organizational (Graham, Charles R. *et al.*, 2013; Porter & Graham, 2016), technological (Martin & Whitmer, 2016; Suhail & Lubega, 2011), and social (Crawford, N. & McKenzie, 2011; Selwyn, 2017).

Notwithstanding this abundant and diverse academic literature, a comprehensive portrait of digital educational technologies and an integrated framework for explaining the transformational potential of blended learning in higher education are missing. Additional to this gap in literature, general assumptions about blended learning oversimplifying the complexity of the technology-education relationship may limit our understanding of this phenomenon. One main assumption relates to the disruptive potential of digital technologies in most industries (Christensen & Raynor, 2013). However, although recent studies have shown improvements in the learning-teaching process regarding the outcomes performance (Bernard, R. *et al.*, 2014), to the best of our knowledge no disruptive transformations of the education system as an entire sector have been reported in literature. In fact, the understanding of what this new concept (i.e., disruptive transformations) means in this complex context of implementation may provide new insights about real transformations in different levels of the education system (e.g., classroom, institutions, local or national territories).

As a technology-enabled learning approach, blended learning requires a common playground where researchers and practitioners may continue the discussion about technology, education and their relationship. The history of technology and education provides multiple examples that suggest "that the implementation of technology in education is rarely a predictable or even controllable process" (Selwyn, 2011, p. 60). Nonetheless, questioning the transformative nature and potential impacts of technology is necessary. This is especially true given that the unprecedented volume and rate of

developments in digital technologies for education have generated significant anticipation of improvements to the core processes of education.

To this regard, Lievrouw & Livingstone (2002) offer a broad definition of technology. They state that the understanding of technology and its impacts builds on three levels of analysis: 1) what artifacts and devices are deployed in a specific sector or activity; 2) the activities and practices enabled by the use of such technologies; and 3) the context of the social and institutional aspects and structures encompassing the use of these technologies. This definition shows the complexity of technological innovations and may provide some clues for a better understanding of the technology-education relationship in the context of blended learning. In particular, higher education is currently undergoing significant transformations in terms of democratization, standardization, and perhaps most importantly for the purposes of this study, digitalization.

*Democratization* is largely driven by steady growth in the global demand for higher education (UNESCO, 2018). The democratization of the education as a primary goal is still a problem to solve in many societies, despite global agreements prioritizing this goal. For achieving democratization of education as UNESCO (2016) proposes national initiatives require not only higher levels of accessibility, but higher levels of quality. In this context, digital technologies are presented as enabling and disrupting forces (Acemoglu *et al.*, 2014; Christensen *et al.*, 2011). On the other hand, s*tandardization* as a product of the internationalization of higher education systems is due in part to the rapid development of university exchange programs and overall increase in students' mobility. These standardization trends have propelled the coordination of university programs, mostly through the process of accreditation and international agreements (e.g., The Bologna Process). These transformations in the higher education ecosystem Digital technologies may provide the required tools for

boosting not only standardization, but also curriculum change (González *et al.*, 2013; VanDerLinden, 2014).

*Digitalization*, as the result of the application of digital innovations, includes a broad range of digital devices, platforms, and infrastructural technologies. The intent of digitalization in higher education in most cases is to increase the scalability of educational processes, establish flexibility in learners' access to instruction, and reduce the costs of instruction (Taplin *et al.*, 2013). The digitization process is also defined as all software-driven process comprising datafication and automation "that allow increasingly smart machines to intervene in the world" (Olleros & Zhegu, 2016, p. 6). The convergence of datafication and automation technologies has resulted in "a huge rethink of processes involving dynamic decision-making, pattern recognition and advisory services as machine intelligence optimizes those processes and feedback loops" (King *et al.*, 2017). Diamandis & Kotler (2016) refer to technologies derived from the combination of datafication and automation as "exponential technologies". According to Olleros & Zhegu (2016, p. 6), digitization in the information age is a:

> "push toward process efficiency, such as the early mainframes, and further automation in the factory and production space. Internet went further and disrupted distribution mechanics…".

In "Augmented life in the smart lane," King *et al.* (2017) extend this definition situating digitization as a dynamic process in time by distinguishing it in different technological ages such as the digital age, automation age, and augmented age. However, according to this author, it is in the *augmented age* that it has reached the highest disruptive level. Nevertheless, digitalization, as an amalgam of transformational forces, is far from being a "silver bullet" for the systemic problems of higher education. Largely because

it is often poorly embedded in complex educational contexts, digitalization is showing its limits.

The unprecedented level of *accessibility* to digital technology has fueled a massive rise in *connectivity* among humans, as well as between humans and machines, and machines and machines. *Datafication*, or the digitization of the information, is a natural product of digital accessibility and connectivity. *Automation* as a result from advancements in artificial intelligence (e.g., algorithms and deep machine learning) constitutes another force or driver of digital transformation. These forces or drivers build on a handful technological enablers (e.g., e-learning platforms, applications, technological infrastructure). These driving forces are a construct for illustrating the potential of transformation of specific technologies. Berger (2015) operationalized the digital transformational process as an ensemble of four driving forces (i.e., accessibility, connectivity, datafication, automation) enabled by a small number of technologies whose convergence generates multiple technological proposals (i.e., specific digital technologies such as Moodle, Blackboard, and Canvas).

Aside from these external transformative influences, some internal imperatives also exert transformative pressures that threaten the survival of higher education institutions. In some cases, these pressures are caused by financial restrictions, while in others they may be the result of: programs that are disconnected from job markets, growing competition, the emergence of disruptive business models, and the flattening of the higher education wage premium (Valletta, 2015).

As main limitation, the authors identified the complexity of the education system as Fisher & Newton (2014, p. 919) expressed,

> "The more we learn about the interrelationships between teaching, learning, technology, physical and virtual learning environments, the more we realize we need to continue to deeply research this complex topic further."

In this context, the authors propose the use of cumulative knowledge synthesis processes through comprehensive literature reviews as an effective way to surpass this limitation based on the abundant, diverse and insightful of primary qualitative and quantitative studies (Finfgeld-Connett, 2010; Greenhalgh *et al.*, 2005; Pawson *et al.*, 2005). In particular, this theoretical literature review aims to propose an integrated framework for explaining the transformational potential of blended learning in higher education. For this purpose, we intend to answer the following research questions based on a set of previous academic literature comprising 1,017 abstracts and 37 journal articles: 1) *what digital technologies are deployed in the context of blended learning in higher education*? 2) *what are the current practices and context of use of these technologies?* And 3) *what dimensions are proposed for mapping and measuring the trajectory of digitalization in higher education institutions*? These research questions lead to identify, analyze, and evaluate different elements and aspects of the learning-teaching process in the context of blended learning. Answering them may provide relevant information not only for creating the foundational building blocks for the proposed framework, but also for allowing further research works to extend it.

In the following sections we present the research questions and the methodological approach of the research as well as discuss the findings. The final section discusses the implications of this study for practice and future research.

## 2.2 Method

Based on existing frameworks and guidelines for conducting standalone literature reviews (Paré *et al.*, 2016; Templier & Paré, 2015), this *theoretical literature review* was conducted as a systematic, iterative, and reflexive process. This kind of reviews, as Paré *et al.* (2015) claim, "brings together diverse streams of work and uses various structured approaches such as classification systems, taxonomies and frameworks to organize prior research effectively, examine their interrelationships, and discover patterns or communalities that will facilitate the development of new theories." We used a comprehensive search strategy that allowed us to describe and contextualize a set of concepts and their relationships in order to provide some explanations about the potential levels of transformation in higher education institutions due to blended learning implementations. Additionally, some gray literature sources were used to provide examples and complement the background presented in the introduction and background sections.

The following sections sequentially detail the stages of this review which included: 1) definition of the searching strategy; 2) study selection procedures; 3) quality assessment of articles; 4) data extraction from the selected articles; and 5) data analysis and synthesis. **Figure 2.1** displays the detailed workflow and outcomes of the first three stages.

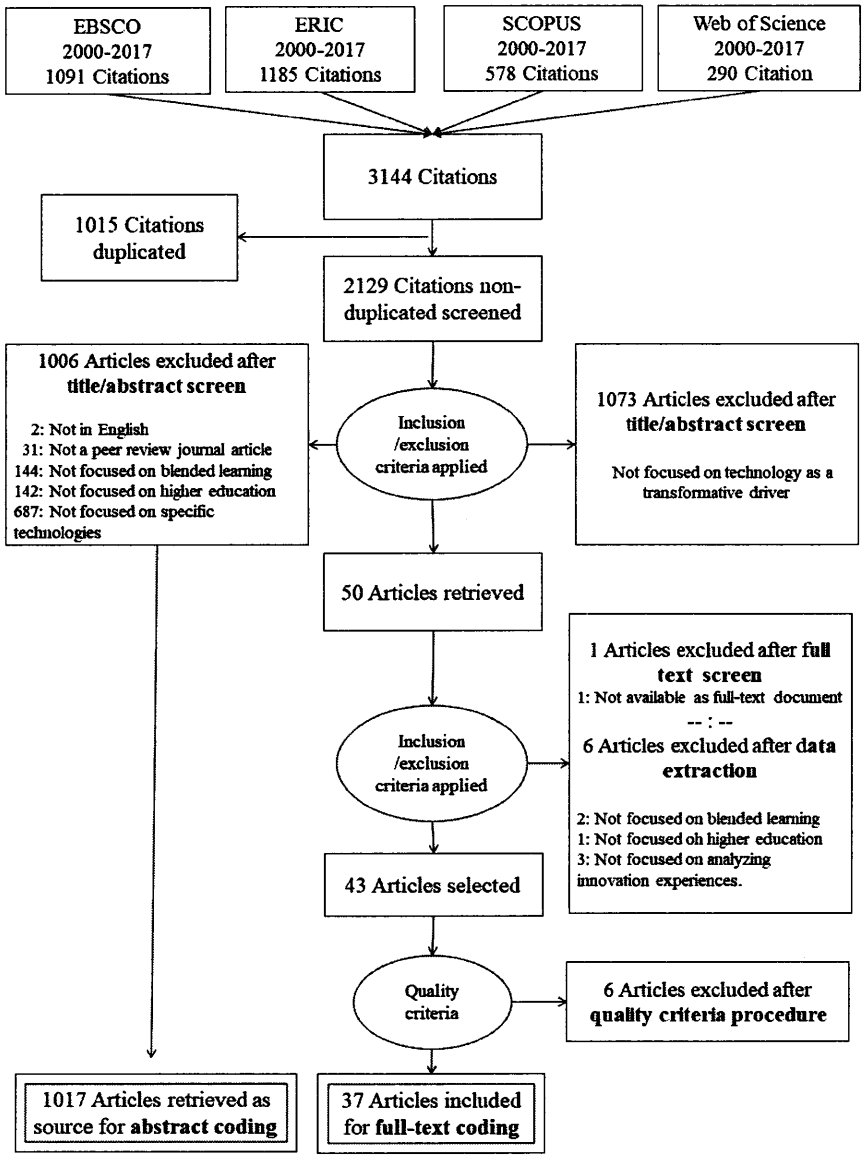


**Figure 2.1** - Flow diagram of the search, study selection, and quality assessment strategies.

### 2.2.1 Literature search strategy

A first iteration was performed in order to evaluate the comprehensiveness of the search strategy, the process, and the relevance of the keywords. As a result, we identified a more precise set of keywords and search terms that were then grouped into three categories (**Table 2.1**). We further requested two independent librarians to validate the search strategy procedure and the online scientific-citation indexes and electronic databases to ensure the relevance of the citations obtained. All the information collected and coded is presented in the Mendeley Datasets repository (Castro & Zhegu, 2018).

**Table 2.1** – Keywords.

| Categories | Keywords and strings of terms | References |
|---|---|---|
| Blended learning | "Blended learning," "blended education," "hybrid learning," "mixed-mode instruction." | 8,340 |
| + Higher education | "Higher education," universit*, college. | 5,184 |
| + Innovation adoption and diffusion | Adopt*, barrier*, challenge*, change*, diffusion*, disruption*, driver*, factor*, impact*, improvement*, innovati*, invention*, pattern*, radical*, redefining, reinvention, restructuring, sustainable, transform*. | 3,144 |

In total, 3,144 citations were obtained by searching for these keywords in the title, abstract, and keyword fields from EBSCO, ERIC, SCOPUS, and the Web of Science. After the deduplication of articles based on the title, author, year, and DOI, 2,129 citations remained in the database. For managing citations, we selected EndNote and include in the reference section all the citations including those presented in the appendices. Additionally, we developed a specific set of functionalities using a MySQL database engine in order to facilitate citation deduplication, traceability of activities, and the generation of summarized tables for further analyses.

### 2.2.2 Study selection criteria and procedures

**Table 2.2** presents the exclusion criteria for the study selection procedure. In order to validate the quality of the screening process, we organized regular meetings in which all differences were discussed and reconciled according to the inclusion and exclusion criteria. We applied criteria one to five during the screening of the title, keywords, and abstracts of 2,129 references. Of those, the 1,017 that discussed specific digital technologies deployed in a context of blended learning in higher education were retained and used to map the current digital technologies adopted in higher education.

**Table 2.2** – Exclusion criteria for the study selection.

| Criteria | Description of the exclusion criteria |
|---|---|
| Not in English language | Articles not written in English. |
| Not a peer review journal article | Articles not classified as peer-reviewed scientific journal articles (e.g., book chapters, editorials, or conference papers). |
| Not focused on blended learning | Articles focused exclusively on e-learning, face-to-face learning, or other pedagogical approaches such as flipped learning, but not in the context of blended learning. |
| Not focused on higher education | Articles not focused on higher education. |
| Not focused on specific technologies | Articles that do not refer to a specific educational technology but that discuss digital technologies from a general perspective. |
| Not focused on technology as a transformative driver | Articles that discuss technology without pedagogical considerations or as a support for traditional practices. |
| Not available as a full-text document | Articles not available as a full-text documents. |

We applied criterion six to these 1,017 citations to identify articles focusing on technology as a transformative driver. This criterion allowed us to excluded 1,073 citations that discuss technology without pedagogical considerations or present technology only as a support for traditional learning-teaching practices. As a result, we obtained a set of 50 articles for further screening, coding and analysis. Thereafter, we performed the full text screening procedure and applied the seven criterion (**Table 2.2**) on the 50 articles, resulting in a final set of 43 articles. We did not perform backwards and forwards search procedures.

### 2.2.3 Quality assessment

Most methodological studies argue that quality assessment of primary studies are appropriated mainly for theory-testing reviews (i.e., meta-analysis, systematic literature reviews) (Paré *et al.*, 2015). In regard to this topic, these quality appraisals are also a generally accepted practice for realist reviews as one specific type of theory-building review (Greenhalgh *et al.*, 2011; Paré *et al.*, 2015). Although this is not the case for theoretical literature reviews, we decided to perform a appraisal of the quality of the selected articles in three categories: purpose, sources, and methods. After the initial iterations on our sample, we identified some issues related to the explicitness of information regarding these categories in several articles. We did not perform a formal assessment as proposed in existing guidelines and checklist of items (e.g., PRISMA) for reporting relevant information in theory-testing reviews (Greenhalgh *et al.*, 2011). Instead, for each category we defined a criterion and it was evaluated using a rating of high, medium, or low to which values of 1, 0.5, and 0, were assigned respectively. For the purpose category we assessed whether the research objective, purpose, questions, propositions or hypothesis were clearly stated. We also evaluated the explicitness of the primary studies sources. For the last category we assessed whether the research design, research method, data collection instruments, and type of the article clearly stated. The main goal of this activity was to provide some level of reliability and consistency of selected articles for our analysis. Through this process, we excluded six articles that did not achieve the minimum required score (2.0). We performed the quality assessment during the first phase of the full-text article coding process. In total, 37 articles were selected for this literature review after the quality assessment (**Appendix A**).

### 2.2.4 Data extraction strategy

The data extraction and data analysis protocols were designed in iterative and interrelated phases in order to facilitate the synthesis and reporting activities in the early stages of the research process. This allowed for validation of the consistency of the outcomes. We used a direct content analysis approach (Hsieh, H.-F. & Shannon, 2005) using ATLAS.ti (a computer-assisted qualitative analysis tool). For the purpose of this work, regarding the academic literature, we propose three terms for better understanding our search strategy and study selection procedures. First, we named *selected citations* to the 1,017 citations resulted after the title and abstract screening procedure. Second, we named *selected articles* to the 37 articles resulted after the full-text screening procedure. Finally, we named *selected literature* to both set of sources.

We coded in Excel the article titles and abstracts of the *1,017 selected citations* as a way to identify the state of the art analyzing information about research objectives, article perspectives, and adoption characteristics described. This information helped to map patterns, trends, and trajectories in scientific research on digital educational technologies and their impacts on teaching and learning outcomes. The characteristics analyzed included the article's general purpose, main ideas, problems identified, and perspectives (e.g., organizational, sociological, pedagogical, technological) (**Table 2.3**).

**Table 2.3** – Coding sheet for abstracts.

| State of the art | Code structure and rationale |
|---|---|
| **Research objective and article perspective** | |
| General purpose | Open-ended |
| Main idea | Open-ended |
| Problems identified | Open-ended: gaps and problems identified for future work or research agenda. |
| Article perspective | Coded: organizational, sociological, pedagogical, technological, not stated, etc. |
| **Adoption landscape (characteristics description)** | |
| Actors | Open-coded: students, faculty, academic units, administrative units, universities, government, commercial providers, institutional networks, not stated, etc. |
| Technologies identified | Open-coded. |
| Discipline or field | Open-coded: disciplines or academic domain studied |
| Leading innovator | Coded: individual, organization, external system |
| Implementation type | Open-coded |
| Concepts | Open-coded: challenges, opportunities, barriers, drivers, etc. |

Based on the full-text coding sheet (**Table 2.4**), we further extracted information from the *37 selected articles* using ATLAS.ti. As repositories of the data collected, we used ATLAS.ti for the coding process, and Excel and the database engine MySQL as tools for the consolidation of the information as a table board. This allowed for the elaboration of conceptual maps and summarized tables as intermediary tools for data analysis and synthesis.

**Table 2.4** – Coding sheet for full-text articles.

| State of the art | Code structure and rationale |
|---|---|
| **Phase 1: Research objectives and method** | |
| Purpose | Open-ended: purpose, aim, or objectives. |
| Research questions | Open-ended: research questions, propositions, or hypothesis if stated. |
| Research unit | Coded: course level, academic unit, administrative unit, institutional, academic initiatives or projects, not stated, etc. |
| Article type | Coded: empirical—qualitative, empirical—quantitative, conceptual or theoretical framework, mixed-methods, literature review, not identified. |
| Research type | Coded: exploratory, descriptive, explanatory. |
| Research design | Coded: experimental, survey, comparative, case study, observational, action research, mixed-method. |
| Data collection instruments | Coded: case study, questionnaires/surveys, content analysis, interviews, focus groups, national reports, information system logs and data, meeting results, meeting minutes, not stated. |
| Data source and sample | Open-ended: information regarding data sources and research sample. |
| **Phase 2: Adoption landscape (characteristics description)** | |
| Countries analyzed | If available, countries analyzed in the study. |
| Level of Analysis | Coded: multiple universities, local, regional, national, multiple countries, transnational zones, not stated, etc. |
| Degree level | Coded: bachelor's, master's, doctorate, continuum education |
| Adoption/transformation degree | Awareness/exploration, adoption/early implementation, mature implementation/growth, not stated (Porter, 2016). |
| Concepts | Open-ended: practices, roles, content structure, curriculum, space management, time management, tasks, sustaining, disruptive, outcomes—advantages. |
| **Phase 3: Findings and results** | |
| Findings and results | Open-ended. |
| Limitations | Open-ended. |
| Conclusions | Open-ended. |
| Future work | Open-ended. |
| Gaps | Open-ended. |

### 2.2.5 Analysis and synthesis strategy

We analyzed the collected data through an iterative process. In each step we: 1) evaluated whether the question could be answered with the data collected to adjust the data collection process when needed; 2) updated the descriptive statistics tables previously defined according to a structured thematic analysis based on the academic literature; 3) identified commonalities and divergences among authors and theories with respect to the transformative potential of digital technologies; and 4) interpreted and synthesized the analyzed information.

Based on the coding results, we elaborated criteria for classifying specific digital technologies and three descriptive statistics tables. These tables comprise: 1) a literature characterization regarding the perspective of analysis whether explicitly stated or interpreted by us and the main actors analyzed in the analyzed; 2) a portrait of specific digital technologies used in blended learning implementations for higher education based on the aforementioned criteria and a classification of educational technology enablers; and 3) some dimensions proposed in literature for mapping and measuring the trajectory of digital technologies in higher education institutions.

## 2.3 Findings and results

The information extracted from the analysis of the 1,017 abstracts is presented in **Table 2.5**. This information is organized according to: 1) the perspective adopted by the article (e.g., pedagogical, organizational, technological, other); 2) the research unit of the analyzed papers (e.g., student, academic units, institutions, etc.); and 3) the leader and/or promoter of the implementation (e.g., individual, institutional, ecosystem).

**Table 2.5** – Literature characterization ordered by total selected citations.

| | Actor | | | | | | |
|---|---|---|---|---|---|---|---|
| | Students | Faculty & academic units | Institutions | Not identified | External system | Total of studies | (%) |
| **Article perspective** | | | | | | | |
| Pedagogical | 723 | 151 | 54 | 24 | 2 | 898 | 83.30 |
| Organizational | 33 | 26 | 32 | 1 | 1 | 81 | 7.96 |
| Technological | 15 | 11 | 6 | 5 | 0 | 36 | 3.54 |
| Others | 9 | 2 | 2 | 1 | 0 | 14 | 1.38 |
| Total | 780 | 190 | 94 | 31 | 3 | 1029 | |
| **levels of implementation** | | | | | | | |
| Institutional | 337 | 147 | 83 | 22 | 1 | 590 | 58.01 |
| Individual | 426 | 32 | 4 | 8 | 1 | 471 | 46.31 |
| Ecosystem (Local/national) | 7 | 8 | 7 | 1 | 1 | 24 | 2.36 |
| Total | 770 | 187 | 94 | 31 | 3 | 1,085 | |

(*) Percentage out of the 1,017 selected citations coded.

The vast majority of these studies (n = 723) adopt the pedagogical perspective of blended learning and analyze the effects of digital technologies on students' learning outcomes. A number of other studies (n = 33) focus on organizational issues and provide important insights into the ongoing digitalization of universities and colleges. Fewer papers (n = 15) focus on the technological perspective of blended learning practices. Disproportionality also exists with respect to the research unit of the analyzed papers. The bulk of the studies (n = 780) targeted students as their research unit. This seems to reflect the emerging consensus from these papers about the progressive shift in focus from teacher-centered to student-centered. The next most popular research unit was faculty and academic units (n = 190) as active agents of institutional change, followed by institutions (n = 94). Regarding the *level of implementation*, fifty-eight percent of papers discuss organizational (faculty- or university-lead) experiences of digitalization. Papers in this category include experiences reported for two or more courses with multiple different instructors. Forty-six percent consider individual (professor-lead) experiences; however, in some cases, studies also analyzed organizational interventions in the implementation. Finally, this preliminary step of the

literature review revealed insufficient research available on the external contexts of digital transformations in universities.

Our findings show three main perspectives of analysis (i.e., pedagogy, technology, organization). In most cases, when previous literature reported their work in any of these perspectives a link or a relationship was described with other elements. For this relationship we identified the nature, degree, mechanisms, and contexts as the main aspects of the relationship between pedagogy-technology-organization. Our finding also identified multiple levels of blended learning implementations in higher education institutions. **Figure 2.2** summarize our finding from the selected citations (**Table 2.5.**) and the analysis of the selected articles (**Appendix A**).

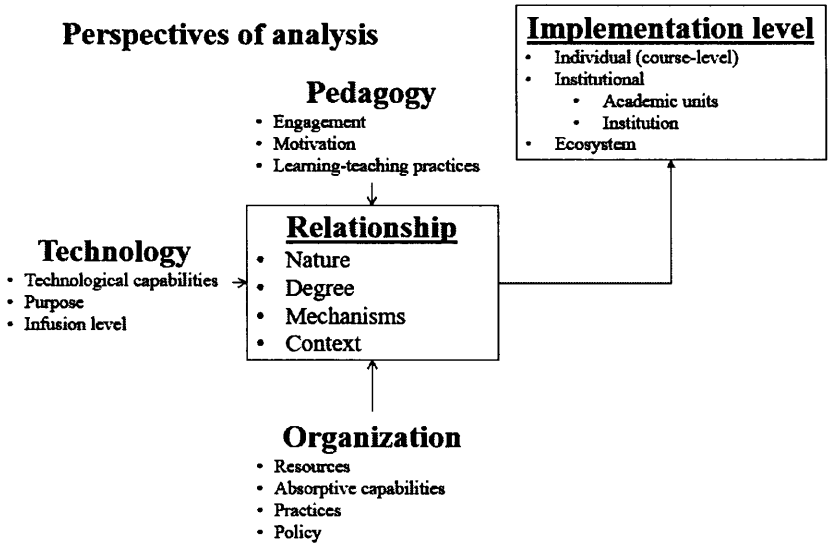


**Figure 2.2** - Perspectives of analysis and implementation levels of blended learning

### 2.3.1 What digital technologies are deployed in the context of blended learning in higher education?

Our findings show some common elements most researchers use to describe educational technologies. We analyzed these elements on the first content analysis iteration for the 1,017 *selected citations'* abstracts to identify the rationale of use for describing technology. We structured the results and propose three criteria (i.e., delivery platform type, digital media type, purpose of use) for classifying specific digital technologies reported in *selected citations* (**Table 2.6**).

**Table 2.6** – Criteria for specific digital technologies classification.

| Criteria | Rationale |
|---|---|
| Delivery platform type | Platform, tools, or Apps |
| Digital media type | Text, audio, video, images, animations, multimedia |
| Purpose of use | General or broad purpose, digital media production or delivery, communication (asynchronous, synchronous), data collection activities (e.g., online surveys), immersive experiences, educational administrative activities (reporting grades, uploading presentations), social networking, etc. |

On a second iteration, we assigned at least one value of each criterion to digital technologies reported on the aforementioned abstracts to elaborate an initial list of digital technologies categories. Further iterations allowed us to refine the set of categories of these specific digital technologies into *31 digital technologies categories* (**Appendix B**). Our findings show some common aspects between these technologies that allowed us to identify another level of classification. This new classification (i.e., e-learning platforms, applications, specific domain learning platforms, adaptive learning platforms, technological infrastructure) may provide some clues about current trends in digital technology deployment for blended learning. In these trends we identified some elements associated with what Berger (2015) calls "*driving forces for digital transformations*" and King *et al.* (2017) refers as *ages* (i.e., digital age, automation age, and augmented age). According to Berger (2015), these forces (i.e.,

accessibility, connectivity, datafication, and automation) are driving current transformations in most industries. However, another force (i.e., augmented experiences) is already in place as King *et al.* (2017) states when discussed about the augmented age. The following general model may summarize and integrate these elements (**Figure 2.3**) and we also present an example about a specific software may highlight the relationship between them. *Alta* is the newest product released by Knewton, Inc. This courseware solution use Knewton's adaptive learning platform as a technology enabler to provide an intelligent tutoring system that allows personalized learning experiences. Accessibility, connectivity, datafication, and automation are present in *Alta*; however, datafication and automation are the ones that provide it its distinctiveness.

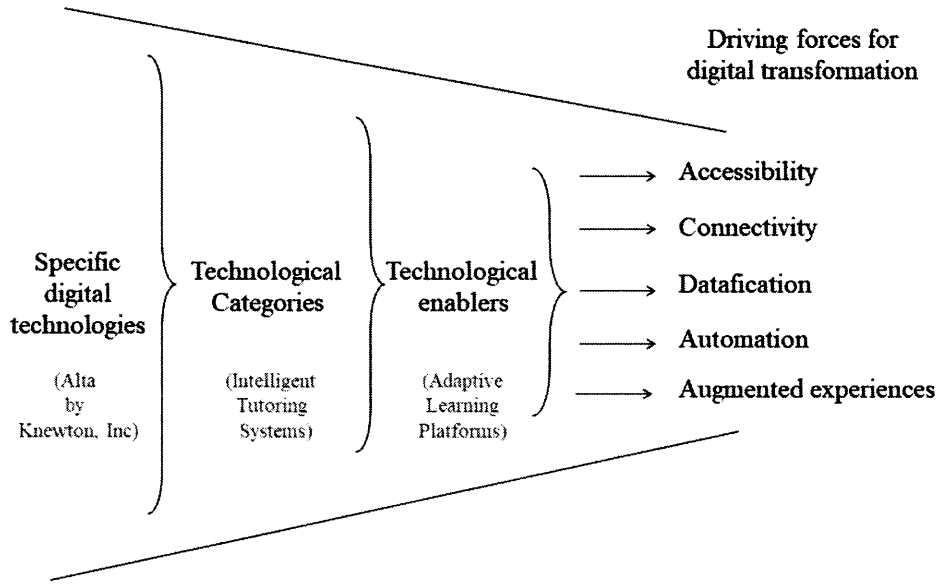


**Figure 2.3** Driving forces and digital technologies
Based on Berger (2015) and King *et al.* (2017).

After reviewing and analyzing the *selected articles* (**Appendix A**), we elaborated a more detailed description of the technological enablers and presented some examples for each enabler (**Table 2.7**).

**Table 2.7** – Educational technology enablers.

| Technological enablers | Examples of specific software or hardware (Technological categories) | Definitions |
|---|---|---|
| E-Learning platforms | Moodle, Canvas, Blackboard (Learning management systems). Edx, Coursera, Udemy (MOOC) | Web-based software for broad academic purposes that provides a vast set of learning-teaching functionalities (e.g., delivering content, reporting academic results, and facilitating interaction between teachers and students). |
| Applications | WhatsApp, Skype (Instant Messaging and chat tools). Khan Academy, Google Drive, Duolingo - Learn Languages for Free (Mobile Apps). Zoom (online conference tools). | Web-based, mobile apps or computer software providing accessibility to learning-teaching functionalities and systems. |
| Specific domain learning platforms | Web Coursework Support System (WCSS) to assist students doing coursework within their Zone of Proximal Development (ZPD) (Li & Chen, 2009) | Software and hardware providing learning-teaching functionalities in specific academic domains (e.g., language learning or mathematic tools). The software in this category provides a range of applications that focus mainly on content delivery and competence development. |
| Adaptive learning platforms | Alta (Intelligent tutoring system), ELARS (E-Learning Activities Recommender System) (Hoic-Bozic *et al.*, 2016) | Software using functionalities such as data mining and artificial intelligence to improve learning-teaching processes. These types of software, typically focus on specific academic domains (e.g., math, languages), but we classified in a different category to highlight their automation capabilities. |
| Technological infrastructure | Internet, desktop virtualization, Android | Software and hardware used to develop, operate, or support information technology (IT) services (e.g., computer servers, operating systems (OS), computer networks, data centers). |

**Table 2.8** presents a portrait of specific digital technologies used in blended learning implementations for higher education and their classification into educational technology enablers. This portrait also presents the number of abstracts from the selected citations discussing each digital technology category (Column 2). The vast majority of these studies focus on e-learning platforms (n = 671) and applications (n=575). Technologies classified in these two technological enablers are more centered in accessibility, connectivity and in some cases datafication (n=9). With regard to datafication and automation, only few studies discuss subjects associated to virtual learning environments with adaptive features, recommender systems, personalized learning platforms, intelligent tutoring systems, or virtual companion systems for education (VCS).

**Table 2.8** – Portrait of technological enablers, digital technology categories and specific digital technologies.

| Technological enablers | Digital technology categories | | # | Specific digital technologies |
|---|---|---|---|---|
| E-learning platforms (671, 65.98%) | 1. | E-learning platforms | 671 | Virtual learning environments (VLE), learning management systems (LMS), content management systems (CMS), SPOCs, open university platforms, MOOCs. |
| Applications (575, 56.54%) | 2. | Online discussion tools | 105 | Online discussion board, online forums |
| | 3. | Authoring tools | 102 | Authoring tools, online tutorial, mobile content, digital content design, PowerPoint. |
| | 4. | Website creation tools | 71 | Wiki, web 2.0 tools, blogs. |
| | 5. | Video tools | 54 | YouTube, vodcasts, video streaming, videos, video lectures, video annotation tools, TV, screencasts, reflection tools, note taking tools, movies & films. |
| | 6. | Mobile apps | 51 | Mobile learning, mobile content, mobile devices, laptops, iPod Touch. |
| | 7. | Online survey tools | 38 | Online formative assessment tools, online formal assessment tools, feedback tools, assessment tools. |
| | 8. | Social networking systems | 27 | Twitter, social media. |
| | 9. | OER & learning objects | 16 | Reusable learning objects, open electronic resources (OER). |
| | 10. | Online conference tools | 15 | Audioconference, videoconference |
| | 11. | Digital Games and Gamification | 14 | Gamification, digital games. |
| | 12. | Immersive technologies | 14 | Virtual worlds, virtual reality, augmented reality. |
| | 13. | Audio tools | 13 | Podcasts, audio. |
| | 14. | Knowledge organization & sharing platforms | 10 | RSS feeds, knowledge sharing platforms, e-Portfolio. |
| | 15. | Audience response systems | 9 | Clickers, audience response systems. |
| | 16. | Data analysis tools | 9 | Video analytics, learning analytics tools, academic monitoring systems. |
| | 17. | Cloud-based tools | 7 | Google Docs, cloud-based tools. |
| | 18. | Instant messaging and Chat Tools | 7 | WhatsApp, skype, chat, SMSs. |
| | 19. | Text-based tools | 4 | Reflection Tools, note taking tools, computer-assisted writing tools. |
| | 20. | Electronic books | 3 | E-books. |
| | 21. | Digital storytelling tools | 2 | Animation tools, animated modules. |
| | 22. | Assistive technologies | 1 | Assistive technologies. |
| | 23. | Delivery media | 1 | DVD. |
| | 24. | E-mail | 1 | E-mail. |
| | 25. | Image-based tools | 1 | Photo journals. |
| Specific domain learning platforms (70, 6.88%) | 26. | Specific domain learning tools | 41 | Training tools, systems for creativity learning activities, simulators, problem-based learning tools, math software, language learning tools, GIS learning tools. |
| | 27. | Virtual labs | 26 | Virtual microscope, virtual labs. |
| | 28. | Hardware kits, embedded systems and robotics | 3 | Robotics, hardware kits, embedded systems. |
| Adaptive learning platforms (13, 1.28%) | 29. | Recommender systems | 8 | VLEs with adaptive features, recommender systems |
| | 30. | Intelligent tutoring systems | 5 | Personalized learning platforms, intelligent tutoring systems, virtual companion systems (VCS) |
| Infrastructure (2, 0.20%) | 31. | Infrastructure | 2 | Internet, desktop virtualization. |

(*) Percentage out of the 1,017 selected citations – Some articles discussed more than one technology

### 2.3.2 What are the current practices and context of use of these technologies reported in selected literature?

This study analyzes the described learning-teaching practices either at individual or institutional levels on the 37 selected articles. We structured the narrative description on the five categories identified as technological enablers (e.g., adaptive learning platforms). In this narrative we also intend to present current technological capabilities, motivations, and contexts of implementation of blended learning in higher education. Additionally, during this process, we refined the detailed profile of selected articles and presented these results in **Appendix A.**

#### 2.3.2.1 Current practices about *E-learning platforms* as technological enablers

Platforms discussed in this category include LMS, MOOCs, and specific platforms for online universities. These platforms are generally used as integrative tools in a classroom context. These types of broad-purpose platforms enable activities including: content delivery; reporting of academic results; and facilitation of interactions among teachers and students. The main trends in literature in this category focus on LMS and MOOCs.

The majority of articles analyzed for e-learning platforms relate to course-level experiences; however, some studies also explore institutional implementations. In particular, Nachmias & Ram (2009) present the case of a decentralized design process with centralized institutional expert support for improving content delivery capabilities. Their findings show that the pedagogical design process is an important dimension to consider when evaluating the transformation potential of digital technologies. Some of the analyzed studies reported explicit design considerations incorporating pedagogical frameworks for systematic implementations. For example, Danker (2015) describes how flipped approaches can provide active learning activities

for small groups in the context of a large lecture-style class, thus promoting individualized learning paths.

Three out of seven articles discussing e-learning platforms do not explicitly mention pedagogical design considerations. These studies focus on analyzing the technology adoption process (Grgurovic, 2014) and the effects of the technology on student outcomes or behaviors (Martin & Whitmer, 2016). Similarly to Chou & Chou (2011), our findings show that technological adoption without explicit and aligned pedagogical designs does not necessarily improve learning-teaching activities. Studies without an explicit pedagogical design for this enabler (e-learning platforms) focus mainly on content delivery, human-human interactions, and data-driven teaching activities.

#### 2.3.2.2 Current practices about *Applications* as technological enablers

The applications category is defined as all web-based, PC stand-alone, or mobile applications providing accessibility to learning-teaching functionalities and systems. From instant messaging and chat tools to electronic books and video conferences, this enabler encompasses a diverse range of technological solutions. These solutions also include all portable, handheld computing devices such as tablets, e-readers, and smartphones as required elements for operating mobile apps (Walta & Nicholas, 2013; Xu, 2010). Our findings show that articles discussing mobile devices focused mostly on their portability rather than other distinctive technological capabilities such as convergence or personalization. Portability or mobility concepts in these articles relate to the ease of access of mobile devices to software platforms and apps.

Other examples include the integration of multiple applications and devices such as augmented reality (AR), RFID, and mobile devices as presented in Chang & Liu (2013). As a result of the variety in technological solutions and teaching strategies, numerous potential scenarios are possible. These changing contexts also require

improving faculty members' abilities in managing learning experiences (El-Ghareeb & Riad, 2011). In these contexts, Chang & Liu (2013) also assert that informal and formal learning may share spaces, thus improving learning outcomes while promoting higher levels of engagement and motivation. At the present time, motivation and engagement (Pellas & Kazanidis, 2015) and collaborative activities (Bang, 2013) are also two of the main interests in the academic context for immersive technologies. These technologies include the hardware and software used to create a sense of immersion by mixing aspects of physical and simulated digital worlds. Augmented reality, digital games, virtual worlds, virtual simulators, and virtual reality are some of the technologies providing these kinds of experiences. The main technological capabilities identified in this category include scalability (Kleinert *et al.*, 2015) and human-to-human interaction (Ettarh, 2016).

Studies on technologies in the applications category show explicit design considerations. Our review uncovered two distinct issues among implementations (Appendix A). First, we identified some cases with a course redesign based on explicit learning-teaching concerns and the personal pedagogical experiences of faculty members. Among these cases, our findings indicated that implementation objectives included improving assessments and feedback (Xu, 2010), and enhancing learner-learner interactions (Ghadirian *et al.*, 2016). Second, a group of studies reported implementations applying existing and well-known pedagogical frameworks, such as the community of inquiry framework (Walta & Nicholas, 2013).

*Data analysis tools* group is defined as all software providing functionalities for collecting, processing, analyzing, and reporting academic results. Such tools are becoming a major element for improving learning-teaching activities. Their main identified purposes were: assessing students' perceptions; improving assessment practices in in-class activities for crowded environments (Masikunas *et al.*, 2007);

improving feedback practices; (Francis & Shannon, 2013); and enabling data-driven teaching activities by using adaptive functionalities and learning analytics (Martin & Whitmer, 2016). Other alternatives may provide automation to processes to balance instructor workload in high time-demanding activities such as assessment and feedback (Nakayama, M. *et al.*, 2010).

Finally, studies on applications also highlight differences in the levels of expertise and institutional support (Reiss & Steffens, 2010), as well as the different stages or maturity levels of institutional implementations (Graham, Charles R. *et al.*, 2013). We identified the characteristics of the implementation process as another potential dimension for assessing the transformational level of digital technologies.

#### 2.3.2.3 Current practices about *Specific domain learning platforms* as technological enablers

Specific domain learning tools are defined as all software providing specific functionalities, such as language learning tools or mathematical software. These tools provide a range of applications that are focus on content delivery (Hinkelman & Gruba, 2012), competence development (Oddie *et al.*, 2010), and collaboration (Poelmans & Wessa, 2015). Other cases, such as computer-assisted language learning (CALL), present some changes in the patterns of adoption. According to Hinkelman & Gruba (2012), instructors in their study preferred "locally authored multimedia material" in blended learning contexts rather than mass-marketed course books. This tendency is potentiated for new developments in authoring tools and learning management systems facilitating content production. Typically, implementations of specific domain learning tools are initiated by academic units (e.g., department, faculty) and require institutional technological and pedagogical support. Studies on blended learning implementations using specific domain learning tools describe: 1) more aligned pedagogical and technological processes; and 2) varying levels of institutional support and stages of

implementations. These implementations, in most cases, show mature and structured technology adoption processes already incorporated in the daily learning-teaching activities.

2.3.2.4 Current practices about *Adaptive learning platforms* as technological enablers

Adaptive learning platforms are technologies oriented towards improving learning processes using data mining and artificial intelligence. These "exponential technologies" (Diamandis & Kotler, 2016) allow for the creation of different paths of learning for each learner according to their own pace and performance. Strategies reported in the selected studies are comprised of elements including automated communications, individualized content delivery (Bai & Smith, 2010), and personalized feedback (Yang *et al.*, 2014). These exponential technologies (i.e., datafication, automation) are getting more attention as potential solutions for improving educational processes. Our findings identified that, in spite of initially flexible designs, iterative adjustment is required in order to align data-driven activities with individual and group needs analyses. Software tools identified in this category show significant improvements in scalability and quality of computer-based, individualized learning processes. Nevertheless, limitations in integrative processes throughout the whole academic chain of value may constrain the full potential of these technologies.

Platforms implementing these technologies include LMS, online adaptive tutorials, virtual companion systems, learning activity recommender systems, and intelligent tutoring systems. These platforms appeared as a response to changes in pedagogical approaches such as personalized, work-based, and collaborative learning activities. The technological development levels of these platforms are varied and depend of the specific platform deployed and the variety of technological settings in each institution. For example, LMS (e.g., Moodle) present some adaptive functionalities based on

information gathered from pre-tests and learning analytics techniques. These functionalities comprise personalized content delivery and feedback (Yang *et al.*, 2014) and students' self-paced learning activities (Martin & Whitmer, 2016). However, they show low levels of technological development compared with specialized intelligent tutoring systems (e.g., Knewton).

#### 2.3.2.5 Current practices about as *Technological infrastructure* as technological enablers

Technological infrastructure, for the purposes of this study, is defined as all hardware, computer networks, software, and facilities used to develop, operate, and support information technology services. We identified few articles discussing technological infrastructure in the context of blended learning implementations. Among the reviewed articles, one article focused exclusively in infrastructure. This article analyzed an optimization technique for low bandwidth environments that improves network efficiency and multimedia performance; this is particularly relevant in developing countries (Suhail & Lubega, 2011). Articles about technological adoption in education discussed Internet access as one of the major barriers for successful implementations. Topics related to connectivity became less relevant in the literature as technological developments improved broadband internet connections at both institutions and homes. However, aspects at institutional levels associated with technological convergence and interoperability remain less explored.

### 2.3.3 What dimensions are proposed in selected literature for mapping and measuring the trajectory of digitalization in higher education institutions?

During the initial phases of the coding and analysis process we identified some relevant concepts that oriented the further development of the models and framework. Some of these concepts in particular provided the basis for the identification of the set of dimensions for mapping and measuring the trajectory of digitalization in higher

education institutions (**Figure 2.4**). This study identifies, describes and classifies a spectrum of dimensions proposed in previous literature. These dimensions may provide some basis for analyzing digital transformation in higher education institutions from a blended learning perspective.

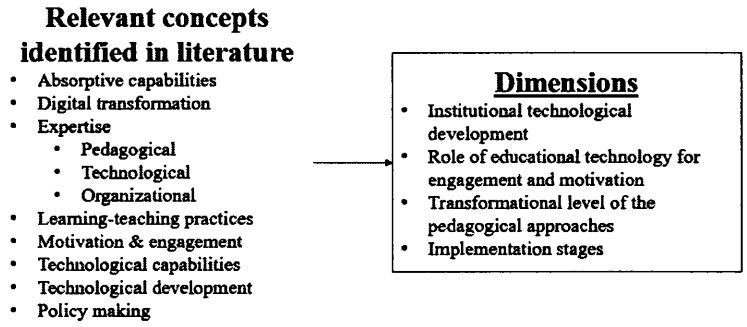


**Figure 2.4** - Dimensions for mapping and measuring the trajectory of digitalization in higher education institutions

First, one well studied dimension concerns the transformative level of pedagogical approaches. Graham, C. R. (2006) proposed a categorization of educational technologies that brings complementary elements for depicting their transformative level. The first category is *enabling mode.* In this mode, institutions use the basic characteristics of current technologies to improve access to content and to facilitate communication between students and faculty. The second category is *enhancement mode*. In this mode, universities redesign courses and processes to align face-to-face and online activities. Finally, *transformation mode* proposes radical transformations of pedagogy using technology as a catalyst to empower the learning process. In this context, the transformation from one perspective to another is at the core of the evaluation to identify the true nature of the organizational transformation.

As the second dimension, this study presents the relationship between digital technologies and students' engagement levels. The level of teacher-learner engagement and motivation is a crucial element to consider when redesigning the learning-teaching process. Hedberg (2006) described three levels of engagement, namely: passive interest, dynamic interaction, and a flow state. Likewise, Selwyn (2011, p. 59) identifies some promising approaches and initiatives of technological implementations in educational contexts that promote higher levels of engagement in the educational process (e.g., personalization, learner-centered). From an e-learning perspective, Metros (2003), as cited in Hedberg (2006), states that educational technologies can be deployed to contribute in different ways to achieve each one of these levels of engagement. Technologies can help to: 1) transfer conventional instructional tools, strategies, communication, and delivery methods toward a technology-enhanced learning environment; 2) translate (by redefining and reshaping) conventional instructional tools, strategies, communication, and delivery methods in accordance with a technology-enhanced learning environment; and 3) transcend (go beyond) conventional instructional tools, strategies, communication, and delivery methods to promote new paradigms for teaching and learning. From this perspective, only technologies that transcend current practices could be considered as disruptive.

As the third dimension, the organizational perspective builds mainly on the characteristics of the adoption and implementation processes. Graham, Charles R. *et al.* (2013) proposed a framework for institutional blended learning adoption that is comprised of three stages: 1) awareness/exploration, 2) adoption/early implementation, and 3) mature implementation/growth. This institutional perspective provides organizational elements to analyze implementations, such as strategies, resource management, and policies. As Graham, Charles R. *et al.* (2013) describe, in stage 1, despite institutional awareness, implementations remain as course-level explorations with limited organizational support. In stage 2, institutions provide support as a

generally adopted strategy based on a set of policies and practices. Finally, in stage 3, blended learning strategies and support are embedded in ongoing operational institutional practices.

This study, as a fourth dimension, highlights the variety of technological settings that exist in blended learning implementations. These settings include multiple technologies with different maturity levels. As initially stated, the process of digital transformation is presented as an ensemble of five driving movements. These driving movements (i.e., connectivity, accessibility, datafication, automation, augmented experiences) are enabled by a small number of technological enablers whose convergence generates multiple specific digital technologies (Berger, 2015; King *et al.*, 2017). Typical analyses identified in this study focused on these specific technologies instead of the broader dimension of technological resources in universities. These driving forces may be key components of an integrated measure for assessing levels of institutional technological development when aligned with individual and institutional learning-teaching practices. This alignment should be an essential component of the technological strategy to produce higher levels of transformation. Assessing educational technological resources in the universities on a scale of "low", "medium", and "high" with regard to each driving force could provide an integrated metric of the technological development dimension.

As previously stated, existing technological solutions in higher education institutions are not enough to determine the transformative degree of a digitalization process. Instead, a multi-dimensional approach is required in order to explain this transformative process. **Table 2.9** summarizes the four dimensions identified in the selected literature that are based on existing frameworks. These dimensions comprise the proposed framework for mapping the trajectory of digitalization in higher education institutions presented in this study.

**Table 2.9** – Dimensions and frameworks identified from the literature for mapping the trajectory of digitalization in higher education institutions

| Value | Institutional technological development | Educational technology role for engagement and motivation | Transforming level of the pedagogical approach | Implementation stages |
|---|---|---|---|---|
| 1 | Low | Transfer | Enabling mode | Awareness/exploration |
| 2 | Medium | Translate | Enhancement mode | Adoption/early implementation |
| 3 | High | Transcending | Transformation mode | Mature implementation/growth. |
| | | Metros (2003) as cited in Hedberg (2006) | Graham, C. R. (2006) | Graham, Charles R. *et al.* (2013) |

### 2.3.4 Integrating the model

Although we conducted a comprehensive literature review for the identification of concepts and dimensions, some other key aspects may be missing. Future research may extend the conceptual model and framework adding relevant concepts and dimensions allowing a better insight this complex process. To operationalize some of the identified dimensions this study uses previous models and frameworks mapping and measuring digitalization processes in higher education institutions (**Table 2.9**). As previously stated, existing technological solutions in higher education institutions are not enough to determine the transformative degree of a digitalization process. Instead, a multi-dimensional approach is required in order to explain this transformative process. We oriented our efforts toward identifying the main concepts and dimensions involved in mapping the educational technologies transformative levels described in previous literature. Aside from the technological development dimension, we found three other useful dimensions (**Section 2.3.3.**) that can determine the transformative level of these technologies as proposed in the conceptual model (**Figure 2.5.**)

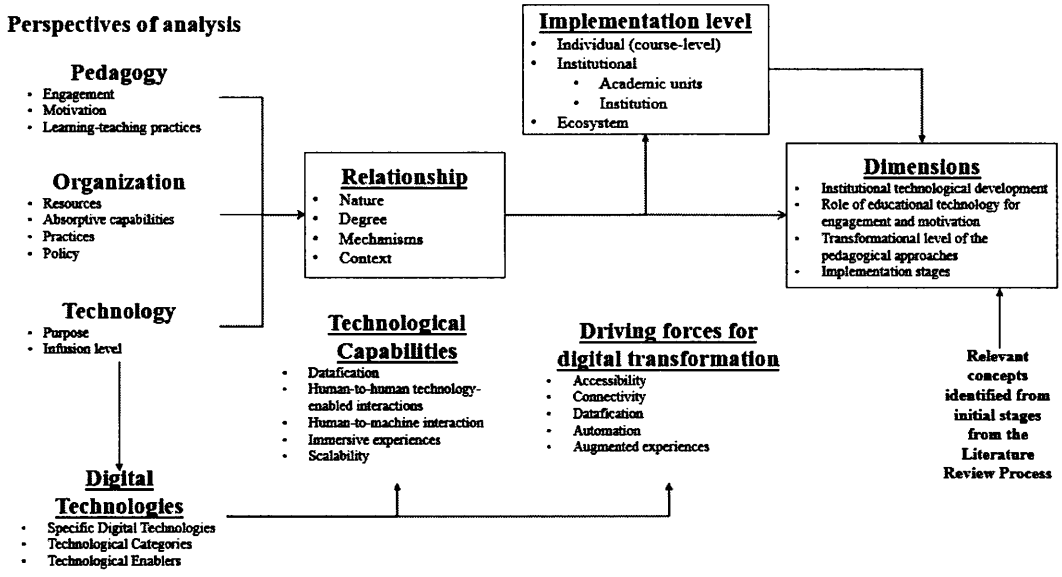


**Figure 2.5** – Conceptual model for explaining the transformational potential of blended learning in higher education

This integrative framework may provide a broader perspective of blended learning as a phenomenon of study. This multidimensional perspective may provide a common ground for 1) identifying new research and practical problems; 2) challenging some existing assumptions about the relationship between pedagogy, technology and the organization; and 3) providing a bridge for researchers and practitioners to collaborate to maximize the understanding of the constraints and impacts of blended learning implementations. Despite the conceptual model presents the ecosystem level of implementation, this framework focus on both, individual (i.e., classroom level) and institutional levels.

**Figure 2.6** presents, in a radar diagram, the ensemble of these dimensions and hypothetical scenarios for two institutions to provide an example of potential

trajectories of digitalization. Each of these dimensions is operationalized in three levels that describe the stages or the transformation degree that an institution can achieve when adopting educational technologies and aligning them with pedagogical and organizational practices. The framework proposed possesses two main functions. First, it may help to map the current status of the trajectory of digitalization in an institution. This information can be used as: 1) a static tool for analyzing and proposing a future strategy of implementation; and 2) as a dynamic tool when providing information of multiple assessment during the time to observe the evolution of the process. Second, it may also be used as a tool for comparing the level of transformation between higher education institutions. Mapping these trajectories of digitalization could provide essential elements for further research about beneficial conditions for successful implementations of blended learning from a broader perspective.

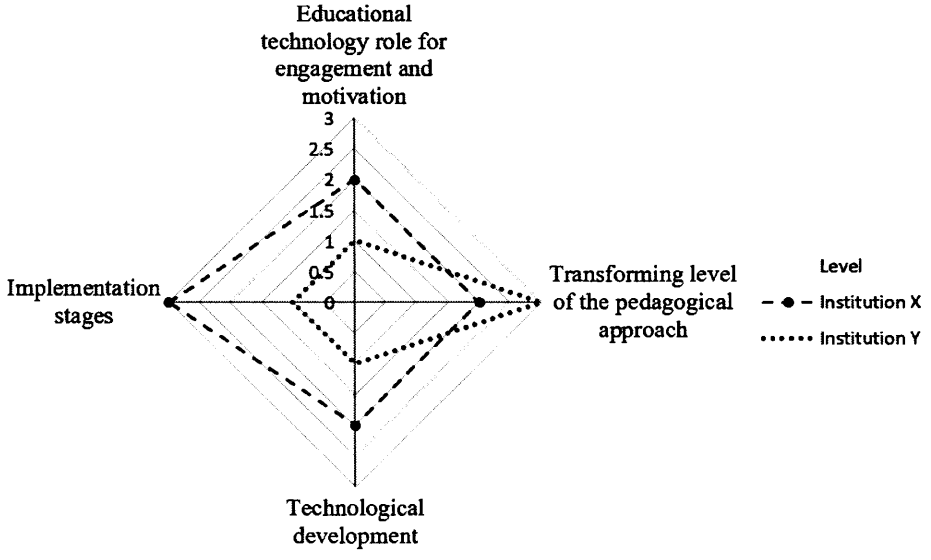


**Figure 2.6** - Framework for mapping and measuring the transformational level of digital technologies.

The framework presented here provide an integrated vision of multiple dimensions that may be aligned to produce transformations in any of the levels of implementations analyzed. From a course-level example, Li & Chen (2009) discuss the need for alignment between learner's diversity and pedagogical practices through a adaptive coursework system. This alignment, as Hutchings & Quinney (2015) propose should go further when "adopting disruptive pedagogies and enabling technologies associated with 'flipping the classroom' for transformative learning" for institutional levels. Institutional strategies may consider a clear understanding of the relationship pedagogy-technology-organization in order to reduce the risks associated with implementations of innovative technologies. On the other hand, despite there is no significative improvement in academic results in the two courses analyzed, Xu (2010) reports higher levels of engagement when using digital technologies to provide personalized feedback. Although, current technologies offer functionalities for providing feedback, the convergence of multiples devices and software may transform this pedagogical practice and improve the way of interaction between students and instructors. This improvement would be transformative to the course level if it is aligned with the institutional strategy to facilitate the process and minimize the effort of the instructor. Plenty other cases may also provide some implicit discussion in literature regarding the alignment of multiple aspects when implementing blended learning in higher education institutions. We argue that this discussion should be explicit and a priority for most blended learning implementations and in general for technology adoption for educational purposes.

## 2.4 Discussion

The aim of this *theoretical literature review* was to propose a framework for explaining the transformational potential of blended learning in higher education. By coding and analyzing the selected literature that comprise 1,017 abstracts and 37 journal articles,

we intend to : 1) portray the digital educational technologies reported in the selected sources; 2) analyze the current practices and contexts of use of these technologies; and 3) identify what dimensions are proposed for mapping and measuring the trajectory of digital technologies in higher education institutions.

We identified an emerging consensus in current academic literature that technology represents an enabler for both organizational and social transformations (Christensen *et al.*, 2009; Eggers & Macmillan, 2013). However, despite certainty in the need for deep transformations, there is not yet any consensus on the patterns of change. The complexity and dynamics of the education system requires a permanent and more refine research process to unlock the multiple perspectives and relationships involved (e.g., social, pedagogical, technological, organizational, political) Fisher & Newton (2014, p. 919). These demand for higher education comes not only in numbers, but also in diversity.

Current technological development may provide sophisticated tools for educational purposes to attend that demands and diversity, nevertheless the reason for using them and how they are incorporated in the classroom should be a main concern. The alignment of tools functionalities and technological capabilities required clear institutional strategies and higher levels of expertise in teachers and instructors' support in both pedagogical and technological aspects. As we stated before, some driving force for digital transformation have been in place for a long time, and with each new age or generation of technologies may offer others (e.g., augmented experiences). This driving forces and the associated technological enablers should not considered as isolated elements (Berger, 2015), instead as an amalgam of forces existing in digital technologies at different levels of development or maturity. This level of maturity should be the main aspect to considered in the alignment with the other dimensions explained in this study.

For example, standard implementations of learning management systems (LMS; e.g., Moodle) present high levels of accessibility and connectivity as core elements in the bulk of digital educational technologies. However, datafication and automation are still poorly developed for this LMS in standard implementations. On the other hand, tools such as adaptive learning platforms, including intelligent tutoring systems (Khawaja *et al.*, 2013), virtual companion systems (Hsieh & Wu, 2013), and recommender systems (Hoic-Bozic *et al.*, 2016), present high levels of accessibility, datafication, and automation. These kinds of tools typically work as isolated platforms, thus providing lower levels of connectivity as they are not integrated into the entire value chain of the educational process.

Technological change is currently creating profound transformations in higher education systems, largely through the emergence and rapid improvement of digital-based educational business models that create competitive pressures for incumbent universities (Kamenetz, 2010). Currently available technologies may allow universities to transform their organizational processes and enhance learning-teaching activities (Graham, Charles R. *et al.*, 2013). Examples of these technologies include: the Internet, mobile computing (Wang, M. *et al.*, 2009), multi-sided platforms (Tiwana, 2014), cloud computing, and intelligent algorithms with all their applications for adaptive learning platforms (Ogan *et al.*, 2009). However, despite this technological development, we argue that it is not enough to disrupt higher education. Complexity in educational contexts and the existence of a variety of scenarios for implementations at both the course and institutional levels may affect transformations. Adner & Kapoor (2010) argue that transformations may take a long time if organizational strategies do not consider the specific ecosystems that could accelerate or inhibit the transformation process. We agree with these authors that the development of an ecosystem perspective of digital transformations will help to adequately align technologies, strategies, capabilities, roles, and public policies.

Our hypothesis was that, while moving to automation, the transformative level of digital technologies will change. We assumed that technologies that deployed automation and artificial intelligence solutions, would produce higher degrees of transformative changes in terms of digitalization outcomes. However, we could not find sufficient support for this initial hypothesis. We noted that the transformative level of technologies and their sustainable or radical impacts on the teaching-learning experience have only been studied in very specific contexts and applications. Therefore, cross comparisons between large categories of digital technologies of driving forces remain to be studied further. Additionally, by carefully comparing the impact of a specific technology from one context and implementation to another, we noted that the outcomes could vary considerably. The same technological solution may be sustainable in one context and highly transformative in another (El-Ghareeb & Riad, 2011). We concur with Selwyn (2011, p. 59) who stated that the nature of education is complex and educational transformations require the analysis of other perspectives, particularly in terms of social contexts and real-world problems, such as educational quality and educational inequalities, that are still waiting for solutions. Technology adoption requires this alignment in order to disrupt learning experiences at all levels, from the course-level experiences to the institutional and the overall higher education ecosystem. However, further research is required to detail this operationalization and uncover these conditions.

## 2.5 Limitations, contributions, and implications

### 2.5.1 Limitations

First, we identified the limitations of this study with regard to the study selection. After analyzing 1,017 abstracts in the first stage, we selected only peer-reviewed scientific journal articles, written in English, that explicitly discussed blended learning as a

technology-enabled, innovative learning-teaching experience (as presented in Table 2.2). This study selection process resulted in 37 articles for the analysis, thus limiting the generalizability of the reported results.

### 2.5.2 Implications and recommendations for future research

Future work should focus on: 1) identifying potential mechanisms for quantifying each dimension of the framework; 2) empirically validating this framework; and 3) using the proposed framework for measuring the transformative level of digital technologies in blended learning to analyze and compare blended learning and e-learning implementations. Researchers may also focus on providing more detailed accounts of who is really motivating blended learning innovations and in what conditions and contexts. Other types of knowledge synthesis types such as realist reviews may provide required elements for generalizability when analyze and evaluate those conditions or contexts from high quality primary empirical works. These accounts could provide complementary insights about the transformation process. In particular, they may shed light on the power and influence of academic units with respect to technological policies. Additionally, with respect to the implementation contexts, using alternative approaches for synthesizing knowledge may provide the required elements "to unpack the mechanisms of how complex interventions work (or why they fail) in particular contexts or settings" (Paré *et al.*, 2015). Finally, the findings of this study showed some patterns about technology capabilities in educational digital technologies. Future work should focus on uncovering these patterns and analyzing them as a complementary aspect of the technological dimension when evaluating blended implementations in higher education.

### 2.5.3 Implications for practice and policy

The information presented in this study is important for: creating a comprehensive portrait of current digital technologies and educational practices; identifying patterns and trends in the development of the relationship between technologies and educational practices; and enabling further comparative studies. Practitioners should focus on using this information, and the proposed typology and framework to: 1) map their current technological environment; and 2) measure the transformative level of their particular technological environment. These activities may provide higher education institutions with the required elements to develop institutional strategies and policies, improve their learning-teaching processes, and properly align all dimensions of the proposed framework for successful implementations of blended learning. As a result, institutional processes may respond more effectively to particular course-level contexts.

Policy-makers may improve their technology strategy using this framework as a reference to get a better understanding about the dimensions identified in blended learning implementations. Institutions can also use this framework for mapping and evaluating technology strategies in face-to-face and online learning approaches. It may provide them with an integrated tool for prioritizing and aligning investments and efforts in future technology-based implementations.

## 2.6 Conclusions

Blended learning, as a technology-enable learning approach, may align pedagogy and educational technology for improving learning-teaching processes and, in some cases, reduce operational costs for universities (Christensen & Eyring, 2011). This study presents a portrait of digital technologies deployed in blended learning implementations and a multidimensional framework for measuring the transformative

level of the technological change presented in these implementations. The dimensions identified in the selected literature include: 1) the role of educational technologies for students' and instructors' engagement and motivation; 2) the transformative level of technologies with respect to pedagogical approach; 3) the level of institutional technological development; and 4) the stages of blended learning implementations in higher education institutions.

By analyzing and interpreting previous literature, we concluded that the technological aspect of blended learning implementations is not enough to disrupt learning-teaching practices. Based on our findings and analysis, we argue that blended learning implementations are a multidimensional phenomenon. These complex implementations may require the permanent identification of the potential dimensions involved in the process and the alignment of their components among these dimensions. Radical or disruptive transformations may be present in all levels of implementations (i.e., individual (classroom level), academic units, institutional, ecosystem). However, these potential transformations also require cultural and strategic changes at social levels to ensure satisfactory adoption and diffusion of blended learning in the higher education ecosystem (Hutchings & Quinney, 2015). Further research is required to refine this framework and operationalize the quantification of the dimensions of blended learning.

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CHAPTER III

# BLENDED LEARNING IN HIGHER EDUCATION: TRENDS AND CAPABILITIES

**Blended learning in higher education: trends and capabilities.** Based on the post-peer-review, pre-copyedit version of an article published in **Education and Information Technologies**. The final authenticated version is available online at:
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## Abstract

Education is a complex system that requires multiple perspectives and levels of analysis to understand its contexts, dynamics, and actors' interactions, particularly concerning technological innovations. This paper aims to identify some of the most promising trends in blended learning implementations in higher education, the capabilities provided by the technology (e.g., datafication), and the contexts of use of these capabilities. This narrative literature review selected and analyzed forty-eight peer-reviewed journal articles. The findings highlight some common capabilities among digital educational technologies. In particular, digital tools or platforms with human-to-machine interaction capabilities may enhance automated processes for

blended learning delivery modes. In this context, digital technologies such as video capsules and intelligent tutoring systems may improve learning-teaching activities. First, by providing access to more students and facilitating self-paced online learning activities. Second, by offering an individual path of learning for each student, thus improving out-of-class activities and feedback. Educational technology capabilities (ETC) provide complementary insights to identify the best approach when aligning learning goals in technology-based implementations. Further research will be required to empirically validate these results.

**Keywords:** Blended learning, capabilities, digital educational technology, higher education, narrative literature review, trends.

## 3.1 Introduction

The United Nations Educational, Scientific and Cultural Organization (UNESCO) has identified *education* as a main societal priority, while acknowledging serious problems still not solved, especially in developing countries. This organization relates the access to quality education to highly positive impacts in terms of income distribution and human prosperity. UNESCO proclaimed three principles within the framework *Education 2030.* The first principle restates *education* as a fundamental human right, as well as an enabling one. The second principle reaffirms education as a public good. Finally, the third principle prioritizes gender equality and inclusion in education as a global initiative for future years (UNESCO, 2016). Despite all efforts, many societies and education systems have failed in achieving UNESCO's principles.

Currently, worldwide demand for higher education is increasing despite frequent critiques related to high costs, accessibility barriers, dropout rates, and the quality of courses (OECD, 2014, pp. 46-47). Furthermore, educational institutions often face

challenges related to the overall relevance of their programs to graduates' continuing education or post-graduate employment (Christensen *et al.*, 2011); and to the actual educational credentials in the higher education system (Collins, 2011). Some of these challenges include: improving multicultural integration, reducing dropout rates, facilitating fluid transitions from educational programs to first jobs, and implementing flexible and relevant lifelong learning processes. To confront these challenges, Redecker et al. (2013) as cited in Scott (2015), suggest that institutions require innovative structural transformations. However, these challenges must first be investigated through broader, multidisciplinary, multi-level research that addresses the social, pedagogical, economic, demographic, and financial aspects of education (Geels, 2005).

In this context, technology is promoted as an effective solution for reducing inequality in education (S. Graham, 2002, as cited in Selwyn, 2011, p. 97). Graham, S. (2002) identified three ways in which people see technology as a facilitator of inclusion and equality in education: 1) increasing the diversity of mechanisms and modes in education; 2) decreasing barriers to education as a democratization mechanism; and 3) enhancing individual control over one's own education in terms of content, delivery mode, and pace of learning. These promises have not yet been fulfilled despite massive investments in content production and educational technologies such as Open Educational Resources (OERs) and Massive Open Online Courses (MOOCs). These technological solutions as the only transformative elements in the education system are not enough. Social, economic, political, and cultural contexts also represent both barriers and enablers for these transformations. In this regard, approaches such as blended learning may provide alternative opportunities for higher education institutions to deal with these challenges and respond to external pressures to effectively deploy technological innovations in the classroom.

Blended learning considers content and instructional delivery methods as key elements for providing better learning experiences (Garrison & Kanuka, 2004). These methods comprise face-to-face classroom instruction with online digital learning with appropriate integration and balance. (Graham, C. R., 2006). Programs in this modality are increasingly being adopted in higher education institutions and are clear examples of technological, pedagogical, and organizational innovation in universities. By 2007, almost 50% of four-year institutions in the U.S. offered courses in blended learning (Parsad et al, 2008, as cited in Arbaugh, 2014). This rapid diffusion of blended learning has led to considerable research about its impact on learning performance, student outcomes (Torrisi-Steele & Drew, 2013), and teaching pedagogy (Gerbic, 2011). This impact will depend on how universities manage change with respect to the implementation of blended learning initiatives, as well as how they continue to support these systems once implemented.

Blended learning lacks a precise definition which often hinders analyses of its implementations and comparisons between implementation outcomes (Picciano, 2009; Tshabalala *et al.*, 2014). In one recent attempt to overcome this problem, Fernandes *et al.* (2016) provided a more refined definition which is the selected definition for this research. They state that blended learning integrates the use of learning theories and teaching practices in a "flexible, multimodal and multi-linear redesign", whereby multi-linear learning refers to self-paced and individualized learning processes. We extend this definition arguing that blended learning is a technology-enabled learning approach that combines online and face-to-face delivery modes, learning theories and pedagogical practices embedded in a dynamic multi-level (i.e., classroom, institutional, ecosystem) and multi-dimensional context of implementation (i.e., pedagogical, technological, organizational, and individual aspects of performance).

The literature shows technology as a complex element operating in a varied set of educational settings. In this scenario, it is not the technology, but instead how it is used that drives the transformational process in blended learning implementations. Furthermore, information (as a key element in innovation adoption and diffusion processes) is required throughout the entire innovation process, firstly to identify the need for innovation, and secondly to evaluate implementation outcomes (Rogers, 2003). According to Selwyn (2011, p. 164), one of the biggest challenges in implementing new technologies is the difficulty of measuring their impact on the educational system. In most cases, these implementations show a pattern of inconsistency in the use of technology. As a result, the effects and outcomes of implementing technologies in educational contexts are uncontrolled and not predictable (Laumakis *et al.*, 2009). Additionally, Fagerberg *et al.* (2009) assert that individual and organizational learning processes are historically path-dependent, which constrains how new blended learning implementations can be deployed.

Research about technological transformations often involves performing analyses of future technological trends and their impact, which typically involve different periods of time to develop a potential impact analysis (Selwyn, 2011, pp. 166-167). The short- and medium-term concern a detailed state-of-the-art description, while the long-term corresponds more to speculative forecasting. In education, this type of analysis involves groups of learners in classrooms and institutions, as well as the entire educational ecosystem.

Currently, digital technology applications in higher education are numerous and varied, but their impact on education is uneven. Academic and practitioner research presents these applications from different perspectives, trends, and levels of analysis. These analyses focus mainly on evaluating learner outcomes; analyzing students' and faculty members' dispositions and preferences; comparing implementations from different

delivery methods; and general interaction among students and instructors (Halverson, L. R. *et al.*, 2014). However, little research on blended learning implementations in higher education has focused on: 1) identifying research trends from a multiple-perspective approach and 2) challenging main assumptions about capabilities of educational technology with regard to its transformational potential. Most blended learning literature focuses its attention on specific digital tools or platforms rather than on distinctive capabilities that technology may offer for a smoother alignment with pedagogy. This paper aims to identify trends in literature about blended learning implementations in higher education, the capabilities provided by the technology, and the contexts of use of these capabilities. To achieve these goals, the author chose the following research questions:

1. What are the emerging trends in blended learning implementations in higher education?
2. What are the current capabilities in the educational technology used in these blended learning implementations in higher education?
3. How are these educational technology capabilities used in blended learning implementations in higher education?

These questions highlight digital technology as an enabler for improving or transforming learning activities. In particular, this research focuses its attention on the concept of educational technology capability to provide a tool for analyzing and comparing digital technology implementations.

This paper is divided into seven sections: The first section presents concepts related to educational technologies, their capabilities, and their use in blended learning implementations. The second section presents the conceptual framework and research questions. It is followed by sections dealing with the research method and the finding and results. Finally, the paper presents a discussion section, some policy implications

for the educational sector, conclusions, limitations of the current analysis, and suggestions for future research work.

## 3.2 Conceptual framework

Technology dynamics, as a complex process, requires a broader conceptual framework for its analysis (Geels, 2005, 2011). This study uses Geels' multi-level perspective on sustainability transitions to guide the understanding of technology adoption, diffusion, and educational practice transformations in different levels of the higher education system. This framework allows describing the transitions of the novelty diffusion between levels of a socio-technological system in order to identify patterns and trends in the technological development process analyzed in literature.

The author also bases his analysis on the three main elements discussed by Christensen (1997). These elements include: 1) the technological enabler, which normally refers to sophisticated technologies that allow for the simplification and automation of organizational processes; 2) the business model innovation, which may allow for an organization to deliver services to customers in ways more suitable to their needs; and 3) the value network, which is the commercial infrastructure network or ecosystem built by an organization or set of organizations. These elements may allow higher education organizations to understand the transformation dynamics related to technology-based innovations from an institutional perspective.

All the elements mentioned before include a coordinated effort to understand and align strategies, capabilities, and roles for each player in higher education institutions. In this context, organizational transformations require not only technological enablers, but also organizational enablers (Christensen, 1997) in order to deploy their transformational potential. Thus, transformations may fail or take a long time if

organizational strategies do not take account of the entire industry ecosystem (Adner & Kapoor, 2010; Christensen *et al.*, 2009; Koza & Lewin, 1998).

## 3.3 Method

The author structured this research using a literature-based approach to concept development (Branch & Rocchi, 2015). In the first phase, the author performed a purposive and iterative search to identify the most relevant articles in the social, organizational, technological, and pedagogical literature. **Table 3.1** presents the list of keywords and search terms that were used for identifying the initial search of relevant studies using the search engines ERIC, EBSCO, SCOPUS and Web of Science. Based on the final set of articles selected in chapter II, this study started looking for descriptions of digital technologies, their characteristics and functionalities. Some of these studies were excluded when no explicit information about characteristics, functionalities, or potential abilities of these technologies. The author performed a backward search process to identify complementary sources and finally identify a set of fifty-four studies for further analysis.

**Table 3.1** - Keywords and search terms

| Categories | Keywords and search terms |
|---|---|
| Blended learning | "Blended learning", "blended education", "hybrid learning", "mixed-mode instruction". |
| + Higher education | "Higher education", university*, college. |
| + Innovation adoption and diffusion | Adopt*, barrier*, challenge, change*, diffusion, disruption, driver, factor, impact*, improvement, innovation, innovativeness, invention, pattern, radical, redefining, reinvention, restructuring, sustainable, transform*. |

(* indicates to the database to search/retrieve the string with any ending)

The list of selected articles for this study is presented in **Appendix C**. Two technological tools were selected for managing the research data: EndNote for

organizing literature references and ATLAS.ti for handling data from the qualitative analysis. The author applied a qualitative content approach to analyze and synthesize the data collected for each perspective.

First iterations provided the authors with valuable information about themes related to potential trends, digital technology characteristics (i.e., user control, compressibility, etc.) and functionalities (i.e., e-mailing, printing, assessment, etc.). The information about characteristics and functionalities was analyzed and classified into some groups with the potential for providing distinctive capabilities of these technologies such as scalability, interaction, and data analysis. During latest iterations of the coding and note-taking process, the author: 1) refined the list of capabilities and usage contexts reported in literature; 2) structured the findings and results in two subsections: trends in educational technologies and educational technology capabilities; 3) These findings allowed the author to provide a more precise definition of the concept of *educational technology capability* and served as the basis for the discussion and conclusions; 4) elaborated a conceptual map relating the concepts of digital technology characteristics, tools or platforms functionalities, and educational technology capabilities. In particular, for highlighting the findings about these capabilities and its potential for enabling learning purposes.

## 3.4 Findings and results

### 3.4.1 Research trends in selected literature about digital technologies in blended learning for higher education

This paper uses the terms *trends* to describe certain patterns, paths, trajectories, or orientations that technologies or related aspects may follow. These trends describe various approaches and purposes in selected literature that relate to: strategic responses of education institutions to technological challenges; pedagogical frameworks or

practices in classroom contexts; research trends in the sociology of education and technology; and classifications of educational technologies. This study uses the varied and heterogeneous set of trends to identify common characteristics in digital technologies producing capabilities when used in educational contexts. These capabilities may provide some criteria to describe the transformational potential of these digital technologies. This multiple-perspective analysis provides insight into educational technology capabilities at different levels of analysis and into how these capabilities are used in educational contexts. **Table 3.2** summarizes findings from this section.

**Table 3.2 - Identified research trends in selected literature**

| **Research trends from a social perspective (Section 3.1.1)** | **Research trends from an organizational perspective (Section 3.1.2)** | **Research trends from a technological perspective (Section 3.1.3)** | **Research trends from a pedagogical perspective (Section 3.1.4)** |
|---|---|---|---|
| - Reconfiguration of space, time, and responsibility<br>- Individualization of education<br>- Educational inequalities Educational contexts | - Adoption and diffusion of innovations<br>- Unbundle global academic programs and curriculum for local institutions<br>- New alliances and changes in the credential system<br>- Lifelong learning<br>- Bring your own device (BYOD) | - Learning Management Systems (LMSs)<br>- Learning Space<br>- Textbook vs. OER<br>- Device ownership & Mobile first<br>- Adaptive Learning Technology<br>- Learning Analytics<br>- Flexible Infrastructure | - Student-centered approaches<br>- Active learning<br>- Personalized learning<br>- Peer collaborative learning<br>- Flipped classrooms<br>- Communities of inquiry |
| **Authors** (Examples) | | | |
| (Selwyn & Facer, 2014)<br>(Crawford, N. & McKenzie, 2011) | (Graham, Charles R. *et al.*, 2013)<br>(Torrisi-Steele & Drew, 2013)<br>(Adner & Kapoor, 2010)<br>(Brett, 2011)<br>(Collins, 2011) | (Siemens, 2013)<br>(Chang & Liu, 2013) | (Hoic-Bozic *et al.*, 2016)<br>(Ginns & Ellis, 2009)<br>(Garrison & Arbaugh, 2007) |

#### 3.4.1.1 Research trends from a social perspective

General societal aspects, including educational principles, economic policies, and cultural values, are main elements of the sociotechnical landscape analysis (Geels, 2005). Some of these aspects are also considered trends in research in the emerging field of the sociology of education and technology. Selwyn & Facer (2014) identified and classified most of these elements and their related problems in four main trends: 1) the reconfiguration of space, time, and responsibility; 2) the individualization of education; 3) the study of educational inequalities; and 4) the educational contexts where technology is used.

The first trend relates to the human-to-human technology-mediated interactions among actors in the educational system regarding aspects of space, time, and responsibility. The second trajectory relates to the individualization of education. In these trends, capabilities such as datafication, human-to-machine interactions, and personalization may provide the required technological support to assure specific and individualized paths for each student. The third and fourth trends relate to the study of educational inequalities and the educational contexts where technology is used. Articles related to these trends analyze technologies with respect to educational access describing social principles such as the democratization of education; and uncovering structural societal problems. Technologies identified in these trends may provide capabilities, such as scalability, that higher education institutions cannot provide using existing resources. However, these technologies have not produced the expected results in terms of quality, appropriateness, and acceptance in higher education institutions, despite their accelerated development.

#### 3.4.1.2 Research trends from an organizational perspective

Most organizational approaches to blended learning are concerned with technological innovations, institutional practices, inter-institutional interactions, and the impact of technological policies (Garrison & Kanuka, 2004). Research in blended learning as an organizational innovation enabled by technological development focuses on two main streams. The first stream comprises studies using theoretical frameworks related to the adoption and diffusion of technological innovations. The second stream reports technology implementations at institutional levels, particularly strategic responses to technological challenges. These studies show different analyses of the challenges, barriers, benefits, and drivers behind the adoption of blended learning innovations. As Torrisi-Steele & Drew (2013) have stated, innovations may require more than simply embedding technology into current teaching and learning practices. The literature shows the following as the most promising trends: unbundling academic programs and curriculums in local institutions (Kleß & Pfeiffer, 2013); and implementing strategies to respond to the accelerated and diverse change in technologies, such as bring your own device (BYOD) (Brett, 2011).

Higher education institutions struggle with constraints to produce or access content for specialized courses in a cost-effective way. These limitations provide the basis for the development of the *unbundling academic programs and curriculums* trajectory. Although technologies and resources such as MOOC platforms, open educational resources, and commercial digital content provide the necessary functionalities to enable this trajectory, real-world implementations must still contend with many organizational and policy challenges. Digital platforms, as currently implemented, may not be real competitors in the higher education system, especially in the face of well-established non-profit institutions. However, the convergence of all these aspects in strong platforms may create a complementary relationship for credential-granting

among educational institutions, multi-sided platforms (e.g., Coursera and edX), and digital content publishers (e.g., Pearson Education). In this scenario, courses from universities and MOOC platforms may facilitate the unbundling of university-level academic curriculums. However, there is still a low institutional acceptance of these new solutions when it comes to granting academic credits (Collins, 2011).

On the other hand, the use of smartphones and tablets is rapidly growing as students are bringing these personal devices to classrooms and campuses. These devices are opening pathways for trends such as BYOD (Brett, 2011). This modality brings new challenges for institutions due to the diverse spectrum of technologies not considered or supported in their strategies regarding technical support and staff knowledge. Despite the diversity of these trends, this analysis identified some common educational technology capabilities comprising the interactions between learners and instructors with digital devices and platforms, the ability to provide specific and individualized content to multiple learners, and the ability to offer these services on a larger scale.

#### 3.4.1.3 Research trends from a technological perspective

Numerous articles describe technologies that are likely to impact the education ecosystem in the short- and medium-term. These descriptions usually lead to classifications regarding technological purposes or main functionalities. The literature analyzed shows a set of research trends in digital technologies about blended learning in higher education implementations such as: next generation of learning management systems (Yang *et al.*, 2014), adaptive textbook and OER (El-Ghareeb & Riad, 2011), learning analytics (Siemens, 2013), adaptive learning technology (Foshee *et al.*, 2016), digital devices ownership and mobile learning (Brett, 2011), and learning spaces (Chang & Liu, 2013). Complementary to these trends, findings also state the need for flexible and integrated technological infrastructures as major components for allowing interoperability.

On the one hand, most technology-based educational initiative, typically, do not use the full potential of the implemented technologies. Most e-learning and blended learning implementations use learning management systems (LMSs) solely as teaching management or content delivery tools without any true pedagogical transformation of courses (Woods, Baker, and Hopper, 2004, as cited in Torrisi-Steele & Drew, 2013). Nevertheless, due to their high level of adoption in academic institutions, these platforms may play an important role extending their capabilities and moving toward the next generation of learning management systems. The next step in online content delivery continues with MOOCs. This technological development is presented as creating a shift from local institutional platforms to a global-scale development, and thus, according to their promoters, toward a more democratic access to quality education. However, to date, MOOCs have not achieved their desired impact.

On the other hand, interactive and scalable online textbooks and OERs extend LMS and MOOC capabilities to provide better educational content. These technologies, by exploiting educational data analysis, may improve learning-teaching processes. Siemens (2013) defines learning analytics as the:

> "measurement, collection, analysis, and reporting of data about learners and their context, for the purposes of understanding and optimizing learning and the environments in which it occurs."

These technologies and capabilities may provide better assessment and feedback processes, and also serve as the basis for personalization using automated tutoring systems.

Mobile computing devices offer a new convergence point for digital technologies in hardware and software. These robust devices have the capacity to run most personal

computer software. Their reliable operating systems offer a set of sophisticated functionalities and an open platform for application development, thus constantly improving their personalization capabilities. These devices are also facilitating access to existing systems or platforms, including LMSs and MOOCs. Furthermore, in conjunction with immersive technologies, such as virtual reality (VR) and augmented reality (AR), they provide the capability to create new learning spaces. Traditionally, classrooms, laboratories, and learning commons provided the required environment for learning-teaching processes; however, digital technologies are transforming other physical spaces, such as museums, into learning spaces (Chang & Liu, 2013). Finally, the lack of integration, interoperability, and convergence characteristics in systems and platforms are also reported as barriers to technological innovations. In this context, further successful blended learning implementations require a flexible and robust technological infrastructure to support them. In particular, for higher levels of institutionalized adoption (Graham, Charles R. *et al.*, 2013).

#### 3.4.1.4 Research trends from a pedagogical perspective

Instructors, teachers, and institutions incorporated available learning theories and technologies into the learning process and were met with clear indications of learning improvement, but not disruptive transformations. Most trends identified in articles from a pedagogical perspective comprise frameworks, models, and practices at individual and group levels such as student-centered approaches, active learning, personalized learning, peer collaborative learning, flipped classrooms, and communities of inquiry.

Practices at the individual level include learning differentiation and personalization, multiple intelligence types, learning styles, self-paced learning, and synchronous and asynchronous learning activities (Foshee *et al.*, 2016). Practices at the group level include cognitive, teaching and social presence as core elements of the *communities of*

*inquiry* (Shea & Bidjerano, 2010). In these communities, according to Garrison & Arbaugh (2007), a group of learners engage in collaborative work, creating an adequate space for meaningful learning experiences. Among these approaches, *personalization, learner-centered,* and *enhancing learners' motivation and engagement* seem to be the *most promising* for implementing technology in educational contexts. McLoughlin & Lee (2008) argue that the principles of *personalization, participation,* and *productivity* are the basis for instruction in the twenty-first century. Personalization as a solution to a standardized and mass-oriented education system is attracting the attention of commercial and open-initiative digital technology producers. This approach bases its development in digital technologies such as *Learning Analytics* and *Big Data*, digital content delivery, adaptive learning platforms, and mobile computing. The convergence of these technological approaches facilitates the development of more complex and flexible learning tools.

Other approaches intend to improve learning outcomes and motivation, as well as the successful transfer of knowledge within the learning process. Particularly in terms of digital literacy, Littlejohn *et al.* (2012) contend that some technology promoting peer learning activities has a positive effect on learners' engagement and motivation. However, teachers' skills not only in virtual class sessions, but also in in physical classrooms may enhance or undermine learners' *motivation and engagement.* Therefore, it is important to explore the entire educational system and its components to better understand the barriers to, and drivers of, learners' motivation and engagement. This understanding is an essential prerequisite to the incorporation of new technologies as potential solutions in the learning-teaching process.

Finally, despite these collaborative and supportive social contexts, digital technologies also provide individualized and personalized practices. These practices may also offer the educational constructivist model the tools required to prioritize the learner as the

center of the process rather than the instructor (McLoughlin & Lee, 2008). However, aligning these apparently contradictory pedagogical approaches and technologies is a major challenge for instructors when redesigning their courses.

### 3.4.2 Conceptual model of educational technology capabilities

For the purpose of this paper, the author defines digital educational technology (DET) as all digital technologies designed or used for learning and teaching activities in formal or informal educational contexts. This concept is based on previous definitions related to technology, digital technology, and educational technology. These three definitions allow the author to identify the boundaries of digital educational technologies for this study. First, technology, as defined by Lievrouw & Livingstone (2002), comprises the designed, built, and deployed artifacts or devices; the enabled practices associated with their use; and all social and institutional aspects and structures circumscribed in their use. Second, digital technology is defined as "computer-based systems" in a broad perspective including contemporary software and hardware systems with the purpose of handling digital information (Selwyn, 2011, p. 13). Finally, The author identified educational technology as all technology, digital or otherwise, designed, created, and applied to the education process (Dutton, 2013, p. 329).

Data and information-intensive processes in higher education institutions may act as potential organizational enablers for transforming existing products or services into more advanced technological products (Tiwana, 2014, p. 9). Digital technologies improve some basic characteristics of data and information, including storage, record retrieval, distribution, density and compressibility, manipulability, and user control (Sydenham & Thorn, 2005). These improved characteristics allow digital technologies to alter the way users interact with their environment, and thus these characteristics give digital technologies the possibility to offer functionalities such as convergence, integration, personalization, ubiquity, measurability, and (ideally) democratization of

access to education (Tiwana, 2014). These characteristics and functionalities may allow digital technologies such as computers, the Internet, adaptive software platforms, mobile computing, and technological platforms to become enablers for organizational transformations (Berger, 2015; Christensen *et al.*, 2009). Nevertheless, these technological enablers also require alignment with organizational enablers to be effective.

Educational technology capabilities (ETC) are defined as a set of common abilities present in different digital technologies enabling a set of learning purposes (e.g., personalization). The main assumption is that capabilities are built on a distinctive combination of technological characteristics and tool functionalities. Thus, capabilities may be present in various tools and one tool may provide multiple capabilities. This perspective may present ETCs as a tool for evaluating and comparing technology implementations and their transformational potential. **Figure 3.1** presents a conceptual model representing the relationship between digital technology characteristics, tools and platforms functionalities, and capabilities in educational technology.

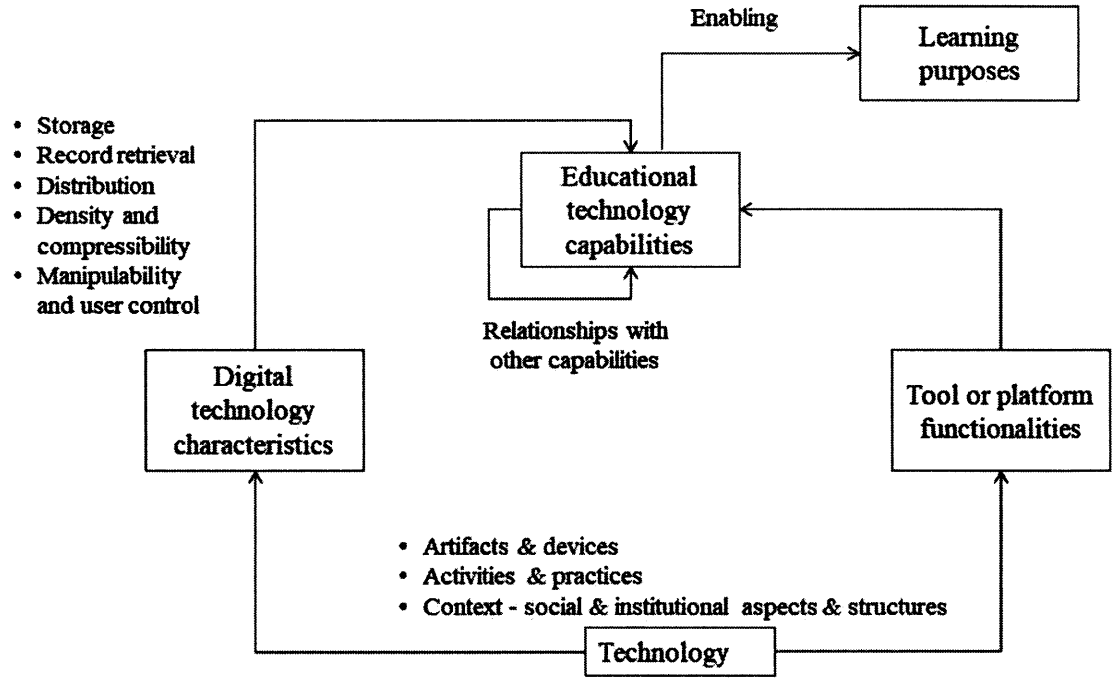


**Figure 3.1** - Conceptual model of technology capabilities

### 3.4.3 Educational technology capabilities

Based on the selected literature, the author analyzed technology from the perspectives identified in the previous section. This analysis focused on common characteristics of the technology (e.g., data collection) producing specific capabilities when used in educational contexts (**Table 3.3**). This section presents these educational technology capabilities providing a detailed explanation about how these capabilities are used in blended learning implementations for higher education contexts.

**Table 3.3** - Educational technology capabilities

| Capability | Rationale | Example of technologies |
|---|---|---|
| Datafication | Capabilities for data collection, data analysis, and data-driven design and decision processes. | Audience response systems (Masikunas *et al.*, 2007), adaptive functionalities in LMS platform (Martin & Whitmer, 2016), automated assessment and feedback systems (Nakayama, M. *et al.*, 2010). |
| Human-to-human technology-enabled interactions | Capabilities for technology-mediated human interactions, mainly with online collaborative activities, peer-review assignments, and synchronous or asynchronous communication. | LMS, web 2.0 technologies, and a recommender system (RS) (Hoic-Bozic *et al.*, 2016). |
| Human-to-machine interactions | Capabilities providing higher levels of interactivity and automation. Systems can be considered active actors in the learning-teaching process. | Intelligent tutoring systems (Khawaja *et al.*, 2013), virtual companion systems and recommender systems (Hsieh & Wu, 2013), wearable devices, and mobile technologies. |
| Immersive experience | Capabilities providing the sense of experiencing alternative simulated realities by mixing physical and digital worlds aspects for enhancing collaboration, motivation and engagement. | Digital games (Bahji *et al.*, 2015), immersive virtual simulators (Kleinert *et al.*, 2015), augmented reality, RFID, and mobile devices (Chang & Liu, 2013), virtual worlds technology (Pellas & kazanidis, 2014, 2015). |
| Scalability | Capabilities providing automated resources for attending higher demands of services in cost-effective ways. | Online adaptive tutorials (Bai & Smith, 2010), LMS (Greyling *et al.*, 2008), MOOC (Gynther, 2016), adaptive learning systems (Foshee *et al.*, 2016). |

### 3.4.3.1 Datafication

Datafication refers to the use of automated tools, technologies, and processes for data collection, analysis, and reporting to improve the design and deployment of learning-teaching activities. Findings show improvement in learning-teaching activities when aligning pedagogical approaches (e.g., student-centered or flipped classrooms) with existing student's information on educational tools. Collecting this information may take place in the classroom as well as pre-class online. When deployed, these processes (e.g., online assessment tools) offer instructors information about students' knowledge gain and difficulties. This information may be used for providing automated and instantaneous personalized assessments and out-of-class feedback (Francis & Shannon, 2013), or group in-class feedback. The process of collecting data may also be performed during in-class sessions when using online tutorials, or specific assessment

tools such as audience response systems (ARS). When using ARS, instructors may intend to assess the knowledge level of the class, and also to enhance interaction among learners (Masikunas *et al.*, 2007).

Traditional tools such as LMSs and MOOCs may also provide datafication capabilities; however, these are still immature technologies with regard to this capability. In some cases, (e.g., LMS platforms) this capability provides information for analyzing students' behavior or learning difficulties, and thus can deliver appropriate content (Martin & Whitmer, 2016). In other cases, datafication may help instructors to identify students' performance when analyzing data from multiple systems (Khawaja *et al.*, 2013), particularly for automated assessment and feedback processes (Nakayama, M. *et al.*, 2010).

Tools providing this capability use technological approaches, such as learning analytics and big data, to add value to existing practices. These approaches may provide the basis for creating customized learning paths for students either in individual or group activities. These activities may cover in-class lectures (El-Ghareeb & Riad, 2011), as well as out-of-class activities (Hsieh & Wu, 2013). Initial findings show differences in the level of detailed information and expertise when instructors use educational technologies. The patterns in these differences seem to be associated with the maturity of the implementation with regard to the instructor's expertise and the organizational level of adoption (e.g., course-level, academic department, institution).

#### 3.4.3.2 Human-to-human technology-enabled interactions

The capability of human-to-human interaction facilitates online collaborative activities, peer review, and synchronous or asynchronous communication and is one of the most studied in the literature surrounding blended learning. It relates mostly to online discussion forums, social networking systems, online conference tools, instant

messaging, chat rooms, and email tools among other technologies. Although these technologies provide space and time independence in communication and collaborative activities, no studies report substantial transformation in current practices. However, implementations integrating human-to-human, technology-enabled interactions, and other capabilities, such as datafication, with specific design considerations present some level of transformation.

Findings show that, despite initial flexible designs, a permanent iterative adjustment is required to align data-driven activities and academic students' needs analysis. For example, (Li & Chen, 2009) identified that appropriate complexity in assignments, learners' diversity, and learners' interactions design are essential elements for improving learning outcomes. In this context, a recommender system is proposed as a solution to reduce post-class assistance sessions. This system promotes peer collaboration for technical questions and answers based on automatic recommendation functionalities, thus showing improvement in completion rates for coursework assignments. Additionally, (Hoic-Bozic *et al.*, 2016) investigated the impact of technology-based collaboration and personalized knowledge sharing strategies in a computer science program. The main technological components of these problem-based learning strategies are based on LMS, web 2.0 technologies, and a recommender system. This system comprises several recommendation options, including: optional learning activities, peer-collaborative assignments, suitable web 2.0 tools, and individual or group advice. These authors reported on the effectiveness of the implementation, student satisfaction, and also on improvements in learning outcomes. Additionally, they reported no increase in teaching loads due to these iterative planning and execution activities. These activities were designed and performed in a small class context; nevertheless, as they assert, they can be extended to large classes with some changes in the type of activities and the number of group participants.

Finally, complexity in face-to-face human interactions is also present in online environments. The author identified a few studies analyzing negative effects in this technology-enabled learner-to-learner interaction. (Dursun & Akbul, 2012) explored the relationship between cyberbullying behaviors and communicator styles in anonymous learner-to-learner interactions using web 2.0 technologies. Literature shows different negative elements depending of the type of technology. These authors identified a set of cyberbullying types not presented in their study, but already identified and analyzed in other studies using different technologies for interactions such as online gaming and social networking. These findings show that educational technology capabilities may also block or impede blended learning implementations when potentially troublesome issues are not considered in course designs or adjusted during the process.

#### 3.4.3.3 Human-to-machine technology-enabled interactions

Systems with human-to-machine interaction capabilities integrate characteristics such as interactivity, interoperability, automation, and technological convergence. Interactive systems and platforms with artificial intelligence functionalities offer new alternatives for tutoring activities based on intensive assessment and feedback, particularly for large courses. Technologies such as intelligent tutoring systems (Khawaja *et al.*, 2013), virtual companion systems (Hsieh & Wu, 2013), immersive virtual simulators (Kleinert *et al.*, 2015), wearable devices, and mobile technologies present clear examples of these kinds of interactions.

Learner-to-machine interactions are becoming more relevant in the scientific literature, which primarily analyzes educational automation processes. Studies in this category reported results on learning performance, knowledge gain improvement, and students' motivation. Hsieh & Wu (2013) reported learning performance improvements using virtual learning companion systems (VLCS) and also analyzed their alignment with

students' cognitive styles. Likewise, in clinical education, Kleinert *et al.* (2015) stated that immersive virtual simulators (IVS) showed positive effects in knowledge gains and motivation. However, no positive impacts on clinical decision-making processes were observed. According to Kleinert *et al.* (2015), this may be related to the number of options available in the system. They argue that a better design of the system is required to promote improvements in clinical decision-making processes and student performance. Finally, technologically mature systems offering this capability may become active actors in the learning process.

Activities that the literature reports as potential targets for automation comprise: tutoring, assessment, feedback, and content delivery. These activities provide individualized learning paths for each student. Technologies providing this capability include online adaptive content and tutorials, virtual companion systems, learning activities recommender systems, and intelligent tutoring systems. The following examples show how and in what contexts instructors are using adaptive technologies to provide personalization.

First, Khawaja *et al.* (2013) presented an adaptive tutoring system based on intensive assessment and feedback in large-size courses. Among other things, this tutorial allowed for adapting tasks, content, feedback, assessment, and remediation for each student and showed a general improvement in learning outcomes. Likewise, Bai & Smith (2010) proposed a scalable and sustainable set of digital content modules and an intent to investigate their usability. The module containing assessment activities can be delivered independently of the technological platform. They assert that this solution provides collaborative functionalities and a cost-reduction strategy for academically disadvantaged students in under-resourced communities.

Second, as Hsieh & Wu (2013) analyze, VLCSs and e-learning activities recommender systems show improvements in learning performance and, as a result, align students' cognitive styles and guidance methods. These systems may also offer specific and complementary adaptive functionalities for learning purposes. VLCSs were initially used for children's entertainment and medical assistance. Recommender systems allow for combining some pedagogical approaches such as student-centered, personalized, collaborative, and problem-based learning. (Hoic-Bozic *et al.*, 2016), in a comparative study of engineering courses using this kind of technology, analyzed the effectiveness of these approach's alignment. This implementation showed improvement in students' learning outcomes as a result of this integrative model's implementation.

Third, technological developments in LMSs' adaptive functionalities and artificial intelligence-based platforms show some improvements in scalability and quality of computer-based individualized learning processes. In terms of competency development, (Yang *et al.*, 2014), based on their experimental results, argue that contextual and adaptive instruction improves critical thinking skills and English literacy, which are two twenty-first century competencies. In this case, they analyzed some adaptive functionalities of Moodle for grouping activities, organization, and personalized content delivery and feedback based on information gathered from a pre-test. Additionally, the literature describes large-size and teacher-centered classrooms as potential candidates for higher levels of improvement when deploying technologies providing personalization (Danker, 2015), particularly when aligned with pedagogical approaches such as flipped classrooms. This kind of approach may promote individualized learning and facilitate self-paced pre-class activities (Danker, 2015), peer support, one-on-one tutoring for in-class activities (El-Ghareeb & Riad, 2011), or group tutoring in in-class activities (Kleinert *et al.*, 2015).

#### 3.4.3.4 Immersive experience

Immersive experience is a capability that provides learners with the sense of immersion by combining aspects of physical and simulated digital worlds. Peer learning and collaborative activities are the most common pedagogical approaches with respect to technologies providing this capability. Some examples of these technologies are augmented reality, virtual worlds (e.g., Second Life), and virtual reality systems. Bahji *et al.* (2015) present these technologies as enablers for enhancing engagement and motivation in the learning process and for improving students' support and competency development (Kleinert *et al.*, 2015).

Examples of these kind of implementations, particularly for virtual world technologies, describe their use in course evaluations (Ata, 2016). Other authors have analyzed: how in-class learning activities promote interaction and collaborative environments (Tapsis *et al.*, 2012); how these technologies affect students' learning behavior (Mitchell & Forer, 2010); and the effects of virtual worlds on students' achievements by measuring students' motivation (Pellas & kazanidis, 2014). In another example, creating a new learning space, Chang & Liu (2013) assessed the acceptance of a system promoting a ubiquitous learning environment and its impact on learning outcomes. By using technologies such as augmented reality, radio-frequency identification (RFID), and mobile devices, the system provides physical spaces with learning environment capabilities. According to them, learners' acceptance level of the system was high, particularly with regard to the quality of the animation and technology integration.

Actual developments in technologies related to this capability show that they are used in educational contexts as a support for traditional practices, but with low levels of maturity in their use. However, potential benefits for pedagogical practices are also described in these studies as highly transformational. Findings also show an interesting blurred boundary between informal and formal spaces for learning acquisition,

particularly when transforming physical spaces, such as museums, into interactive, immersive learning spaces.

#### 3.4.3.5 Scalability

The scalability capability may provide required automated resources for higher levels of service demand in a cost-effective manner. In educational contexts, this capability has at least two dimensions: First, providing a means to attend to different students' needs in or out of large classes in a flexible and individualized way (Khawaja *et al.*, 2013). Technology in this dimension may improve learning processes by scaling an instructor's capacity to attend to students' academic needs (e.g., intelligent tutoring systems). Second, providing a means for creating, bundling, unbundling, and deploying digital content in multiple platforms to facilitate content access and sharing activities among instructors and institutions (e.g., LMS and MOOC).

For the first dimension, Khawaja *et al.* (2013) analyzed the impact of adaptive tutoring systems on learning outcomes based on intensive assessment and feedback for large-size courses. These authors reported "less satisfactory results" in the data analyzed. They assert that elements related to activities such as cognitive load, influence final learning outcomes. These elements may be refined for particular contexts to assure appropriate levels of academic assignments (Khawaja *et al.*, 2013). On the other hand, Danker (2015) analyzed the impact of flipped classrooms and individualized learning on deep learning among students in large size and diverse classes. According to this author, flipped approaches can provide active-learning activities for small groups within a large lecture class. These approaches based on self-paced pre-class activities facilitate tutoring activities during the class.

For the second dimension, Bai & Smith (2010) provide an example with their "scalable, shareable, and sustainable e-learning modules as textbook chapters." Students and

instructors can access these modules independent of the platform. Technologies such as LMS, MOOC, and adaptive learning systems may provide this capability. Gynther (2016) presents a clear example when proposing and analyzing the use of a framework for an adaptive MOOC in blended learning contexts. This implementation responded to a requirement of the Danish government to offer a Bachelor's degree for school teachers. This framework is based on general design principles for personalized curriculum and adaptive learning design. Despite their findings showing good implementation results, these results also showed low peer support and demonstrated a need for increasing teacher presence.

Finally, findings showed some relationships between technology capabilities. For example, in some instances, datafication can be considered as a foundation to allow personalization and human-to-machine interactions. In others, personalization may not be possible without scalability. This interrelated nature requires further research to uncover the specific contexts and the level of dependence.

## 3.5 Discussion

The literature analyzes blended learning implementations mainly from two different perspectives. First, from a general perspective identifying the effects, barriers, challenges, drivers, and opportunities affecting the entire organization or system. Second, from a more specific point of view identifying how particular technological tools or platforms impact learning-teaching activities. Units of analysis relate to different levels of deployment such as classrooms, organizational implementations, or national initiatives framed by governmental policies. Each implementation comprises a large and diverse set of learning-teaching practices, instructor expertise levels, pedagogical frameworks, technological tools, and organizational and cultural values forming very complex and unique educational settings. The main contributions of this

paper are: 1) the identification of the most promising trends in blended learning implementations in higher education, 2) the identification of some capabilities provided by the technology (e.g., datafication), and 3) the analysis of the contexts of use of these capabilities.

As presented in the findings, the set of identified trends provided the author an initial insight into common educational technology capabilities present in different digital technologies. The educational technology capability concept analyzed in this study seems also suitable as a crosswise analysis tool for understanding transformation processes in a multi-level perspective. As a first step, this paper analyzed the identified technological trends in order to identify patterns about distinctive characteristics in digital educational technologies that could produce a major change in the education system. In a second step, this paper identified some usage contexts of educational technologies presented in higher education institutions related to these capabilities.

For particular digital technologies such as LMSs, extensive information exists about their successful institutional adoption. Dahlstrom *et al.* (2014) present statistics showing that 99% of higher education institutions in the U.S. are operating LMSs, where 85% of instructors use it at least once in its basic functionality, and 47% use it daily in their courses. On the one hand, Moodle (for example) can be used for different purposes depending on an instructor's expertise and needs. The basic level offers a repository of content that is available for download. An intermediate level may correspond to a more interactive communication and knowledge-sharing platform. Finally, a higher level may use adaptive functionalities of this platform. However, personalization as an educational purpose enabled by human-machine interactions capabilities in LMSs are still at lower levels when compared with more adaptive platforms such as Knewton. On the other hand, tools or platforms may present low levels of technology development. For example, when LMS platforms integrate

adaptive functionalities in basic levels of development or with very restrictive functionalities (Perišić *et al.*, 2018).

Different technologies may provide the same capability; however, such capability may present different levels of technological development in various technological tools or platforms. In the case of the human-machine interaction capability, current LMSs provide basic levels of adaptive functionalities that translate into a personalized learning path for each student. Other platforms (e.g., Knewton) use sophisticated artificial intelligence-based tools to improve the scalability and quality of computer-based individualized learning processes. Although initial commercial products were technologically insufficient to create a useful and scalable system (Selwyn, 2011, p. 71), current developments in digital educational content platforms and in adaptive learning systems may allow for the creation of integrated, individualized, and scalable learning environments.

Universities and colleges present remarkable differences in course-level content and curriculums for similar academic programs. These differences may also hinder more scalable solutions to the entire higher education system. Nevertheless, among other elements, these differences provide distinctive institutional characteristics and potential scenarios for innovations. For example, institutions present differences regarding the delivery of highly codified and stable content to first-year students and students in more advanced stages of academic programs. As Thomson (2016) proposed, eventually all first-year courses may benefit from digital technologies allowing the transformation of these courses into online-only delivery mode. These kinds of technologies with human-to-machine interaction capabilities may also provide more automated delivery processes for blended learning delivery modes. In this context, digital technologies such as video capsules and intelligent tutoring systems may improve learning-teaching activities. First, by scaling access to more students and facilitating self-paced online

learning activities. Second, by providing an individual learning path for each student, thus improving out-of-class activities (Hsieh & Wu, 2013) and feedback (Francis & Shannon, 2013).

On the other hand, these technologies may not provide appropriate solutions for advanced courses where knowledge is less stable and standardized. For these kinds of courses, digital technologies with human-to-human technology-enabled interactions capabilities, such as intelligent recommender systems, may enhance interactions among learners in collaborative learning environments. In this context, this system is proposed as a solution to reduce instructors post-class assistance sessions. This system promotes peer collaboration for technical questions and answers based on automatic recommendation functionalities (Li & Chen, 2009).

This study has defined educational technology capabilities as a set of common abilities present in different digital technologies enabling a set of learning purposes. These capabilities show different levels of maturity and these levels are characterized by two aspects. The first aspect relates to differences in the development level of the technological tools and the second aspect relates to the level of instructor expertise in using a particular technology and aligning pedagogy to potentiate the design of the learning-teaching activities. This exploratory analysis shows higher levels of transformation in pedagogical practices when technological tools or platforms show higher levels of maturity or when multiple capabilities are successfully aligned with learning goals during the implementation.

Finally, these findings may be explained by a better understanding of the alignment between technology and pedagogy, and by a reinforcing effect when several capabilities are interacting and providing more refined implementations. As a result, educational technology capabilities as a concept may provide an alternative and broad

perspective for analyzing and improving not only the level of alignment of pedagogy and technology, but also a technological investment strategy. In this scenario, various implementations with different technologies may be analyzed and compared with respect to cost-effectiveness, instructor and organizational expertise, and technological development level. However, further research is required to provide more detailed insights and validate these findings.

## 3.6 Policy implications

Different digital tools and platforms used in educational contexts may provide the same educational technology capability despite their differences in some specific functionalities. Deploying, using, and managing various tools or platforms imply an increase in economic investment, support time, and permanent training processes for students, instructors, and faculty members interested in using these tools in their learning-teaching activities. Educational technology capabilities as a conceptual tool for analyzing future technological implementations may facilitate policy makers and practitioners to prioritize institutional efforts in blended learning implementations. This conceptual tool may provide some insights about redundancy and wasteful investments in time and economic resources for acquiring and deploying digital technology in higher education institutions.

## 3.7 Conclusions

This paper attempts to identify some of the most promising trends in educational technology, in the capabilities provided by the technology (e.g., datafication), and in the contexts of use of these capabilities in blended learning implementations in higher education.

In order to answer the proposed research questions, this study analyzed the literature related to technological implementations in a higher education context, specifically for blended learning delivery. This multi-perspective analysis identified a set of existing trends that allowed the author to refine a list of capabilities that new technologies may offer in educational contexts. Educational technology capabilities, defined as a set of common abilities present in different digital technologies enabling a set of learning purposes, may provide distinctive elements for evaluating and comparing technologies and their transformational potential in course-level or institutional implementations. In the process of identifying how instructors use these capabilities, patterns about potential relationships among them were uncovered. However, this being an exploratory study, not all pertinent aspects were covered and further research will be required on these questions.

Many challenges have arisen due to the rapid development of technology in response to social demands, and the current digital transformation has created new pressures for higher education systems. The introduction of MOOCs and other digital technologies has highlighted the controversies and problems of educational systems around the world. These new technologies have created an enormous interest among universities and companies offering educational content and alternative technological solutions, allowing the rapid growth of network alliances among these actors. However, digital technologies still have not addressed several major social problems (e.g., high costs, high accessibility barriers, high dropout rates, and low course quality) related to education as envisioned by many in the academic community. There remains a gap for structural and technological solutions to create a democratic, decentralized, and personalized education system that succeeds in engaging the majority of students.

In this scenario, alternative and complementary dimensions for analyzing and evaluating technology-based implementations are required to gain better insight into

the process and its transformational potential. This analysis identified educational technology capabilities as a crosswise concept independent from specific technological tools and perspectives of analysis. This exploratory research provided a definition for a technological capability and presented a conceptual model describing the identified relationships between technologies, technological characteristics, and educational technology capabilities. Specifically, this framework intends to contribute to the analysis and evaluation of blended learning implementations in higher education, presenting educational technology capabilities as an alternative and transversal concept. By providing an alternative view of digital technologies, educational technology capabilities may help researchers and practitioners gain a better understanding of the nature of the relationship between technology, pedagogy, organization, and society in general in a multi-level perspective analysis. This alternative view moves the analysis of digital tools towards a more direct link with pedagogical objectives rather that the description of technical functionalities use in learning-teaching activities.

## 3.8 Limitations and future research directions

This exploratory research has several limitations. First, as this paper performed a purposive and iterative search, some relevant articles could not be identified and included. However, this search provided forty-eight relevant sources, thus assuring an appropriate level of comprehensiveness. Second, the multiple perspective of analysis provided a broader set of sources that enriched the search strategy; however, these heterogeneous sources made it difficult to reach conceptual saturation when searching and selecting additional literature.

Future research could explore additional trends identified in social, organizational, technological, and pedagogical perspectives for validating the findings and refining the set of educational technology capabilities identified in this paper. Researchers might

also analyze and summarize empirical studies with regard to educational technology capabilities in order to validate the propositions about capability maturity levels for the technological development and user expertise dimensions. Further research might also focus on identifying factors and barriers promoting or impeding higher capability maturity levels in blended learning implementations. Finally, a map of digital technologies based on a typology of capabilities may provide great value for practitioners and their future implementations.

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**Compliance with ethical standards**

**Competing interests:** The author declares no competing interests.

CHAPTER IV

# TRANSPARENCY IN PREVIOUS LITERATURE REVIEWS ABOUT BLENDED LEARNING IN HIGHER EDUCATION

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## 4.1 Abstract

Standalone literature reviews serve various purposes, including the: development of new theories; shaping of future research; production or dissemination of knowledge; and support of evidence-based practices. This kind of work, in some cases, raises questions about their scientific rigor, systematicity, and transparency. This descriptive review assesses transparency in previous reviews of blended learning in higher education. This assessment relates the rigorous and detailed report of methodological decisions and activities during the research process. We examined forty standalone literature reviews for their main themes and disclosure of methodological choices. The findings of this study show low levels of transparency in 73% of these reviews, most of which were classified as narrative, scoping, and theoretical reviews. The observed lack of explicitness may affect the internal and external reliability of the process and the potential utility of this work in scientific and practitioner contexts.

Keywords: blended learning, descriptive review, higher education, research methods, transparency assessment.

## 4.2 Introduction

Research using literature-based approaches is essential for multiple purposes and standalone literature reviews can be constructed in a number of different ways to meet varied needs. For example, reviews can: relate to the development of new theories (e.g., theoretical reviews); shape future research studies (e.g., scoping reviews); produce or disseminate knowledge (e.g., narrative reviews); promote scientific discussion and reflection about concepts, methods, and practices (e.g., critical reviews); or provide support of evidence-based practices (e.g., meta-analysis).

In some cases, standalone literature reviews face critiques on the soundness of their research process, in particular, with respect to their systematicity, transparency, and scientific rigor (Paré *et al.*, 2016). Paré *et al.* (2016) note two main constraints on review papers' transparency: (1) lack of clarify when discussing methodological decisions of their work; and (2) structural restrictions imposed by the publishing environment to produce detailed information about systematicity in the research process. Paré *et al.* (2016) assert that systematicity and transparency are useful and adequate for positivist and interpretivist approaches. In fact, authors of interpretivist reviews may enhance the trustworthiness of their conclusions by making their research methodologies explicit (Paré *et al.*, 2016).

On the other hand, authors such as Boell & Cecez-Kecmanovic (2015) criticize the unnecessary extension of systematic processes for all literature reviews. They support their statements by citing the positivist origins of systematicity in literature reviews, and linking these origins to a specific group of testing theory reviews (e.g., systematic

literature reviews, meta-analysis and umbrella reviews) in the medical and healthcare fields (Tong *et al.*, 2012).

Research protocols and the limitations of systematic reviews are at the center of this debate. Boell & Cecez-Kecmanovic (2015) argue that these approaches limit the originality and creativity of the research process in literature reviews. This debate requires bringing back basic aspects of the research process such as systematicity, transparency, and scientific rigor. These aspects provide the insights required to distinguish between systematic and transparent literature review processes and systematic reviews (SR) as final research products. Contrary to the arguments presented in Boell & Cecez-Kecmanovic (2015), we concur with Paré *et al.* (2016) who assert that a systematic and transparent process: 1) can be performed without losing flexibility and creativity in the review process; and 2) can contribute to a highly rigorous review.

Research about education and technology is extensive and analyzes multiple perspectives using different approaches. In particular this study focuses on blended learning. This field also presents extensive scientific research; however, the investigation of its transformational potential is still in its initial stages, in particular with regard to knowledge synthesis processes. The present study assesses review papers about blended learning in higher education as an innovative technology-enabled learning approach. This transparency assessment seeks to uncover the main themes discussed, level of transparency, and current practices in reporting methodological decisions in the selected studies.

Although Dziuban *et al.* (2018) referred to blended learning as the new normal, they noted that implementations in higher education are still struggling in some varied and complex contexts. Early definitions described blended learning as the integration of

face-to-face instruction and online learning. These definitions considered the mixture of content, media, and instructional delivery methods as the key elements for this educational approach (Garrison & Kanuka, 2004). Most definitions in the literature are variations of the continuum between these delivery methods (Dzakiria *et al.*, 2012) and these definitions often come with alternative labels such as hybrid courses, flexible learning, and mixed-mode learning.

Other authors define blended learning as a shift from teacher-content to student-experience. This shift may offer "the right balance of pedagogy and technology to the right learner in the right moment" (Oliver & Trigwell, 2005). Some authors argue that there is still no clear definition (Picciano, 2009; Tshabalala *et al.*, 2014). However, researchers continue developing more refined definitions with better insights into this phenomenon as in Fernandes *et al.* (2016). These authors stated that this approach also encompasses flexible environments in redesigned, self-paced, and individualized learning-teaching processes. Using a concept-based approach, Fernandes *et al.* (2016) extracted multiple definitions of blended learning from previous literature. Thereafter, working with experts in the field and terminologists, they analyzed these existing definitions and proposed a new, more-refined definition. for the purpose of this study, the authors define *blended learning* as a technology-enabled learning approach that combines online and face-to-face delivery modes, learning theories and pedagogical practices embedded in a dynamic multi-level (i.e., classroom, institutional, ecosystem) and multi-dimensional context of implementation (i.e., pedagogical, technological, organizational, and individual aspects of performance).

This paper is divided into the following sections: background, purpose, and research questions; research methods; findings and results; discussion; conclusions; and limitations and future work.

## 4.3 Background, purpose, and research questions

Several researchers have studied and classified literature reviews (Cooper, 1988; Paré *et al.*, 2015; Rowe, F., 2014) with respect to their fundamental goals and specific purposes. With regard to these goals, Rowe, F. (2014) grouped standalone reviews into four categories based on the type of contribution to theory: describing, understanding, theory testing, and explaining a phenomenon. Similarly, Paré *et al.* (2015) developed a typology and identified nine types of specific reviews based on their purposes: narrative, descriptive, scoping, critical, meta-analysis, qualitative systematic, umbrella, theoretical, and realist. **Table 4.1** lists these review classification systems (Rowe, F., 2014) and presents some of their generally accepted purposes and typical research questions.

**Table 4.1** Literature review typology classified by the contribution to theory.

| Contribution (Rowe, F., 2014) | Standalone review type | Generally accepted purposes | Typical research questions |
|---|---|---|---|
| Describing | Narrative review | Uncovers what has been written on a subject or topic (findings). | - What do we know about topic X or what have we learned about topic X? |
| | Descriptive review | Identifies trends and patterns in pre-existing propositions, theories, methodologies, or findings. | - Does prior research on topic X support any interpretable patterns or trends with regard to topic Y? |
| Understanding | Scoping review | Presents a general view of the scientific knowledge on a specific subject and allows for identification of gaps in the literature and potential new directions for research. | - What questions/topics/issues have been investigated in prior research on topic X?<br>- What questions/topics/issues need to be investigated in future research on topic X? |
| | Critical review | Uncovers weaknesses, contradictions, controversies, or inconsistencies on a specific topic. | - What are the main weaknesses, contradictions, controversies or inconsistencies in prior research on topic X or method Y? |
| Testing theory | Meta-analysis | Integrates statistical data from a specific topic providing meaningful inferences by settling existing controversies from diverse primary quantitative studies. | - Is the association between variables X and Y positively (or negatively) significant?<br>- Does intervention X lead to a significant increase (or decrease) in outcome Y?<br>- What is the direction of the effect? What is the size of effect? Is the effect consistent across the included studies? What is the strength of the evidence of the effect? |
| | Qualitative systematic review | Extracts and integrates statistical data from a specific topic but reports this evidence in narrative descriptions. | |
| | Umbrella review | Analyzes and aggregates both meta-analyses and qualitative systematic reviews to produce a higher level of evidence (synthesis article). | |
| Explaining | Theoretical review | Extends existing theories or contributes to the development of new conceptual frameworks and models. | - States the research objectives but, in most cases, there is no explicit research question. |
| | Realist review | "discerning what works for whom, in what circumstances, in what respects and how" (Pawson *et al.*, 2005). | - Under what circumstances does complex intervention X work best and for whom? Why or what is it about this intervention that works? |

Information summarized from Paré *et al.* (2015) and Templier & Paré (2017).

For the review types in **Table 4.1**, Paré *et al.* (2015) identified seven key characteristics including: the overarching goal, the scope of the questions, the search strategy, the nature of the primary sources, whether the review process includes a quality appraisal, and the methods for analyzing and synthesizing findings (**Table 4.2**). We evaluated these characteristics and used them as criteria for classifying the review papers examined as part of the present study.

**Table 4.2** Key characteristics of standalone review types.

| Contribution (Rowe, F., 2014) | Standalone review type | Key characteristics | | | | | |
|---|---|---|---|---|---|---|---|
| | | Scope of questions | Search strategy | Nature of primary sources | Explicit study selection | Quality appraisal | Methods for synthesizing/ analyzing findings |
| Describing | Narrative | Broad | Usually selective | Conceptual and empirical. | No | No | Narrative summary. |
| | Descriptive | Broad | Representative | Empirical. | Yes | No | Content analysis / frequency analysis. |
| Understanding | Scoping | Broad | Comprehensive | Conceptual and empirical. | Yes | Not essential | Content or thematic analysis. |
| | Critical | Broad | Selective or representative | Conceptual and empirical. | Yes or no | Not essential | Content analysis or critical interpretative methods. |
| Testing theory | Meta-analysis | Narrow | Comprehensive | Empirical (quantitative only). | Yes | Yes | Statistical methods (meta-analytic techniques). |
| | Qualitative systematic | Narrow | Comprehensive | Empirical (quantitative only). | Yes | Yes | Narrative synthesis. |
| | Umbrella | Narrow | Comprehensive | Meta-analysis and qualitative systematic. | Yes | Yes | Narrative synthesis. |
| Explaining | Theoretical | Broad | Comprehensive | Conceptual and empirical. | Yes | No | Content analysis or interpretative methods. |
| | Realist | Narrow | Iterative and purposive | Conceptual and empirical. | Yes | Yes | Mixed-methods approach. |

Information summarized from Paré *et al.* (2015), and Templier & Paré (2017). Reproduced with the authors' authorization.

Some authors argue that standalone literature reviews may show higher levels of methodological rigor, despite their type (Paré *et al.*, 2016). In this context, a transparent and systematic process may contribute, among other factors, to producing highly robust review papers. Paré *et al.* (2016) define systematicity as a mechanism that may decrease the risk of biases, errors, and misinterpretations among other potential problems inherent to the research process. On the other hand, transparency is defined as the rigorous and detailed reporting of methodological decisions during the research process. Explicit reporting may improve both the internal and external reliability of the

review process and enhance the trustworthiness of a work and its conclusions (Paré *et al.*, 2016).

Researchers from various fields are calling for higher levels of systematicity and transparency as relevant research aspects. In particular, for transparency, in the field of health, Tong *et al.* (2012) proposed twenty-one items (grouped in five categories) to assess transparency in qualitative syntheses. From a more general perspective, Paré *et al.* (2016) proposed a framework for guiding and evaluating review papers while systematicity and transparency, and Templier & Paré (2017) proposed twenty-two items to assess transparency for improving transparency in further literature review works.

For the purposes of the present study, which is based on work by Paré *et al.* (2016), we assessed transparency review papers about blended learning in higher education as an innovative technology-enabled learning approach. Specifically, we analyzed how transparency in the research process was reported in the selected standalone literature reviews to answer the following research questions:

1. What trends exist in these types of literature reviews, what are their main themes, and how transparent are they?
2. What practices do the selected reviews use to ensure transparency?

Based on previously mentioned guidelines and frameworks, we present a generally accepted process for conducting standalone literature reviews (**Figure 4.1**). This process consists of six iterative steps and provided a roadmap to guide the assessment of the review papers and the presentation of findings in the present study (Paré *et al.*, 2016; Templier & Paré, 2015).

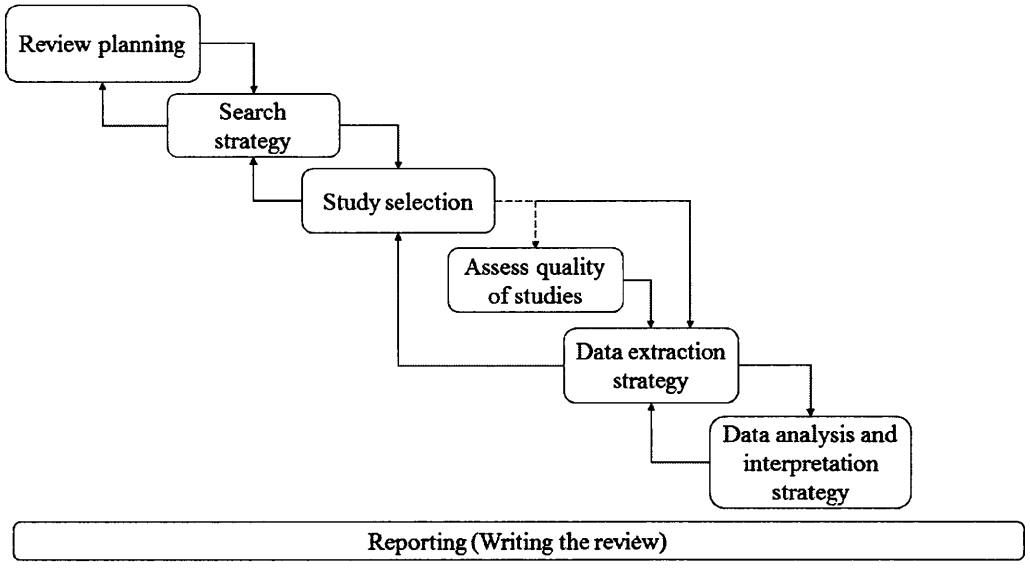


**Figure 4.1** - Research process for standalone literature reviews.

## 4.4 Method

### 4.4.1 Planning the review

After reviewing different typologies of standalone literature reviews, we determined that a descriptive review was the most appropriate format for the present study (Grant & Booth, 2009; Paré *et al.*, 2015; Rowe, F., 2014). This type of review, according to Paré *et al.* (2015),

> "seeks to determine the extent to which a body of empirical studies in a specific research area supports or reveals any interpretable patterns or trends with respect to pre-existing propositions, theories, methodologies or findings."

We selected review papers as our research unit. For each study, we collected, coded, and analyzed bibliometric and methodological data. This data allowed us to identify

trends and patterns related to the themes discussed, types of reviews, and methodological reporting practices.

Based on guidelines for conducting standalone reviews (Booth *et al.*, 2016; Levy & Ellis, 2006; Templier & Paré, 2015), we elaborated a research protocol to plan and guide our study. After each stage, we revised this protocol and adjusted it as needed. Additionally, by including specific validation steps after each stage, we created procedures for reducing the risks of bias and errors in the research process; this research protocol is available upon request. This section presents all activities and decisions performed throughout each stage of our research.

Some utilities were used to aid in the present study. For managing citations, we selected EndNote, and for the coding process we used ATLAS.ti, a computer-assisted qualitative analysis tool. We exported all information produced from these tools and imported it into a MySQL database. Subsequently, we developed a set of functionalities in this database to facilitate the consolidation of the information and to keep a detailed record of the information, thus ensuring the traceability of changes during the research process.

### 4.4.2 Search strategy

Based on a preliminary literature search and analysis, we refined the research problem, the research questions, and the search strategy. The first author conducted the final electronic search based on title, abstract, and authors' keywords in several sources and the second author validated each specific search string. The selected online scientific-citation indexes and electronic databases were EBSCO, ERIC, SCOPUS, and Web of Science. We grouped the keywords and search terms we used for this search into four categories: blended learning, higher education, innovation, and literature review (**Table 4.3**). Based on these categories, we performed the refined search, yielding 631

references. Additionally, various elements of the search strategy were validated with two independent librarians.

**Table 4.3** Categories and keywords and search terms.

| Category | Keywords and search terms |
|---|---|
| - Blended learning | "blended learning" OR "blended education" OR "hybrid learning" OR "mixed-mode instruction". |
| - Higher education | "higher education" OR universit* OR college. |
| - Innovation | adopt* OR barrier* OR challenge* OR change* OR diffusion* OR disruption* OR driver* OR factor* OR impact* OR improvement* OR innovati* OR invention* OR pattern* OR radical OR reinvention* OR sustainable OR transform*. |
| - Literature review | review OR state-of-art OR "state of the art" OR "state of art" OR "meta-analysis" OR "meta analysis" OR "meta analytic study" OR "mapping stud*" OR overview. |

Subsequently, one researcher performed an automatic de-duplicating process based on title, author, year, and DOI. Thereafter, this researcher manually validated the procedure and found seven more references to exclude as duplicates. In total, this process (presented in **Figure 4.2**) excluded 171 references.

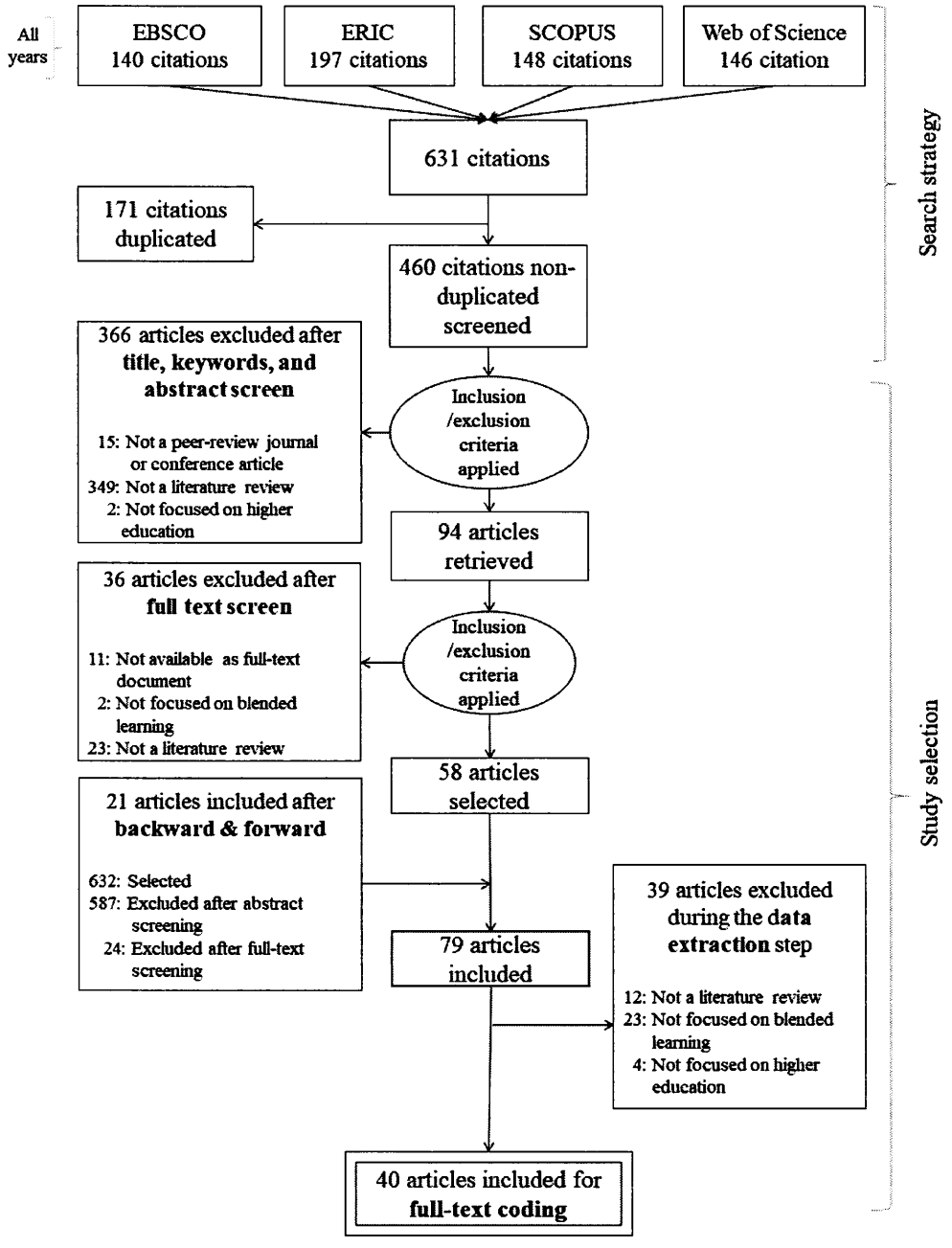


**Figure 4.2** - Search strategy and selection of studies.

### 4.4.3 Study selection

To select the final set of articles for our analysis, we defined a set of inclusion and exclusion criteria to ensure the relevance of the sources selected for answering our research questions. Although, each study's relevance to the research and its comprehensiveness were a major concern, additional aspects, such as the type of publication and language, were also considered. For example, we considered only peer-reviewed journal and conference articles including our keywords and search terms. Additionally, we only selected articles written in English, French, or Spanish. We did not use any filters for the year of publication.

Table 4.4 presents the five exclusion criteria we defined to select relevant sources for this study. With these criteria, we first performed an abstract screening, then a full screening to provide the initial list of articles. We kept detailed notes on the status and the reasons for exclusion in each stage of the study selection. Some articles had more than one reason for being excluded; however, we assigned only the first criterion identified according to the order presented in **Table 4.4**. In case of doubt or lack of information, the exclusion was not applied and the articles were evaluated in further steps of the process.

**Table 4.4** Exclusion criteria.

| Criterion | Rationale |
|---|---|
| 1. Not a peer-reviewed journal article or conference paper | Articles not identified as peer-reviewed journal article or conference paper. |
| 2. Not a literature review | Articles not identified as standalone literature reviews. |
| 3. Not focused on blended learning | Articles that centered exclusively on e-learning, online learning, or technology applied as a support for traditional instruction. |
| 4. Not focused on higher education | Articles that mention or reference universities or higher education system, but do not focus their analysis on them. |
| 5. Not available as a full-text document | Articles not available as full-text documents in the electronic databases that researchers have access. |

First, we performed the abstract screening procedure in which we independently assessed the title, keywords, and abstract text of the 460 citations that remained after the de-duplication process. Next, we prepared for the full text screening procedure by downloading the 94 remaining articles, validating the quality of the PDF documents, and uploading them to ATLAS.ti. Afterwards, we independently performed a full text screening, which resulted in the selection of 58 articles for the further processing. For each step, when necessary, we discussed and reconciled the results of our independent analyses.

The entire search process was conducted in December 2017 including the backward and forward search processes. These complementary processes intended to increase the comprehensiveness of the search. For these processes, we used several different tools and databases to identify the 632 initial citations. For the backward search process, we used ATLAS.ti to analyze the reference section of each selected article. For the forward process we used SCOPUS and Google Scholar. After executing the abstract and full text screening procedures on the set of references identified by the backward process, we added 21 new articles, thus providing a total of 79 articles for further processing. In the final data extraction step, a more detailed insight into these 79 articles resulted in additional exclusions reducing the final list of included articles to 40 (**Appendix D**). The list of excluded articles and reasons for exclusion is presented in **Appendix E**.

### 4.4.4 Quality assessment

As the aim of this study was to assess the methodological reporting process of review articles on blended learning, we did not conduct any quality assessment of the selected articles to exclude additional studies.

### 4.4.5 Data extraction strategy

Data extraction from relevant sources, as a planned and structured process, may reduce the risks associated with "omitting, misclassifying, or misrepresenting key information during the analysis and interpretation steps of the review process" (Paré *et al.*, 2016; Webster & Watson, 2002). In the initial process, the authors created, evaluated, and refined the coding schema related to our research questions. Iterations of these steps were used to produce useful information for narrative descriptions and descriptive statistical data as sources for synthesizing, interpreting, and reporting activities. **Table 4.5** presents the coding schema for extracting bibliometric and methodological data. Based on this schema, each author independently coded each review paper using ATLAS.ti. Thereafter, we exported the information into MySQL for further integration into a consolidated table in Excel. We analyzed this information and discussed the results until we obtained a consensus on the coding decisions.

**Table 4.5** Bibliometric and methodological coding schema.

| Code | | Structure | Rationale, definitions, and examples |
|---|---|---|---|
| 1. | Article keywords | Open-ended | Author's article keywords. |
| 2. | Electronic databases | Open-ended | Database name or scientific electronic index. |
| 3. | Keywords and search terms | Open-ended | Keywords and search terms used by authors for literature search in electronic databases. |
| 4. | Years included | Open-ended | Years of studies included. |
| 5. | Audience | Coded | Researchers, practitioners, policy makers, not stated, etc. |
| 6. | Type of primary sources | Coded | If stated by the authors. Empirical – qualitative, empirical – quantitative, conceptual or theoretical paper, critic paper, bibliometric, mixed methods, literature review. |
| 7. | Number of studies | Number | Number of studies included in the review. |
| 8. | General purpose | Open-ended | Purpose, objective or aim of the article presented by the author. |
| 9. | Research questions or hypothesis | Open-ended | Author's research questions, hypothesis, or proposals if any. |
| 10. | Standalone literature review | Coded | "Y" if the authors explicitly stated their work as a standalone review. |
| 11. | Author's literature review type | Open-ended | If the author mentioned, the review type selected. |
| 12. | Coders' literature review type | Coded | Standalone literature reviews types and their characteristics as criteria for classifying our sample. |

**Table 4.6** presents the coding schema and items for extraction for assessing methodological reporting practices. This schema, which uses seventeen questions

grouped into six sections, was based on guidelines proposed by Paré *et al.* (2016) for systematicity and transparency in standalone literature reviews. We extracted and analyzed information on the transparency characteristics of the selected review papers, then used this system to assess their level of transparency. The data extraction process was performed along the entire article to reduce the risk of missing information not reported in the method section.

**Table 4.6** Assessment form for transparency in literature reviews articles.

| Review steps | Elements to assess |
|---|---|
| S01 - Review planning | 1. Are the review's goals are clearly described and justified?<br>2. The study clearly described and justified the review type and methods? (Using existing frameworks or guidelines for reviews articles)<br>3. (If applicable) Is the review protocol mentioned and published? |
| S02 - Search strategy | 4. Is the search strategy (e.g., databases with dates of coverage) clearly described?<br>5. Are inclusion and exclusion criteria disclosed?<br>6. Is a full electronic search strategy for at least one database presented? (keywords and search terms)<br>7. Is information about tools and procedures for managing references and other research processes clearly presented? |
| S03 - Study selection | 8. Are processes for screening and selecting studies described?<br>9. Is a list or profile of included studies provided?<br>10. (If applicable) Is a list of excluded studies presented with reasons for exclusion?<br>11. Is a flow diagram summarizing the study selection process presented? |
| S04 - Quality assessment | 12. Are quality assessment results for each study presented?<br>13. Are the methods used for incorporating assessments into analyses described? |
| S05 - Data extraction strategy | 14. Are data extraction processes and methods described?<br>15. Are extracted items and/or data extractions forms presented? |
| S06 - Analysis and interpretation strategies | 16. Are the principal constructs or outcomes of interest stated?<br>17. Are the methods of analysis and synthesis described and justified? |

Based on Paré *et al.* (2016).

When enough clear information about an assessment item was available, we assigned a "Y" as a value for "Yes", indicating that the review achieved the requirements expected for that specific item. All items with value="Y" were counted and divided by the number of items in its group. This subtotal was then divided by six, which corresponds to the number of groups in assessment schema. In this way, we normalized the contribution of each step to the final score. The final score, or level of transparency, was calculated using the following formula:

$$Level\ of\ transparency(x) = \sum_{Step=1}^{6} \left( \frac{\#Assessment\ items\ (Value = Y)}{Total\ \#\ of\ Assessment\ items\ in\ the\ section} \right) /6$$

Finally, we overlapped data extraction and analysis activities to evaluate and report the quality of the coding process, analyze and interpret the extracted data, and refine tools for the analysis, synthesis, and interpretation processes.

### 4.4.6 Analysis and interpretation strategy

During each iteration of this step we: 1) evaluated whether the questions could be answered with the collected data and whether the data collection process needed to be adjusted; 2) updated the previously defined tables according to a structured thematic analysis based on selected literature reviews; 3) consolidated the notes taken in ATLAS.ti during each step of the review process; and 4) analyzed and interpreted the data from the tables and note-taking process.

During the analysis, we elaborated and refined some tools, such as a consolidated table board, conceptual maps, descriptive statistics tables, and narratives for each set of codes, for use in the synthesis and interpretation process. Subsequently, as defined in the protocol, we wrote preliminary versions of this article and validated the interpretations in several meetings. In cases of inconsistencies, we revisited the extracted data and the original sources to discuss and reconcile the interpretations.

We identified three main constructs or outcomes of interest: 1) the type of review that the researchers selected, 2) the main purposes of their works, and (3) the level of transparency of their methodological decisions. First, to identify the type of review, we analyzed factors such as the scope of the research questions, type of questions, goal of the review type, and the nature of the primary sources. We also analyzed the procedures applied to the search strategy, study selection, and quality appraisal as well as the

method for analyzing and synthesizing findings. We performed independently this coding and analysis process for identifying the type of review. Then, for those articles in disagreement, we revisited the articles using the coding information to understand the other's perspective. We had several meetings to discuss our perspectives and for some articles we did not reach an agreement. We sent these articles and the assessment schema to an external researcher. We analyzed the result of his assessment and finally we reached an agreement. Second, based on the research purposes and questions of the selected reviews, we identified the main themes of the studies. Third, based on the previously established criteria for assessing transparency (Table 4.6) and the associated formula, we identified the level of transparency (LT) of each review paper and divided them into quartiles of transparency. These quartiles could provide a basis for analyzing the methodological practices of standalone review in the domain of blended learning in higher education.

## 4.5 Trends in standalone review types and main themes

This section presents the findings related to the identified trends in the types of standalone literature reviews on blended learning in higher education, as well as the main themes and levels of transparency in these reviews. The analyses performed in the present study demonstrate that, despite the extensive availability of original research on innovations related to blended learning in higher education, few reviews focus on synthesizing this knowledge. Searching electronic databases and scientific citation indexes yielded a set of 15,285 articles that mention or discuss blended learning (as of the date of our search). From this set, 8,354 possessed keywords related to higher education. This set was reduced to 5,119 then 631 when we narrowed the search to include the keywords related to innovation and literature review, respectively. Applying the exclusion criteria (**Table 4.4**) to these 631 articles resulted in only 40

standalone reviews selected (**Table 4.7**), of which 37 were journal articles and 3 were peer-reviewed conference papers.

The detailed profile of selected review papers is presented in **Appendix D**. As criteria for classifying these studies, we used the standalone literature review typology presented in Paré *et al.* (2015) (**Table 4.1**) and the characteristics of these review types (**Table 4.2**). **Table 4.7** summarizes the assigned type for each review included in the present study (ordered by year of publication). In our selection, we identified seven out of the nine types of reviews described in the typology. Our analysis did not show reviews papers fulfilling the criteria for umbrella, realist, or other emergent types of reviews. Our analyses also revealed that reviews other than narratives were published within the last five years.

**Table 4.7** Included reviews classified by type and year (2007-2017).

| Type of literature review | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | Total | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Narrative | | | 3 | 2 | 2 | 4 | 3 | 2 | 7 | 3 | | 26 | 65.0% |
| Descriptive | | | | | | 1 | | 2 | | 1 | 2 | 6 | 15.0% |
| Scoping | 1 | | | | | | | | | 1 | | 2 | 5.0% |
| Critical | | | | | | | | | | | 1 | 1 | 2.5% |
| Meta-analysis | | | | | | | 1 | 1 | | | 1 | 3 | 7.5% |
| Qualitative systematic | | | | | | | | | | | 1 | 1 | 2.5% |
| Theoretical | | | | | | | | | | 1 | | 1 | 2.5% |
| Total | 1 | 0 | 3 | 2 | 2 | 5 | 4 | 5 | 7 | 6 | 5 | 40 | 100% |

**Table 4.8** presents findings related to: 1) the types of literature reviews, 2) the main themes discussed, and 3) the levels of transparency of the reviews (organized in quartiles). With respect to the type of contribution to theory (Rowe, F., 2014), most reviews focus mainly on describing as their overarching goal (80%). The next most common goal was testing theory (10%), followed by understanding (7.5%) and explaining (2.5%).

**Table 4.8** Studies included by type of literature review and main themes.

| Overarching goal | Type of literature review | Main themes (*) | | | | | Total | % |
|---|---|---|---|---|---|---|---|---|
| | | BDCO | EEI | Specific topics | MFP | Trends | | |
| Describing (n=32, 80%) | Narrative | 13 | 9 | 7 | 2 | | 26 | 65.0 % |
| | Descriptive | 1 | | | | 5 | 6 | 15.0 % |
| Understanding (n=3, 7.5%) | Scoping | | | | 2 | | 2 | 5.0% |
| | Critical | | | | 1 | | 1 | 2.5% |
| Testing theory (n=4, 10%) | Meta-analysis | | 3 | | | | 3 | 7.5% |
| | Qualitative systematic | | 1 | | | | 1 | 2.5% |
| Explaining (n=1, 2.5%) | Theoretical | | | | 1 | | 1 | 2.5% |
| | Total | 14 | 13 | 7 | 6 | 5 | 40 | 100% |
| | Percentage (%) | 35% | 33% | 18% | 15% | 13% | | |

(*) Each review can be classified in more than one theme, but the percentage is calculated for the 40 articles.

All of the reviews we analyzed stated their main purposes; however, only sixteen explicitly stated the research questions. After several iterations of analyzing the reviews' research questions, based on existing methods for thematic analysis (Thomas, J. & Harden, 2008), we identified six main themes: 1) barriers, drivers, challenges, and opportunities (BDCO); 2) effect, effectiveness, and impact (EEI); 3) specific topics; 4) models, frameworks, and practices (MFP); and 5) trends.

The first main theme relates to the analysis of barriers, drivers, challenges, and opportunities of blended learning in higher education institutions. The majority of the fourteen articles discussing this theme are narrative reviews (n=13). Among these, three main elements are considered in their analyses: blended course design (Alammary *et al.*, 2014), technology adoption(Harris *et al.*, 2009), and blended implementations (Pavla *et al.*, 2015). These three elements are the basis for the principal constructs of synthesis or outcomes of interest. Specifically, these reviews: provide lists of suggested ingredients for an effective blend (Abu Hassana & Woodcock, 2013); propose guidelines for blending courses (Harris *et al.*, 2009); and offer recommendations for blended learning strategies, both from general (Lamport & Hill, 2012; Ma'arop & Embi,

2016) and specific standpoints, such as enhancing flexibility and interaction (Boelens *et al.*, 2017).

The second main theme relates to the analysis of the effect, effectiveness, and impact of blended learning in the higher education context. Weightman *et al.* (2017) analyzed prior studies on information literacy programs to identify the effects of blended learning in these programs. Their evaluation was performed from a student perspective. With respect to the effectiveness of blended learning programs, Berk (2013), analyzed, from an organizational perspective, different measurement aspects to evaluate teaching effectiveness and how these evaluations influence the development of faculty members in universities. Means *et al.* (2013) conducted a meta-analysis to investigate the practices and conditions influencing the effectiveness of online and blended learning compared to face-to-face learning. Keengwe & Jung-Jin (2012) analyzed how blended learning is used in teacher preparation programs from a perspective of the design of blended learning courses. Arbaugh (2014) investigated factors influencing instructional effectiveness unique to blended learning in management education. Israel (2015) evaluated the effectiveness of integrating massive open online courses (MOOCs) as part of face-to-face and blended learning courses. Abu Hassana & Woodcock (2013) discussed these modes and the opportunities provided by each. They investigated the elements required for blending learning courses and determined several factors for selecting a teaching style in these types of courses.

Three reviews discussed the impact of blended learning. Two focused on students' achievement. Lamport & Hill (2012) discuss achievement from a general perspective for post-secondary institutions, while Vo *et al.* (2017) analyze how student achievement in blended learning contexts varies with academic discipline. Similarly, Rowe, M. *et al.* (2012) analyzed the impact of blended learning in clinical education for healthcare students.

The third main theme of the review papers was the discussion of specific topics. Seven articles discussed topics including teachers, students, and learning activities. For teachers, these reviews present syntheses from primary sources on blended learning about conceptions and approaches in teaching (Caravias, 2015) and teachers' beliefs about teaching and learning (Robles Haros *et al.*, 2016).

Some review papers analyzed how blended learning is used in teacher preparation programs. These papers focused on the perspectives of designing blended learning courses (Keengwe & Jung-Jin, 2012) and integrating information and communications technology (ICT) within the classroom environment (Duhaney, 2012). For learning and teaching activities, some reviews focused on analyzing team teaching approaches (Crawford, R. & Jenkins, 2015) and online formative assessments (Gikandi *et al.*, 2011). One review in our sample analyzed the role of the student in blended learning environments (Shivetts, 2011).

The fourth main theme relates to articles discussing models, frameworks, and related practices. We identified the work of Margulieux *et al.* (2016) as the only theoretical development initiative. Their review presents a taxonomy to clarify the concepts of hybrid, blended, flipped, and inverted courses. Finally, three reviews analyzed and discussed some models and frameworks applied in blended learning contexts. (Sophonhiranrak *et al.*, 2015) studied the factors influencing creative problem solving; Smith *et al.* (2017) evaluated empirical previous studies that focused on the community of practice (CoP) framework and uncovered patterns in their use; and (Al-Azawei *et al.*, 2016b) analyzed existing literature that stated the use of the universal design for learning (UDL).

Finally, the fifth main theme relates to articles discussing about trends and patterns in primary sources. Articles in this category are descriptive reviews type. From a general

perspective, two of these reviews identified methodological, topical, and demographic trends (Drysdale *et al.*, 2013; Halverson, L. R. *et al.*, 2014). The other three descriptive reviews investigated trends of blended learning from a more specific perspective. Alkraiji & Eidaroos (2016) focused their research on studies analyzing blended learning in Saudi Arabia. They analyzed literature based on technological, demographical, and research streams. Loncar *et al.* (2014) investigated primary sources focusing on asynchronous online discussions, seeking to identify trends in educational contexts and technological platforms. Bogdan *et al.* (2017) investigated existing trends in the use of MOOCs in blending learning courses.

## 4.6 Level of methodological transparency and current practices

The following section presents findings related to the level of methodological transparency in the analyzed review papers and discusses how researchers report their methodological decisions while conducting the review process. These sections are organized according to the generally accepted process for conducting standalone literature reviews (presented in **Figure 4.1**).

**Table 4.9** presents consolidated information about the LT of the analyzed reviews, grouped by type and quartiles, where Q1 is the highest level and Q4 the lowest level. Findings show low levels of explicitness when reporting research activities. Of the selected reviews, almost 73% were classified in the two lower quartiles. Articles in these quartiles were mainly narrative, scoping, and theoretical reviews. In contrast, qualitative systematic and meta-analysis reviews had the highest LTs.

**Table 4.9** Studies included by type of literature review and quartiles.

| Type of literature review | Quartiles | | | | Total | % |
|---|---|---|---|---|---|---|
| | Q1 (76%-100%) | Q2 (51%-75%) | Q3 (26%-50%) | Q4 (0%-25%) | | |
| Narrative | 1 | | 9 | 16 | 26 | 65.0% |
| Descriptive | | 5 | | 1 | 6 | 15.0% |
| Scoping | | | 2 | | 2 | 5.0% |
| Critical | | 1 | | | 1 | 2.5% |
| Meta-analysis | 2 | 1 | | | 3 | 7.5% |
| Qualitative systematic | 1 | | | | 1 | 2.5% |
| Theoretical | | | 1 | | 1 | 2.5% |
| Total | 4 | 7 | 12 | 17 | 40 | 100% |
| Percentage (%) | 10.0% | 17.5 | 30.0% | 42.5% | | |

We observed that 75% and 86% of articles classified as Q1 and Q2 were published within the last five years (2012-2017). We performed a series of analyses to identify whether the LT of reviews improved over the time, however no patterns could be identified. Nonetheless, the results show a diversification of literature review types. In fact, all critical, meta-analysis, qualitative systematic and theoretical reviews, and the 83% of the descriptive reviews were published in the last five years. **Table 4.10** summarizes the data related to the items assessed for identifying the methodological reporting practices of the selected reviews presented in **Appendix F**. The data in this table are used in the following sections to complement the report of current practices.

**Table 4.10** Studies fulfilling the transparency assessment items.

| Review type and number of studies | Steps of the review process (S01-S06) and transparency assessment items (1 -17) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S01 | | | S02 | | | | S03 | | | | S04 | | S05 | | S06 | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| Narrative (26) | 26 | 10 | | 15 | 15 | 15 | 1 | 9 | 4 | | | | 1 | 4 | 6 | 4 | 2 |
| Descriptive (6) | 6 | 3 | | 6 | 5 | 6 | 2 | 5 | 3 | | 3 | 1 | | 5 | 5 | 4 | 4 |
| Scoping (2) | 2 | | | 2 | 2 | 2 | | 2 | 1 | | 1 | | | | 2 | 1 | |
| Critical (1) | 1 | | | 1 | 1 | 1 | | 1 | 1 | | | | | 1 | 1 | 1 | 1 |
| Meta-analysis (3) | 3 | 3 | | 3 | 3 | 3 | 3 | 3 | 3 | | 1 | | 2 | 3 | 3 | 3 | 3 |
| Qualitative systematic (1) | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Theoretical (1) | 1 | | | 1 | | 1 | | 1 | 1 | | | | | 1 | 1 | | |
| Total | 40 | 17 | 0 | 29 | 27 | 29 | 7 | 22 | 14 | 0 | 6 | 2 | 4 | 15 | 19 | 14 | 11 |

### 4.6.1 Developing a review plan

The main aspects for ensuring systematicity in a review process include: planning the process, formulating the problem, stating the purpose and research questions, and selecting and justifying the review type. Developing a review plan enhances systematicity in the review process and provides the basis for further detailed reporting of the methodological decisions in the research process (Templier & Paré, 2017). By formulating the problem and stating the purpose and research questions in a review, researchers also establish the field of study, boundaries of the research, and a list of potential suitable reviews types. We assessed these aspects to identify the types of reviews selected by the authors and determine whether or not the justifications for their decisions were present in the articles using the following assessment items: 1) whether the review goals are clearly stated and justified or not; 2) whether or not the article is clearly identified as a review paper, and states the type of review and the justification for the type; 3) whether the article discloses information about the review process or not. The goal of reporting these aspects in review papers is to achieve a transparent review process and increase trustworthiness (Templier & Paré, 2017).

All studies included in our analyses presented their objectives or purposes; however, only 40% (n=16) of the studies explicitly reported their research questions. We used the stated purposes and research questions to: identify six different main themes in the articles in our sample, and classify the literature reviews with respect to the type and scope of their research questions (when available). Thirty-nine out of the forty articles explicitly reported their work as a standalone literature review. Researchers explicitly reported the type of literature review and the methods used in 43% (n = 17) of the studies. In most of these cases, the authors did not report the use of existing guidelines, typologies, or classifications of standalone literature reviews. In most cases, we did not identify justifications for the selection of the review type. In terms of review type, the rate of agreement between classifications stated in the reviews and our classifications was around 53%.

For scoping, qualitative systematic, and meta-analysis reviews higher levels of agreement with the authors regarding the review type were observed. These findings can be explained in part due to the use of explicit guidelines and frameworks for conducting standalone literature reviews. In contrast, the articles that we classified as narrative, descriptive, critical, and theoretical presented different names aligned, in most cases, with the purpose of their work. For example, in narrative reviews these names included bibliographic, critical review, general review, integrative narrative, literature landscape, synthetic review, and systematic literature review. However, the biggest differences in classification were noted in the descriptive reviews. Stated types in these reviews included categories such as critical review, meta-analysis, meta-synthesis, systematic literature review, and thematic review. Although, one of these studies was presented as a meta-analysis, no statistical methods, such as effect size, were used to aggregate data from quantitative studies (Paré *et al.*, 2015).

The disclosure of research protocols was assessed in two ways: 1) by identifying links to a particular website or online repository where the protocol was published; or 2) by searching for explicit statements indicating that this information was available upon request to the corresponding author. Findings showed no studies reporting whether the protocol was published or not, even for the qualitative systematic and meta-analysis reviews.

### 4.6.2 Searching the literature

The main aspects analyzed in this section include: 1) the search strategy, including the databases and timeline of the search; 2) the disclosure of the inclusion and exclusion criteria; 3) the explicitness of the keywords and search terms for electronic searches; and 4) the tools and procedures for managing bibliographic information. By disclosing information about these aspects, selected studies provide meaningful information about the level of comprehensiveness in its search strategy and the relevance of the selected studies.

Our findings show that 73% (n=29) of the reviews stated their studies' sources and 53% (n=21) give timeline parameters for their literature searches. This timeline search included years from 1990 to 2016. Despite the fact that blended learning became a prominent research area in 2003, thirteen reviews included articles published before this year. These reviews focused mainly on comparing blended learning, e-learning, and face-to-face delivery modes with respect to their benefits, barriers, drivers, and effectiveness, as well as the impacts of these delivery modes in the learning-teaching process.

We identified and coded the different approaches for literature searches. These approaches included: the use of online scientific citation indexes, electronic databases, specific journals, articles included in other review papers, or a combination of resource

types. We summarized this information and reported the type and number of occurrences of these sources and the list of the most used sources in **Table 4.11**. One group of these reviews selected specific journals as complementary to increasing comprehensiveness and three articles used references stated in previous reviews to complement or continue their work. Findings also show that most narrative and theoretical reviews did not state the sources and the timeline for their search strategy. These results agree with Templier & Paré (2017) (in the information systems field). As these authors state, narrative and theoretical reviews are highly iterative and authors, in most cases, do not report explicitly define their search process.

**Table 4.11** Number of studies that stated their search resource type and sources.

| Search resources type, | Number of articles | Percentage of articles | List of sources |
|---|---|---|---|
| - Electronic databases | 24 | 60.0% | EBSCO, ERIC, ProQuest, Science Direct, Medline, ABI/Inform, CINAHL, British Education Index, ACM, IEEE Xplore, JSTOR, Lexis/Nexis Business, Wiley Online Library, EdIT (Now LearnTechLib), EdLib, ELSEVIER, EMBase, Redalyc, SAGE Journals, Scielo, SOSIG - Social Science Information Gateway, Taylor and Francis Online. |
| - Online scientific citation indexes | 16 | 40.0% | Google Scholar, Web of Science, SCOPUS. |
| - Journals | 8 | 20.0% | Journals: International review of research in open and distributed learning (IRRODL) journal, journal of management education, educational technology research and development, British Journal of Educational Technology Journal of Computer Assisted Learning, Educational Technology Research and Development, Australasian, Journal of Educational Technology, Educational Technology & Society, Review of Educational Research, Educational Research Review, and Educational Researcher. |
| - Articles | 3 | 7.5% | - |
| Total | 29 | 73% | Total of review papers that stated their search sources |

Note: Some articles stated more than one search resource type

Twenty-eight reviews papers (n=28), or 70% of our sample, disclosed the inclusion-exclusion criteria used for selecting their studies. In most cases, general criteria are concerned with: 1) the search terms regarding blended learning and higher education; 2) the years included in the search; 3) the language selected, primarily English. From

a more specific perspective, some articles specified: 1) the types of sources (e.g., empirical studies); 2) geographical regions or countries (e.g., India, Saudi Arabia); 3) specific academic disciplines (e.g., management); 4) research fields (e.g., social sciences); 5) specific learning activities (e.g., asynchronous online discussions); 6) specific technologies (e.g., MOOCs); 7) specific models or frameworks (e.g., Universal Design for Learning); and 8) type of learners (e.g., undergraduate, graduate).

Findings show that 73% (n=29) of the studied reviews papers explicitly stated the keywords and search terms for their electronic searches and 18% (n=7) reported the tools and procedures used for managing bibliographic information.

In most cases, authors provided evidence related to the literature search and study selection processes. However, this information was only detailed enough in a few cases to extract the information required to assess the items for this step of the review process.

### 4.6.3 Selecting studies

The main aspects analyzed in this section include: 1) the procedure for screening and selecting studies; 2) the disclosure of included and excluded studies and the level of detail provided; and 3) the presentation of summarized information about the review process. By disclosing information about these aspects, selected studies provide meaningful information about the sources for their analysis and interpretation, and the procedures for selecting these sources (Tricco *et al.*, 2011). This procedure filtered articles not focused on the interest of the researchers. A sound screening procedure reduces potential bias when including or excluding articles for further analysis. By presenting detailed information of the included and excluded articles, researchers also provide evidence about the relevance of these studies for obtaining meaningful results and answering the research questions.

Our data show that 55% (n=22) of the analyzed articles described the processes used for screening and selecting studies. This practice is more consistent in descriptive, scoping, qualitative systematic, and meta-analysis reviews. Of the articles we analyzed, 35% (n=14) presented a list of included studies. Among these papers, only three were classified as narrative reviews.

In addition to information about included studies, detailed and structured information about the exclusion procedures is also important for researchers and practitioners to be able to validate the soundness of the criteria and the scientific rigor in the process. This information can be presented in two ways: first, as the number of excluded studies in each step of the review process; and second, as a list of studies with the reason for the exclusion. Recommended practices from existing guidelines (e.g., Cochrane Database of Systematic Reviews) encourage researchers to include this information as flow diagrams that summarize the results of the search and the study selection strategies; however, in our sample, only 15% (n=6) of studies presented information in graphical form.

### 4.6.4 Assessing quality

The main aspects analyzed in this section are: 1) the disclosure of detailed information on the quality assessment results for selected sources; and 2) the disclosure of information about the specific procedure for the quality assessment process. The goal of these activities is to ensure that, as a means for increasing also the quality of the findings and results, only sources with high levels of quality are gathered (Bandara *et al.*, 2015). Our data show low levels of this practice; only 10% (n=4) of the review papers provided information about the methods that were used to assess the quality of the primary sources. Among these studies, only two presented information about the quality assessment results. In one case, the authors used the total number of citations the articles received as a measure of quality (Halverson, L. R. *et al.*, 2014). In the other

case, the authors use recognized quality assessment tools, such as Glasgow checklist for educational interventions (Weightman *et al.*, 2017). This information was presented as part of the detailed profiles of included studies.

### 4.6.5 Extracting data or key aspects from included studies

As Whittemore *et al.* (2014) state, an "accurate reporting of individual studies is essential to improve the quality of any knowledge synthesis method." These activities seek to define, organize, and execute agreed upon procedures for extracting data from the primary sources in order to reduce the risks associated with "omitting, misclassifying, or misrepresenting key information" (Paré *et al.*, 2016; Webster & Watson, 2002). The main aspects analyzed in this section are: 1) the reporting of the data extraction processes and methods; and 2) the disclosure of the specific items or data extraction forms for collecting the data in a structured way. In total, 48% (n=19) of the studied reviews reported the items or information required to extract data from their primary sources. Some presented this information as a list of elements (Al-Azawei *et al.*, 2016b), while others used structured forms with more detailed information (Arbaugh *et al.*, 2010). Fifteen of these articles described the processes and methods used for extracting the data.

### 4.6.6 Synthesizing and interpreting data, and formulating conclusions

The main aspects analyzed in this section are: 1) the reporting of the principal constructs or outcomes of interest for the analysis and synthesis processes; and 2) the disclosure of the methods of analysis and interpretation for presenting the findings, results, and conclusions, and answering the research questions. In total, 35% (n=14) of the reviews stated the principal constructs or outcomes of interest. Out of these fourteen articles, only eleven described and, at least partially, justified the methods used for the analysis and interpretation of the findings and results. With respect to the reporting of

the methods of analysis and interpretation, our data show four explicitly stated methods: In the three meta-analyses, the authors reported the summary effect calculations and the related procedures. In the qualitative systematic review, the authors reported, in addition to their statistical methods, a thematic analysis to complement their findings. Finally, in the other types of reviews, the authors reported content analyses and thematic analyses as the selected methods for data analysis and interpretation of findings.

## 4.7 Discussion

Paré *et al.* (2016) proposed a framework for conducting standalone literature reviews. This framework presents transparency and systematicity as two interrelated key aspects for enhancing the trustworthiness of literature reviews. We selected this framework to elaborate an assessment schema. As stated in our research questions, this work assessed transparency in standalone literature reviews of blended learning in higher education. This assessment focused on the rigorous and detailed reporting of methodological decisions and procedures during the research process. This explicit reporting may facilitate one objective of scientific research, which is the internal and external reliability of the review process. The main contributions of this paper are: 1) the identification of the main themes discussed in blended learning literature reviews for higher education context from the innovation perspective 2) the extension of the framework presented in Paré *et al.* (2016) to include an assessment tool for identifying the levels of transparency of review papers 3) the analysis of current practices in reporting methodological decisions and activities for providing recommendations for enhancing trustworthiness.

Despite the fact that blended learning is a well-developed research field, literature reviews related to aspects such as technological adoption, diffusion, and

implementation appear to be in their initial stages. This research seeks to uncover the current practices in reporting methodological decisions in these standalone literature reviews. We evaluated these practices based on our assessment schema which is comprised of seventeen elements, each evaluating one of the six steps that are generally accepted for conducting literature reviews. For our main constructs or outcomes of interest, we identified the level of transparency, type of review, and overarching goals of the reviews with regard to theory contribution. We structured the presentation of the practices into the six steps for conducting a review and the levels of transparency identified in each review paper into quartiles.

Our data show that 65% of the articles in our sample are narrative reviews and 15% are descriptive reviews. This 80% of our sample focuses on describing a phenomenon of interest as the overarching goal (Rowe, F., 2014). We identified that the majority of the cases of narrative reviews and more than the 50% of the descriptive reviews were classified in the two lower quartiles of transparency. Being classified in these quartiles implies low levels of disclosure with respect to methodological decisions. These findings concur with those presented in the work of Templier & Paré (2017) regarding the low levels of transparency narrative, descriptive, and theoretical reviews in information systems.

Furthermore, the majority of studies not classified as describing review types were published over the past five years and scored mostly in the two higher quartiles. Despite this trend of review type diversification, our data only show only 20% (n=8) classified in the other three categories. Among these studies, three were classified in the category of understanding, four in theory testing category, and one study focusing on theory building or explaining. The increasing interest in blended learning as field of research could be a possible explanation for this change in the types of reviews that researchers select. The abundance of original studies may allow for this diversification due to

greater variety in the primary sources. Another potential explanation relates to higher requirements for systematicity and transparency in the publishing process. However, further empirical work should analyze this situation and provide deeper insights about why researchers in this field are shifting away from narratives to other types of reviews.

In the explaining category (Rowe, F., 2014), our findings show no articles classified as realist reviews. This review type, as Pawson *et al.* (2005) argue, intends to uncover, "what works for whom, in what circumstances, in what respects, and how." This type of review, according to Paré *et al.* (2015) may complement conventional meta-analysis and qualitative systematic reviews to enhance evidence-based decision-making processes for blended learning or other educational technology implementations for higher education. Few articles were classified in this category. This low number of theoretical reviews may be explained by the relative novelty of blended learning as a research domain as compared to other more mature domains such as information systems (Templier & Paré, 2017). However, further research analyzing this behavior in blended learning research from a broader perspective may provide a better insight into the theoretical review process.

Our findings show low levels of transparency in our sample. Most articles were classified in the two lower quartiles. In particular, narrative, scoping, and theoretical reviews comprise almost all the reviews in these two quartiles. This lack of explicitness may affect the internal and external reliability of the process (Paré *et al.*, 2016) and the potential impact of these scientific works in scientific and practitioner contexts (Wagner *et al.*, 2016). We concur with Templier & Paré (2017), who stated that narrative and theoretical reviews, as any other review type, should align their search strategies and report them to "allow readers to judge if the methods and decisions made were appropriate and aligned with the research question."

As Vom Brocke *et al.* (2009) stated, by sharing a detailed, systematic, and transparent process, scholars may have a positive impact on the scientific community and provide new insights into previous research. However, few review papers disclose information about the guidelines or frameworks used for conducting their research. In particular, identifying whether this information is reported explicitly or not should be added in future transparency assessment schemas for standalone literature reviews. For those reviews using these guidelines or frameworks, the level of transparency was higher. This is expected as these guidelines remark the generally accepted steps and activities for conducting standalone literature reviews. Our data show that most of the reviews disclosing this information are systematic qualitative reviews and meta-analysis.

We concur with Paré *et al.* (2016), who stated that standalone literature reviews, "need to adhere to the same high standards of quality and trustworthiness as other empirical studies." Review articles in blended learning may use and improve these guidelines and frameworks, not as inflexible and a priori instrument (as Boell & Cecez-Kecmanovic (2015) states), but as a rigorous report process to improve the quality of the study (Vom Brocke *et al.*, 2009). A better insight into these practices may help researchers to enhance trustworthiness in their review papers, and practitioners to identify meaningful works that can support their individual and organizational activities when implementing blended learning techniques. However, transparency is one of many elements comprising the quality of a review paper that may affect positively the article's scientific impact (Vom Brocke *et al.*, 2009). The impact of a review on the scientific and practitioner communities involves also a number of other factors such as an author's expertise and reputation, and journal impact (Wagner *et al.*, 2016).

## 4.8 Conclusions

Methodological papers describe different purposes for standalone literature reviews, including the development of new theories, shaping future research studies, production or dissemination of knowledge, and support of evidence-based practices (Grant & Booth, 2009). Researchers are calling for increased levels of systematicity and transparency as key aspects of the review process (Paré *et al.*, 2016). This call is also relevant for standalone literature reviews on blended learning in higher education as a pathway for enhancing the trustworthiness, quality, and potential scientific impact of this kind of academic work (Wagner *et al.*, 2016). In the present study, forty standalone literature reviews on blended learning in higher education were assessed for their level of transparency on the reporting of methodological decisions and on how researchers are ensuring transparency in this research domain.

Blended learning, as an alternative to online and face-to-face delivery modes in higher education, may offer a high potential for improving the learning-teaching process and its outcomes. However, review papers in this research domain show low levels of transparency, and, in most cases, these papers are narrative, descriptive, and theoretical reviews. We argue that, regardless of the type of review, each standalone literature review must have a minimum level of systematicity and transparency. In particular, in our selection of forty review articles, we identified higher levels of transparency in review papers using methodological guidelines or frameworks to conduct the review process. We did not assess or focus on their findings, interpretations, or the quality of the review paper in aspects other than transparency.

Finally, although transparency is one of several required aspects when evaluating the quality of a review paper, it may provide some complementary insights about how rigorously was the research process was conducted. In this context, the implications for

practice may include the consideration of using elements such as the assessment schema and the transparency level for selecting of studies. This work may provide practitioners and policy maker with a framework to identify studies with higher levels of trustworthiness. For practitioners as a support for individual or organizational activities when implementing and using blended learning, and for policy makers as a tool for identifying proven practices and context of implementation in relevant synthetized research to improve public policies.

## 4.9 Contributions

The empirical contributions of this study include the collection of detailed information about the main themes discussed in previous literature reviews, and about their methodological reporting practices. These literature review papers focused on blended learning in higher education as an innovative technology-enabled learning approach. The present study collected data based on coding schemas, and used a mathematical formula for calculating the transparency level for each article in the sample. In order to identify some patterns, this study classified the review papers in quartiles with respect to their transparency level.

This study's implications for future research include: 1) a detailed procedure for assessing the levels of transparency in previous literature reviews. This procedure describes the mostly accepted activities when carrying out a rigorous review process. 2) An analysis of current practices in reporting methodological decisions and activities. This assessment schema and others from different research fields (Templier & Paré, 2017) provide practitioners with an analytic tool for evaluating how transparent is the reporting of methodological decision in standalone reviews. This information may be important for researchers for enhancing trustworthiness in their future review papers

and for conducting further comparative studies in the research field of education about research practices.

## 4.10 Limitations and future work

We identified and performed multiple activities over the entire research process to minimize the risk of codification errors, biases, and misinterpretations. Initial considerations, methodological decisions, and activities were documented in the research protocol and refined throughout the process to provide the basis for an explicit reporting of our research process. However, some limitations may affect the generalizability of our results. First, due to the lack of explicitness about positioning existing literature as a standalone literature review, some articles may have been excluded when searching on the electronic databases and online scientific-citation indexes. To minimize the impact of this situation, we executed additional activities such as backward and forward search processes.

As blended learning continues its development as a research domain, future literature reviews may shift in two directions. First, extending the analysis of methodological aspects from other perspectives and contexts. Studies in this direction may uncover differences in practices that can improve current research methods and validate some of the interpretations in this work. Second, identification of gaps in existing literature reviews regarding the adoption and diffusion of technological and pedagogical innovations. Future literature reviews discussing these topics in blended learning implementations in higher education institutions may focus on: 1) who is leading these innovations and in what specific contexts are these implementations successful; and 2) which technologies are promoting structural transformations and under which conditions. This direction may include exploring review papers such as theoretical and

realist reviews to provide a better insight, from an explanatory perspective, considering blended learning as a complex educational intervention.

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# CONCLUSIONS

## 5.1 Main findings

This chapter presents a synthesis of the research work, comprising a substantial summary of chapters 2, 3, and 4. This research focuses on blended learning in higher education and aims at: 1) uncovering the potential for transformation of digital educational technology 2) identifying trends and capabilities leading to structural transformations, and 3) revealing current practices of researchers with regard to the disclosure of methodological decisions and research activities in previous standalone literature reviews.

### 5.1.1 Chapter 2: Digital technologies, blended learning and higher education

Despite the abundant academic literature on blending learning, an integrated portrait of the digital educational technologies is missing. By filling such gap this paper aims to elucidate the trajectories of technological developments related to the blended learning practices in higher education. Sometimes, digital innovation may end up as a mere sustainable technology to the existing learning-teaching experience. Or, some other times, digital innovation can disrupt the previous learning-teaching environment and hence, drastically affect its outcomes. Thus, it matters to investigate the winning conditions for successful implementations of blended learning.

This chapter provides firstly, a portrait of the digital educational technologies related to blended learning in higher education; and secondly, a tool for measuring the transformational level of these technologies. The author identifies some dimensions for

measuring this transformational potential of digital technologies such as the level of institutional technological development, organizational implementation, pedagogical transformation, and engagement and motivation. The main statement in this chapter relates to the idea that technology alone cannot determine the transformative degree of a digitalization process.

### 5.1.2 Chapter 3: Blended learning in higher education: trends and capabilities

The author identified four perspectives of analysis, namely social, organizational, technological, and pedagogical perspectives. The author analyzed the articles classified in each perspective to reveal potential trends with regard to digital technologies in higher education. This set of trends provided the author with an initial insight into common capabilities present in different digital technologies. Subsequently, the author analyzed some usage contexts of these capabilities. This educational technology capability concept seems suitable as a crosswise analysis tool for understanding how blended learning implementations use multiple digital technologies, as technological enablers, for achieving specific learning objectives.

These capabilities show different levels of maturity characterized by two aspects. The first aspect relates to differences in the development level of the capability from the technological perspective. The second aspect relates to the level of instructor expertise in using that capability and how the instructor aligns the capability to specific learning objectives. This exploratory study presents the definition of educational technology capability concept and a typology of these capabilities.

As previously stated, different technologies may provide the same capability; however, such capability may present different maturity levels of technological development for each technological tools or platforms. This integration or convergence of capabilities is another characteristic identified in successful blended learning implementations.

Finally, these findings may be explained by a better understanding of the alignment between technology and pedagogy, and by a reinforcing effect when several capabilities are interacting and providing more refined implementations. As a result, educational technology capabilities as a concept may provide an alternative and broad perspective for analyzing and improving not only the level of alignment of pedagogy and technology, but also a technological investment strategy. In this scenario, various implementations involving different technologies may be analyzed and compared with respect to cost effectiveness, instructor and organizational expertise, and technological development level.

### 5.1.3 Chapter 4: Transparency in previous literature reviews about blended learning in higher education

The processes for analysis and interpretation of findings in previous literature reviews, intended to uncover the main themes discussed, assess the level of transparency, and reveal current practices in reporting process in standalone blended learning reviews in higher education.

Findings show 65% of the articles in the sample are narrative reviews and 15% are descriptive reviews. Thus, 80% of the sample focuses on describing a phenomenon of interest as an overarching goal (Rowe, F., 2014). The author identified that the majority of the cases of narrative and more than the 50% of the descriptive reviews were classified in the two lower quartiles. Being classified in these quartiles shows low levels of information disclosure when reporting methodological issues in these articles.

What it is also interesting is that the majority of the review types not classified as describing were published in the last five years and classified mostly in the two higher quartiles. Despite this trend of review type diversification, findings show only three

studies focusing on understanding, four studies focusing on theory testing, and one study focusing on theory building or explaining a phenomenon.

Regarding the explaining category (Rowe, F., 2014), few articles were classified in this category. This low level of theoretical review publication may be explained by the novelty of blended learning as a research domain when compared to other more mature domains such as Information Systems (IS) (Templier & Paré, 2017). However, further research analyzing this behavior in other sub-areas of research in blended learning and research domains may provide a better insight into the review process regarding the type of review. Findings show no articles classified as realist reviews.

Findings show low levels of transparency in review papers in the sample. Most articles were classified in the two lower quartiles. In particular, narrative, scoping, and theoretical reviews comprise almost the majority of reviews in these two quartiles. This lack of explicitness may affect the internal and external reliability of the process and the potential impact of these scientific works in scientific and practitioner contexts (Paré *et al.*, 2015). Few review papers disclose information about guidelines or frameworks used for conducting their research. As expected, for those using these guidelines or frameworks, the level of transparency was higher. Thus, identifying whether this information is reported explicitly or not should be added to future transparency assessment schemas for standalone literature reviews. This methodological disclosure may have a positive impact in the scientific community providing new insights of previous research and higher levels of trustworthiness.

## 5.2 Theoretical contributions

This study oriented the efforts toward proposing a classification of digital technologies and constructing a framework that provides a map of individual trajectories of

digitalization, while measuring their transformative levels based on a multi-dimensional approach. This tool integrates the different categories of digitalization with the characteristics of pedagogical designs as well as the characteristics of implementation processes. A multi-dimensional perspective is necessary for the alignment of: 1) an adequate choice of educational technologies; 2) the careful redesign of the teaching/learning approaches; and 3) a sustaining context implementation.

Represented in a radar graph, this multi-dimensional perspective includes: 1) the educational technology role with respect to students' engagement and motivation; 2) the transformative level of the pedagogical approaches; 3) the technological development; and 4) the different levels or stages of implementations in higher education institutions. These dimensions explained in chapter 2 comprise the main elements of this proposed tool for measuring the transformational level of digital technologies. This tool presents two main functions. It may help mapping and comparing the institutional level of transformation among higher education institutions.

This research also provides a definition for educational technology capability, proposes a typology, and presents a conceptual model describing the relationships between educational technology capabilities, digital technological characteristics, tool or platforms functionalities, and learning objectives. By identifying, defining, and analyzing the concept of educational technology capabilities, this study provides a crosswise perspective of analysis for digital technology implementations in the context of higher education.

Educational technology capabilities are defined as a set of common abilities present in different digital technologies that enable a set of learning objectives. These capabilities (e.g., datafication, scalability) include sets of combined technological characteristics (e.g., storage, manipulability, user control) and tool functionalities that are present in

different digital technologies and enable learning objectives (e.g., self-paced learning, personalization). Educational technology capabilities show different levels of maturity which are characterized by two aspects: 1) the level of development of the capability from a technological perspective, and 2) the level of instructor expertise in using that capability and how the instructor aligns the capability with specific learning objectives.

This perspective may extend the concept of a technological enabler to complement the analysis of digital transformations. Technological enablers, according to Christensen *et al.* (2009), refer to sophisticated technologies that allow for the simplification of processes to routinize them, thus replacing the previous processes which required significant human resources. In particular, educational technology capabilities may be useful in uncovering whether and why a particular technology has any effect on students' learning outcomes or enhances students' acquisition of specific learning. This exploratory analysis shows higher levels of transformation in pedagogical practices when: 1) technological tools or platforms show higher levels of maturity, or 2) multiple capabilities are successfully aligned with learning goals during the implementation.

## 5.3 Empirical contributions

The study identifies and collects information about digital technologies described in the literature for implementations of blended learning in higher education. This data was analyzed and classified according to the main technical functionalities and presented as categories of technological propositions. Based on these categories of digital technologies, complementary data was extracted regarding current usage practices. This information is important for: creating a comprehensive portrait of current digital technologies and educational practices; identifying patterns and trends in the development of the relationships between technologies and educational practices,

particularly those related to educational technology capabilities; and enabling further comparative studies.

This study also collects detailed information about the main themes discussed in previous literature reviews on blended learning in higher education (e.g., barriers, effects, impacts, pedagogical frameworks). This data helps to identify the current focal points of literature reviews papers on blended learning. Additionally, it may also provide meaningful information for further comparative analyses. These analyses may identify patterns from a broader perspective about the relationships between education and digital technologies.

Finally, this study provides information about methodological reporting practices from previous standalone literature reviews based on selected coding schemas. This study proposes a mathematical formula for calculating the level of transparency for standalone review articles. The author divided selected review articles into quartiles based on their level of transparency in order to identify patterns, specifically with respect to review types. Finally, this study includes a detailed analysis of current practices in the reporting of methodological decisions and activities in standalone reviews. This information is important not only for researchers seeking to enhance the trustworthiness of their review papers, but also for future comparative studies in the research field of education.

## 5.4 Limitations

The quality of a standalone literature review depends on both the rigor of the research process (Paré *et al.*, 2016) as well as the quality of the sources (Tricco *et al.*, 2011). Several limitations of the present study were identified with respect to the research process, specifically in term of the search strategy and study selection. In particular,

Chapter 2 limited the electronic database search to peer-reviewed scientific journal articles that are written in English and contain the keywords defined for the search process. Some articles may not have been included due to these restrictions; nevertheless, the author performed a backward and forward search to minimize the potential risk for erroneous exclusions.

With regard to study selection, due to the specificity of the exclusion criteria, the author may have excluded some relevant articles during the screening process performed on titles, keywords, and abstracts. However, a principle of delayed exclusion was applied throughout the entire process; i.e., in cases of doubt or lack of information, the exclusion was not applied and the articles were evaluated in later steps of the process.

The author identified and performed multiple activities throughout the research process to minimize: the risk of errors in the codification, biases, and misinterpretations. Initial considerations, methodological decisions, and activities were documented in the research protocol and refined throughout the process to provide the basis for an explicit reporting of the research process. Nevertheless, two limitations could affect the generalizability of the results. First, due to the lack of explicitness about positioning the papers as standalone literature reviews, some articles may have been excluded when searching electronic databases and online scientific citation indexes. To minimize the impact of this, the author performed additional activities, including the backward and forward search. Second, with the exception of Cooper (1988), the main methodological papers on standalone literature reviews used in this work come from research domains others than education.

## 5.5 Implications for practice

Previous literature shows technology as a complex element operating in varied educational settings. For blended learning implementations in particular, findings show that digital technologies may initiate sustaining or disruptive innovation. In this case, it is not the technology as an isolated component that drives the transformational process in blended learning implementations, but rather the way it is used.

The information presented in this study is important for: creating a comprehensive portrait of current digital technologies and educational practices; identifying patterns and trends in the development of the relationships between technologies and educational practices; and enabling further comparative studies. Practitioners should focus on using this information, the proposed technology classification, and framework to: 1) map their current technological environment; and 2) measuring the transformative level of their particular technological environment. These activities may provide higher education institutions with the required elements to develop institutional strategies and policies, improve their learning-teaching processes, and properly align all dimensions of the proposed framework for successful implementations of blended learning. As a result, institutional processes may respond more effectively to particular course-level contexts.

Practitioners may also focus on identifying the right technology that provides the appropriate capabilities at the required maturity levels for a proper alignment with their learning objectives. The concept of educational technology capabilities can provide instructors with a tool for evaluating and selecting an appropriate technology to apply in their learning-teaching environments. However, further empirical research is required to validate the assumptions of this type of exploration and, in particular, the

assumptions related to the maturity levels of instructor expertise and technological development.

Finally, this work presents a procedure for assessing the levels of transparency of standalone literature reviews, particularly with respect to the reporting of their research practices. This procedure assesses the most accepted activities when carrying out a rigorous review process. Evaluations of the level of transparency of reviews can offer complementary guidance to support evidence-base practices when implementing blended learning by encouraging the selection of studies with higher levels of trustworthiness.

## 5.6 Policy implications

Different digital tools and platforms used in educational contexts can provide the same educational technology capability despite differences in specific functionalities. Deploying, using, and managing tools or platforms implies an increase in economic investment, support time, and the implementation of a permanent training process for students, instructors, and faculty members interested in using these tools in learning-teaching activities. Educational technology capabilities, as a complementary conceptual tool for analyzing future technological implementations, may encourage policy makers and practitioners to prioritize and align institutional efforts in blended learning implementations. This tool may provide additional insights into redundancy and wasteful investments, in terms of human and economic resources, for the purposes of acquiring and deploying digital technologies in higher education institutions.

## 5.7 Implications for future research

In this study the author collected data about digital tools with respect to the functionalities they provide (e.g., virtual labs, assessment tools). This information was classified into thirty categories namely technological propositions. Subsequently, these technological propositions were grouped into five groups, namely technological enablers. Further research may continue this work by extending the analysis to other areas such as e-learning; and refining the classification of technological propositions and technological enablers into a typology of digital technologies in education, and the set of criteria used for the classification. Future research may also focus on using this classification and the proposed framework for measuring the transformative level of digital technologies in blended learning to analyze and compare blended learning and e-learning implementations. In particular, further research is required to operationalize the measurement of each dimension of this framework.

Additionally, from selected literature, the author collected data about the main actors leading the innovation. This extracted data showed three main levels of analysis. These levels include: individuals (e.g., instructors, faculty members), organizations (e.g., university, academic units), and external systems (e.g., national initiatives, governmental institutions). Researchers may focus on providing more detailed accounts of who is really motivating blended learning innovations and in what contexts. These accounts could provide complementary insights about the transformation process. In particular, they may shed light on the power and influence of academic units with respect to technological policies.

Moreover, some empirical research is required to deepen the understanding of educational technology capabilities and the contexts of their use. These studies may focus on identifying hypothesized capability maturity levels for both the technological

development and user expertise dimensions. Further research might also focus on identifying factors that promote and/or barriers that impede higher capability maturity levels in blended learning implementations.

Finally, as research into blended learning continues to develop, future work concerning standalone literature reviews might proceed in two directions. The first being to extend the analysis of methodological aspects from other perspectives (e.g., pedagogical, social). Studies proceeding in this direction may reveal differences in practices that could improve current research methods and validate some of the interpretations in the present study. The second being to investigate the low levels of transparency and current focuses of some specific review types. This direction should focus on improving the transparency levels in all types of standalone reviews and the understanding of the complexity of the relationship between education and technology. This understanding may reveal the mechanisms of how blended learning implementations in complex educational interventions work or fail, and in which particular contexts or settings. Current review papers in the research field do not achieve this objective. Thus, future directions may use other approaches for synthesizing existing research.

# APPENDIX A

## PROFILE OF ARTICLES SELECTED FOR CHAPTER III ORDERED BY AUTHORS

| | Authors, year, title – (Country or region) | Actors analyzed | Level of implementation | Design considerations | Used for |
|---|---|---|---|---|---|
| 1. | Bahji *et al.* (2015) - Learners' Attitudes towards Extended-Blended Learning Experience Based on the S2P Learning Model – (Morocco). | Students | Course Level | Conceptual framework Learning Model (learning strategy, platform and process). | Motivation and engagement. |
| 2. | Bai & Smith (2010) - Promoting Hybrid Learning through a Sharable eLearning Approach – (USA). | Faculty | Course Level | Courses redesign using open access resource framework. | Personalization, Teaching efficiency, cost reduction, collaboration, assessment, standardization, tutoring, compatibility, scalability, reusability, portability. |
| 3. | Bang (2013) - Hybrid-Mentoring Programs for Beginning Elementary Science Teachers – (USA). | Students | Course Level | Previous design, Pedagogical Frameworks, Expert Organizational Support. | Teacher-learner Communication, Immersion and collaborative capabilities. |
| 4. | Busch *et al.* (2013) - Digital Games and the Hero's Journey in Management Workshops and Tertiary Education – (Germany). | Students | Course Level | Course redesign for self-study and playful interactions. | Engagement, Immersive. |
| 5. | Chang & Liu (2013) - Applying an AR technique to enhance situated heritage learning in a ubiquitous learning environment – (Taiwan). | Students | Course Level | Design for enhancing motivation with story-based activities using alternative physical spaces and augmented reality. | Immersion experience. |
| 6. | Chou & Chou (2011) - Course Management Systems and Blended Learning: An Innovative Learning Approach – (USA). | Students | Course Level | No explicit design and<br>No institutional expert support. | Teacher-learner communication. |

| | Authors, year, title – (Country or region) | Actors analyzed | Level of implementation | Design considerations | Used for |
|---|---|---|---|---|---|
| 7. | Couzens *et al.* (2015) - Support for Students with Hidden Disabilities in Universities: A Case Study – (Australia). | Students, Faculty | Institutional, Orchestration | Expert Support – Previous Design. | Assistive, Collaborative. |
| 8. | Danker (2015) - Using flipped classroom approach to explore deep learning in large classrooms – (Malaysia). | Students | Course Level | Course design for flipped classes with explicit use of inquiry-based learning, active learning, and peer-learning. | Individualization by one-to-one tutoring model. |
| 9. | Dracup (2008) - Role play in blended learning: A case study exploring the impact of story and other elements – (Australia). | Students | Course Level | Course redesign for engaging students with role play. | Asynchronous communication. |
| 10. | El-Ghareeb & Riad (2011) - Empowering Adaptive Lectures through Activation of Intelligent and Web 2.0 Technologies (Arab Countries). | Faculty | Institutional | Redesign course as an adaptive tutoring during in-class activities based on assessment and student's feedback. | Personalization, Assessment, Personalization, Systems integration, communication. |
| 11. | Ettarh (2016) - A Practical Hybrid Model of Application, Integration, and Competencies at Interactive Table Conferences in Histology (ITCH) – (USA). | Students | Course Level | Redesign curriculum and course. | Content delivery, teacher-learner asynchronous communication, learner-learner asynchronous communication, collaborative. |
| 12. | Foshee *et al.* (2016) - Technology-enhanced learning in college mathematics remediation – (USA). | Students | Course Level | Course design for an adaptive self-paced and mastery-based approach. | Personalization. |
| 13. | Francis & Shannon (2013) - Engaging with Blended Learning to Improve Students' Learning Outcomes – (Australia). | Students | Course Level | Course design for aligning assessment and feedback. | Data-driven process, Feedback and assessment, peer assessment. |
| 14. | Fulkerth (2009) - A Case Study from Golden Gate University: Using Course Objectives to Facilitate Blended Learning in Shortened Courses – (USA). | Students | Course Level | Redesign with a pedagogical expert, aligned with technology, institutional support. | Content delivery, teacher-learner asynchronous communication, content production. |
| 15. | Ghadirian *et al.* (2016) - Growth Patterns and E-Moderating Supports in Asynchronous Online Discussions in an Undergraduate Blended Course – (Malaysia). | Students | Course Level | Design for communication improvement. | Asynchronous communication, collaborative. |
| 16. | Grgurovic (2014) - An application of the Diffusion of Innovations theory to the investigation of blended language learning – (USA). | Students, Faculty | Course Level | No previous design, no institutional expert support, but change agent. | Content delivery, teacher-learner Asynchronous communication. |
| 17. | Gynther (2016) - Design framework for an adaptive MOOC enhanced by blended learning: supplementary training and personalized learning for teacher professional development – (Denmark). | Students, Faculty | Course Level | Course design for applying a pedagogical framework for using an adaptive MOOC. | Personalization. |
| 18. | Hinkelman & Gruba (2012) - Power within Blended Language Learning Programs in Japan – (Japan). | Faculty | Academic Unit | Role of power in designing blended learning environments. | Content Production and delivery. |
| 19. | Hoic-Bozic *et al.* (2016) - Recommender system and web 2.0 tools to enhance a blended learning model – (Croatia). | Students | Course Level | Design for enhancing collaboration and problem-based competences. | Personalization, collaboration, technology integration. |

| | Authors, year, title – (Country or region) | Actors analyzed | Level of implementation | Design considerations | Used for |
|---|---|---|---|---|---|
| 20. | Hsieh & Wu (2013) - Exploring learning performance toward cognitive approaches of a virtual companion system in line app for m-learning – (Taiwan). | Students | Course Level | Adaptive guidance methods aligned with student's cognitive style. | Personalization. |
| 21. | Hutchings & Quinney (2015) - The Flipped Classroom, Disruptive Pedagogies, Enabling Technologies and Wicked Problems: Responding to 'the Bomb in the Basement' – (UK). | Students, Faculty | Institutional | Framework proposal, expert support, orchestration from individual, academic unit, and institutional implementations. | Collaborative, assessment. |
| 22. | Khawaja *et al.* (2013) - Can more become less? Effects of an intensive assessment environment on students' learning performance – (Australia). | Students | Course Level | Design for adapting content delivery based on intensive assessment. | Assessment, personalization, content delivery. |
| 23. | Kleinert *et al.* (2015) - Web-Based Immersive Virtual Patient Simulators: Positive Effect on Clinical Reasoning in Medical Education – (Germany). | Students | Course Level | Course design for competence development in clinical decision making. | Engagement and Motivation, scalability in content, content delivery, immersion, human-machine interaction. |
| 24. | Li & Chen (2009) - A coursework support system for offering challenges and assistance by analyzing students' web portfolios – (Taiwan). | Students | Course Level | Design for assisting students in coursework assignments by adaptive activities and peer support. | Personalization, collaboration. |
| 25. | Martin & Whitmer (2016) - Applying learning analytics to investigate timed release in online learning – (USA). | Students | Course Level | No explicit design consideration for using LMS adaptive content settings (by time). | Content delivery. |
| 26. | Masikunas *et al.* (2007) - The Use of Electronic Voting Systems in Lectures within Business and Marketing: A Case Study of Their Impact on Student Learning. | Students | Course Level | Redesign for enhancing learner-teacher interaction. | Data-driven process. |
| 27. | Nachmias & Ram (2009) - Research Insights from a Decade of Campus-Wide Implementation of Web-Supported Academic Instruction at Tel Aviv University – (Israel). | University | Institutional | Individual pedagogical design, Institutional central expert support. | Content delivery. |
| 28. | Nakayama, M. *et al.* (2010) - The role of essay tests assessment in e-learning: a Japanese case study – (Japan). | Students | Course Level | Design for improving assessment in essay tests type. | Automation. |
| 29. | Oddie *et al.* (2010) - Introductory Problem Solving and Programming: Robotics Versus Traditional Approaches – (UK). | Students | Course Level | Course redesign to enhance programming skills development. | Collaborative, Competence development, engagement. |
| 30. | Pellas & Kazanidis (2015) - On the Value of Second Life for Students' Engagement in Blended and Online Courses: A Comparative Study from the Higher Education in Greece – (Greece). | Students | Course Level | Collaborative design for enhancing engagement by using virtual world's platforms. | Engagement and motivation, immersion experiences, technology integration. |

| | Authors, year, title – (Country or region) | Actors analyzed | Level of implementation | Design considerations | Used for |
|---|---|---|---|---|---|
| 31. | Poelmans & Wessa (2015) - A Constructivist Approach in a Blended E-Learning Environment for Statistics – (No identified). | Students | Course Level | Design for deeper learning approaches with peer review practices. | Collaboration. |
| 32. | Reiss & Steffens (2010) - Hybrid Toolboxes: Conceptual and Empirical Analysis of Blending Patterns in Application of Hybrid Media – (Germany). | Faculty | Institutional | Standardized organizational design. | Content delivery, asynchronous communication, personalization, collaborative. |
| 33. | Suhail & Lubega (2011) - Optimization Technique for Implementation of Blended Learning in Constrained Low Bandwidth Environment – (Africa) | Universities | Institutional | No pedagogical design. | Content delivery. |
| 34. | Walta & Nicholas (2013) - The iPod Touch in association with other technologies in support of a community of inquiry in off-campus teacher education – (Australia). | Students | Course Level | Previous design, pedagogical frameworks, expert level. | Collaborative. |
| 35. | Xu (2010) - Examining the Effects of Digital Feedback on Student Engagement and Achievement – (USA). | Students | Course Level | Previous design, amateur. | Teacher-learner asynchronous communication, content editing. |
| 36. | Yang *et al.* (2014) - An Online Adaptive Learning Environment for Critical-Thinking-Infused English Literacy Instruction – (Taiwan). | Students | Course Level | Design for adaptive instruction. | Individualized feedback, collaboration, scalability. |
| 37. | Yilmaz *et al.* (2013) - Design-Oriented Enhanced Robotics Curriculum – (USA). | Students | Course Level | Curriculum redesign form lecture-based teaching style into laboratory-based, project-driven educational experience. | Collaborative, synchronous communication, engagement. |

# APPENDIX B

## TECHNOLOGY PORTRAIT OF BLENDED LEARNING IN HIGHER EDUCATION

| | Digital technological propositions | Digital technologies | Examples of literature discussing about specific educational technology |
|---|---|---|---|
| 1. | E-learning platforms | Virtual learning environments (VLE), learning management systems (LMS), content management systems (CMS), SPOCs, open university platforms, MOOCs. | (Ayala, 2009) (Zhu, 2015) (Fleck, 2012) (Mirriahi & Alonzo, 2015) |
| 2. | Online discussion tools | Online discussion board, online forums | (Barhoumi, 2015) (Macharaschwili & Coggin, 2013) (Richardson, 2009) (MacKinnon, 2015) |
| 3. | E-mail | E-mail. | (Galan-Manas, 2011) |
| 4. | Instant messaging and Chat Tools | WhatsApp, skype, chat, SMSs. | (Barhoumi, 2015) (Macharaschwili & Coggin, 2013) |
| 5. | Website creation tools | Wiki, web 2.0 tools, blogs. | (Miyazoe & Anderson, 2010) (Manca & Ranieri, 2016) (Watson, 2010) (Machado, 2011) |
| 6. | Authoring tools | Authoring tools, online tutorial, mobile content, digital content design, PowerPoint. | (van Oordt & Mulder, 2016) (Mackey & Ho, 2008) (Arduser, 2016) (Pavlik, 2015) (McLaughlin, J. S., 2010) |
| 7. | Video tools | YouTube, vodcasts, video streaming, videos, video lectures, video annotation tools, TV, screencasts, reflection tools, note taking tools, movies & films. | (Barry *et al.*, 2016) (van Oordt & Mulder, 2016) (McKinney & Page, 2009) (Pond, 2016) (Montrieux *et al.*, 2015) (Ball *et al.*, 2013) |
| 8. | Online conference tools | Audioconference, videoconference | (Renes & Strange, 2011) (Szeto & Cheng, 2016) |
| 9. | Online survey tools | Online formative assessment tools, online formal assessment tools, feedback tools, assessment tools. | (Morris, 2010) (Nguyen, 2017) (Thomas, R. A. *et al.*, 2017) (Moeller *et al.*, 2010) |
| 10. | Mobile apps | Mobile learning, mobile content, mobile devices, laptops, iPod Touch. | (Brett, 2011) (Malone, 2012) (Moh, 2015) (Fredlund, 2010) (Walta & Nicholas, 2013) |
| 11. | Specific domain learning tools | Training tools, systems for creativity learning activities, simulators, problem-based learning tools, math software, language learning tools, GIS learning tools. | (Udroiu, 2016) (Shi-Jer *et al.*, 2012) (Barker *et al.*, 2007) (Misfeldt, 2015) (Hmelo-Silver *et al.*, 2009) (Simonovits, 2011) (Neumeier, 2005) (Kamruzzaman, 2014) (Foster *et al.*, 2011) |
| 12. | Social networking systems | Twitter, social media. | (Menkhoff *et al.*, 2015) |
| 13. | Immersive technologies | Virtual worlds, virtual reality, augmented reality. | (Minocha & Roberts, 2008) (Bidarra & Rusman, 2017) (de Freitas *et al.*, 2010) |
| 14. | Open electronic resources & learning objects | Reusable learning objects, open electronic resources (OER). | (Navarro *et al.*, 2013) (Mattheos *et al.*, 2010) |
| 15. | Adaptive learning platforms | VLEs with adaptive features, virtual companion systems (VCS), recommender systems, personalized learning platforms, intelligent tutoring systems. | (Martin & Whitmer, 2016) (Hsieh & Wu, 2013) (Hoic-Bozic *et al.*, 2016) (McKenzie *et al.*, 2013) (Trukhacheva *et al.*, 2011) |

| | Digital technological propositions | Digital technologies | Examples of literature discussing about specific educational technology |
|---|---|---|---|
| 16. | Digital Games and Gamification | Gamification, digital games. | (Bahji *et al.*, 2015) (Busch *et al.*, 2013) |
| 17. | Virtual labs | Virtual microscope, virtual labs. | (Maybury & Farah, 2010) (Meenakshi, 2016) |
| 18. | Audio tools | Podcasts, audio. | (McKinney & Page, 2009) (Knauf, 2016) |
| 19. | Knowledge organization & sharing platforms | RSS feeds, knowledge sharing platforms, e-Portfolio. | (Huang *et al.*, 2011) (Seeland *et al.*, 2016) (Soeiro *et al.*, 2012) |
| 20. | Audience response systems | Clickers, audience response systems. | (McLaughlin, J. E. *et al.*, 2015) (Masikunas *et al.*, 2007) |
| 21. | Cloud-based tools | Google Docs, cloud-based tools. | (García-Ruiz *et al.*, 2014) (Seyyedrezaie *et al.*, 2016) |
| 22. | Data analysis tools | Video analytics, learning analytics tools, academic monitoring systems. | (Giannakos *et al.*, 2015) (Nakayama, M. & Yamamoto, 2011) (Martin & Whitmer, 2016) |
| 23. | Text-based tools | Reflection Tools, note taking tools, computer-assisted writing tools. | (Williamson *et al.*, 2015) (Nakayama, Minoru *et al.*, 2016) (Fang, 2010) |
| 24. | Electronic books | E-books. | (Pickering, 2015) |
| 25. | Hardware kits, embedded systems and robotics | Robotics, hardware kits, embedded systems. | (Oddie *et al.*, 2010) (Sell *et al.*, 2012) |
| 26. | Digital storytelling tools | Animation tools, animated modules. | (Mohd Yusof *et al.*, 2014) (Persky, 2015) |
| 27. | Assistive technologies | Assistive technologies. | (Couzens *et al.*, 2015) |
| 28. | Delivery media | DVD. | (Van der Westhuizen *et al.*, 2012) |
| 29. | Image-based tools | Photo journals. | (Madden & Dell'Angelo, 2016) |
| 30. | Infrastructure | Internet, desktop virtualization. | (Suhail & Lubega, 2011) (Fennell, 2010) |

Full references of the 1,017 abstracts are available upon request.

# APPENDIX C

## LIST OF ARTICLES FOR ANALYSIS IN CHAPTER 4

1. Arbaugh, J. B. (2014). What Might Online Delivery Teach Us about Blended Management Education? Prior Perspectives and Future Directions.
2. Ata, R. (2016). An exploration of higher education teaching in second life in the context of blended learning.
3. Bahji, S. E., El Alami, J., & Lefdaoui, Y. (2015). Learners' Attitudes Towards Extended-Blended Learning Experience Based on the S2P Learning Model.
4. Bai, X., & Smith, M. B. (2010). Promoting Hybrid Learning through a Sharable eLearning Approach.
5. Brett, P. (2011). Students' experiences and engagement with SMS for learning in higher education.
6. Chang, Y. H., & Liu, J.-c. i. (2013). Applying an AR Technique to Enhance Situated Heritage Learning in a Ubiquitous Learning Environment.
7. Collins, R. (2011). Credential Inflation and the Future of Universities.
8. Danker, B. (2015). Using Flipped Classroom Approach to Explore Deep Learning in Large Classrooms.
9. Dursun, Ö. Ö., & Akbul, Y. (2012). Communicator Style as a Predictor of Cyberbullying in a Hybrid Learning Environment.
10. El-Ghareeb, H., & Riad, A. (2011). Empowering Adaptive Lectures through Activation of Intelligent and Web 2.0 Technologies.
11. Foshee, C. M., Elliott, S. N., & Atkinson, R. K. (2016). Technology-Enhanced Learning in College Mathematics Remediation.
12. Francis, R. & Shannon, S. J. (2013). Engaging with blended learning to improve students' learning outcomes.
13. Garrison, D., & Arbaugh, J. B. (2007). Researching the community of inquiry framework: Review, issues, and future directions.

14. Garrison, D., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education.
15. Gerbic, P. (2011). Teaching Using a Blended Approach--What Does the Literature Tell Us?
16. Ginns, P., & Ellis, R. A. (2009). Evaluating the quality of e-learning at the degree level in the student experience of blended learning.
17. Graham, S., (2016). Bridging Urban Digital Devices? Urban Polarization and Information and Communications Technologies (ICTs). *Urban Studies*, 39(1), 33-56.
18. Graham, C. R., Woodfield, W., & Harrison, J. B. (2013). A Framework for Institutional Adoption and Implementation of Blended Learning in Higher Education.
19. Greyling, F., Kara, M., Makka, A., & van Niekerk, S. (2008). IT Worked for Us: Online Strategies to Facilitate Learning in Large (Undergraduate) Classes.
20. Gynther, K. (2016). Design Framework for an Adaptive MOOC Enhanced by Blended Learning: Supplementary Training and Personalized Learning for Teacher Professional Development.
21. Halverson, L. R., Graham, C. R., Spring, K. J., Drysdale, J. S., & Henrie, C. R. (2014). A thematic analysis of the most highly cited scholarship in the first decade of blended learning research.
22. Hoic-Bozic, N., Dlab, M. H., & Mornar, V. (2016). Recommender System and Web 2.0 Tools to Enhance a Blended Learning Model.
23. Hsieh, & Wu, M.-P. (2013). Exploring Learning Performance toward Cognitive Approaches of a Virtual Companion System in LINE App for m-Learning.
24. Khawaja, M. A., Prusty, G. B., Ford, R. A. J., Marcus, N., & Russell, C. (2013). Can More Become Less? Effects of an Intensive Assessment Environment on Students' Learning Performance.
25. Kleinert, R., Heiermann, N., Plum, P. S., Wahba, R., Chang, D. H., Maus, M., Stippel, D. L. (2015). Web-based immersive virtual patient simulators: Positive effect on clinical reasoning in medical education.
26. Kleß, E., & Pfeiffer, A. (2013). The bologna process and its changes for the teacher education in rhineland-palatinate, Germany-media-education-online as an innovative example for statewide cooperation of universities. International Journal of Innovation and Learning, 13(2), 218-232. doi:10.1504/IJIL.2013.052289

27. Laumakis, M., Graham, C., & Dziuban, C. (2009). THE SLOAN-C PILLARS AND BOUNDARY OBJECTS AS A FRAMEWORK FOR EVALUATING BLENDED LEARNING.
28. Li, L.-Y., & Chen, G.-D. (2009). A Coursework Support System for Offering Challenges and Assistance by Analyzing Students' Web Portfolios.
29. Littlejohn, A., Beetham, H., & McGill, L. (2012). Learning at the digital frontier: A review of digital literacies in theory and practice.
30. Martin, F., & Whitmer, J. C. (2016). Applying Learning Analytics to Investigate Timed Release in Online Learning.
31. Masikunas, G., Panayiotidis, A., & Burke, L. (2007). The Use of Electronic Voting Systems in Lectures within Business and Marketing: A Case Study of Their Impact on Student Learning.
32. McLoughlin, C., & Lee, M. (2008). The Three P's of Pedagogy for the Networked Society: Personalization, Participation, and Productivity.
33. Mitchell, P., & Forer, P. (2010). Blended learning: The perceptions of first-year geography students.
34. Nakayama, M., Yamamoto, H., & Santiago, R. (2010). The Role of Essay Tests Assessment in e-Learning: A Japanese Case Study.
35. Parsad, B., Lewis, L., & Tice, P (2008). Distance education at degree-granting postsecondary institutions: 2006-2007. Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Retrieved from http://nces.ed.gov/pubs2009/2009044.pdf.
36. Pellas, N., & kazanidis, I. (2014). Engaging students in blended and online collaborative courses at university level through Second Life: comparative perspectives and instructional affordances.
37. Pellas, N., & Kazanidis, I. (2015). On the Value of Second Life for Students' Engagement in Blended and Online Courses: A Comparative Study from the Higher Education in Greece.
38. Perišić, J., Milovanović, M., & Kazi, Z. (2018). A semantic approach to enhance moodle with personalization.
39. Picciano, A. (2009). Blending with purpose: The multimodal model. Journal of Asynchronous Learning Networks, v13 n1, p7–18.
40. Redecker, C., & Punie, Y. (2013). The future of learning 2025: developing a vision for change. Future Learning (Vol. 1, pp. 3–17).
41. Selwyn, N., & Facer, K. (2014). The sociology of education and digital technology: past, present and future.

42. Shea, P., & Bidjerano, T. (2010). Learning presence: Towards a theory of self-efficacy, self-regulation, and the development of a communities of inquiry in online and blended learning environments.
43. Siemens, G. (2013). Learning Analytics: The Emergence of a Discipline.
44. Tapsis, N., Tsolakidis, K., & Vitsilaki, C. (2012). Virtual Worlds and Course Dialogue.
45. Torrisi-Steele, G., & Drew, S. (2013). The literature landscape of blended learning in higher education: the need for better understanding of academic blended practice.
46. Tshabalala, M., Ndeya-Ndereya, C., & van der Merwe, T. (2014). Implementing blended learning at a developing university: Obstacles in the way.
47. Woods, R., Baker, J. D., & Hopper, D. (2004). Hybrid structures: Faculty use and perception of web-based courseware as a supplement to face-face instruction. Internet and Higher Education, 7, 281–297
48. Yang, Y., Gamble, J., Hung, Y., & Lin, T. (2014). An Online Adaptive Learning Environment for Critical-Thinking-Infused English Literacy Instruction.

# APPENDIX D

## PROFILE OF ARTICLES INCLUDED IN CHAPTER 5

| | Authors & Title | Purpose | Research questions stated? | Main themes | Authors' classification | Coders' classification | Years included | Number of Studies Included |
|---|---|---|---|---|---|---|---|---|
| 1. | Abu Hassana & Woodcock (2013) - Blended learning Issues and Concerns | This study aims: (1) to investigate the need for blended learning in contrast with e-learning and traditional learning. (2) to understand the concept of blended learning. (3) to explore possible ingredients of the blend. (4) to determine the factors that need to be considered when selecting a teaching style. | | DBCO, Comparisons | No stated | Narrative | No Stated | No stated |
| 2. | Al-Azawei *et al.* (2016a) - Universal Design for Learning (UDL): A Content Analysis of Peer- Reviewed Journal Papers from 2012 to 2015. | This study aims to analyze the content of twelve papers, where the UDL was adopted. | | MFP | No stated | Scoping | 2012-2015 | 12 |
| 3. | Alammary *et al.* (2014) - Blended learning in higher education: Three different design approaches. | This paper aims to provide guidance to help teachers of traditional face-to-face courses in selecting the most appropriate approach to use when designing their blended courses. | Y | DBCO | No stated | Narrative | 2014-2004 | No stated |
| 4. | Alebaikan & Troudi (2010) - Blended learning in Saudi universities: Challenges and perspectives. | This study is an attempt to investigate the nature of obstacles and challenges encountered at Saudi universities while implementing a blended learning approach. | | DBCO | No stated | Narrative | No Stated | No stated |
| 5. | Alkraiji & Eidaroos (2016) - Trends and Issues in Educational | The purpose of this study is to reveal the status of studies on educational technologies conducted in Saudi | | Trends | Meta-analysis | Descriptive | 2004-2015 | 52 |

| | Authors & Title | Purpose | Research questions stated? | Main themes | Authors' classification | Coders' classification | Years included | Number of Studies Included |
|---|---|---|---|---|---|---|---|---|
| | Technology Research in Saudi Higher Education: A Meta-Analysis Review. | universities in terms of the trends (i.e. types of technology, target groups, the socio-technical research context, research theories, and the research paradigm and methodology) and the various issues on which the studies under review have concentrated. | | | | | | |
| 6. | Arbaugh *et al.* (2009) - Research in online and blended learning in the business disciplines: Key findings and possible future directions. | In this literature review, we examine and assess the state of research of online and blended learning in the business disciplines with the intent of assessing the state of the field and identifying opportunities for meaningful future research. | | Comparisons | No stated | Narrative | 2000-2008 | 182 |
| 7. | Arbaugh *et al.* (2010) - A review of research on online and blended learning in the management disciplines: 1994–2009. | This paper review studies of online and blended learning in management-oriented disciplines and management-related topics. | | Comparisons | No stated | Narrative | 1994–2009 | 75 |
| 8. | Arbaugh (2014) - What Might Online Delivery Teach Us About Blended Management Education? Prior Perspectives and Future Directions. | This article examines the literatures of blended and fully online management education to determine whether there are factors that may influence instructional effectiveness that are unique to blended learning. | | EEI, Comparisons | No stated | Narrative | 2000-2013 | No stated |
| 9. | Berk (2013) - Face-to-Face versus Online Course Evaluations: A "Consumer's Guide" to Seven Strategies. | The purpose of this paper is to clarify the measurement options available to evaluate teaching effectiveness in online courses primarily for faculty employment decisions of contract renewal, merit pay, teaching awards, promotion, and tenure. | | EEI, Comparisons | No stated | Narrative | No Stated | No stated |
| 10. | Bernard, R. *et al.* (2014) - A meta-analysis of blended learning and technology use in higher education: From the general to the applied. | The goals of this paper are twofold: (1) to describe the characteristics of meta-analysis as an analytical tool, with some commentary on the various aspects of this methodology. (2) to developing a better understanding of the effectiveness of blended learning (BL) in higher education. | Y | EEI | Meta-analysis | Meta-analysis | 1990-2014 | 96 |
| 11. | Bliuc *et al.* (2007) - Research focus and methodological choices in studies into students' experiences of blended learning in higher education. | This paper reviews research into university students' experiences of blended learning, using an approach to classifying the research in terms of methodological complexity and focus. | | MFP | No stated | Scoping | No Stated | 300 |
| 12. | Boelens *et al.* (2017) - Four key challenges to the design of blended learning: A systematic literature review. | The aim of the present review is to offer an overview of how studies on blended learning environments deal with the following key challenges: (1) incorporating flexibility (2) stimulating interaction (3) facilitating students' | Y | DBCO | Systematic literature review | Descriptive | 2003-2014 | 20 |

| | Authors & Title | Purpose | Research questions stated? | Main themes | Authors' classification | Coders' classification | Years included | Number of Studies Included |
|---|---|---|---|---|---|---|---|---|
| | | learning processes, and (4) fostering an affective learning climate. | | | | | | |
| 13. | Bogdan *et al.* (2017) - Current trends in blended university courses with MOOCs. | The aim of this study is to analyze the existing models of MOOCs integration in university blended learning, starting from a corpus of valuable published studies. | Y | Trends | No stated | Descriptive | 2012-2016 | 52 |
| 14. | Boone (2015) - Leading learning organizations through transformational change. | The purpose of this paper is to examine implications of and recommend blended learning strategies. | | DBCO | No stated | Narrative | No Stated | No stated |
| 15. | Brown (2016) - Blended instructional practice: A review of the empirical literature on instructors' adoption and use of online tools in face-to-face teaching. | The purpose of this review was to identify peer-reviewed research that examined the factors shaping blended instructional practice in undergraduate education. | Y | DBCO, MFP | No stated | Narrative | No Stated | 58 |
| 16. | Caravias (2015) - Literature Review in Conceptions and Approaches to Teaching using Blended Learning. | This paper presents a critical review and synthesis of research literature in higher education exploring teachers' conceptions of blended learning and their approaches to both design and teaching. | | Topics | Critical review | Narrative | No Stated | 97 |
| 17. | Crawford, R. & Jenkins (2015) - Investigating the importance of team teaching and blended learning in tertiary music education. | The first stage in investigating the possible importance of team teaching and blended leaning in tertiary music education is to review the current and recent past literature surrounding this study. It is from this that an appropriate methodology can then be designed. | Y | Topics | No stated | Narrative | No Stated | No stated |
| 18. | Drysdale *et al.* (2013) - Analysis of research trends in dissertations and theses studying blended learning. | A summary of trends regarding the growth and context of blended learning research is presented. | Y | Trends | No stated | Descriptive | 2011-2012 | 205 |
| 19. | Duhaney (2012) - Blended learning and teacher preparation programs. | This paper provides a basic review of blended learning and some ways it may be used in teacher preparation programs to support the effective integration of ICT within the classroom environment. | | Topics | No stated | Narrative | No Stated | No stated |
| 20. | Gikandi *et al.* (2011) - Online formative assessment in higher education: A review of the literature. | This paper aims to fill that gap with a focus on how formative assessment support learners in developing domain content knowledge and professional skills in an online environment. We also aim to enhance understanding of the core assessment concepts of validity and reliability as they occur in online contexts. These issues include concepts such as validity and reliability of assessment in online environments in relation to serving the intended purposes, as well as understanding how | | Topics | Integrative narrative review | Narrative | 2004-2010 | 18 |

| | Authors & Title | Purpose | Research questions stated? | Main themes | Authors' classification | Coders' classification | Years included | Number of Studies Included |
|---|---|---|---|---|---|---|---|---|
| | | formative assessment functions within online and blended learning. | | | | | | |
| 21. | Halverson, L. R. *et al.* (2014) - A thematic analysis of the most highly cited scholarship in the first decade of blended learning research. | After finding where the conversations about blended learning was happening and which scholars were at the forefront of these conversations, we now look at what the conversations on blended learning are really about. | Y | Trends | Thematic analysis | Descriptive | 2000-2011 | 60 |
| 22. | Robles Haros *et al.* (2016) - University teachers' beliefs about teaching and learning of b-learning courses. A bibliographic review. | The present study aims to conduct a bibliographic review of studies of teachers' beliefs about teaching and learning in Blended Learning (B-Learning) mode. | | Topics | Bibliographic | Narrative | No Stated | 8 |
| 23. | Harris *et al.* (2009) - Blended learning: Overview and recommendations for successful implementation. | The purpose of this paper is to identify key themes within the blended learning literature and to develop a series of practical recommendations to facilitate the successful adaptation and implementation of a ''blended approach to learning delivery''. | | DBCO, Trends | General review | Narrative | 1997-2009 | 31 |
| 24. | Israel (2015) - Effectiveness of integrating MOOCs in traditional classrooms for undergraduate students. | This paper reviews some recent experiments in the context of current trends in MOOCs by examining methodologies utilized in blended MOOCs in a face-to-face environment. This paper further discusses the preliminary findings related to its effectiveness of learning outcomes and its impact on students and instructors in blended MOOCs format. | Y | DBCO, EEI | No stated | Narrative | No Stated | No stated |
| 25. | Keengwe & Jung-Jin (2012) - Blended Learning in Teacher Preparation Programs: A Literature Review. | This paper reviews relevant literature on the concept and design of blended learning in Teacher Preparation Programs (TPPs). | Y | EEI, Topics | No stated | Narrative | No Stated | 42 |
| 26. | Lamport & Hill (2012) - Impact of hybrid instruction on student achievement in post-secondary institutions: A synthetic review of the literature. | The purpose of this paper is to compare the advantages and disadvantages of hybrid instruction to online and traditional formats from the lens of professors, i.e., what to do and avoid in teaching a hybrid course, and ways of fostering student achievement. | | DBCO, EEI | Synthetic review | Narrative | No Stated | No stated |
| 27. | Loncar *et al.* (2014) - Towards the refinement of the forum and asynchronous online discussion in educational contexts worldwide: Trends and investigative approaches within a dominant research | The purpose of this paper is to gather, analyze, and synthesize data in order to isolate and critically reflect upon these findings. Furthermore, we hope to address how the literature is responding to the changes in classroom and educational practice involving online discussion. | Y | Trends | Critical literature review | Descriptive | 2008-2012 | 43 |

| | Authors & Title | Purpose | Research questions stated? | Main themes | Authors' classification | Coders' classification | Years included | Number of Studies Included |
|---|---|---|---|---|---|---|---|---|
| 28. | Ma'arop & Embi (2016) - Implementation of blended learning in higher learning institutions: A review of the literature. | The aim of this review is to synthesize the available evidence in the literature on challenges faced in implementing blended learning as well as the recommendations or lessons learnt from the experience. | Y | DBCO | No stated | Narrative | 2010-2013 | 8 |
| 29. | Margulieux *et al.* (2016) - A taxonomy to define courses that mix face-to-face and online learning. | We argue that these unreliable results are due to inconsistent definitions of these courses. To address this problem, we propose the Mixed Instructional eXperience (MIX) taxonomy to define hybrid, blended, flipped, and inverted based on two dimensions. To test the usefulness of the taxonomy to organize the literature, we reclassified research using the taxonomy. | | MFP | Thematic review | Theoretical | No Stated | 49 |
| 30. | Means *et al.* (2013) - The effectiveness of online and blended learning: A meta-analysis of the empirical literature. | This meta-analysis was conducted to examine the effectiveness of both purely online and blended versions of online learning as compared with traditional face-to-face learning. | Y | EEI, Comparisons | Meta-analysis | Meta-analysis | 1996-2008 | 99 |
| 31. | Pavla *et al.* (2015) - Blended learning: promising strategic alternative in higher education. | System of higher education is under permanent development. Although it has succeeded in implementations of local or partial changes, perspective global solutions are still missing. To improve this situation, we want to propose a viable strategy for educational managers and decision makers, capable to motivate people, minimize internal tensions and stabilize this sector. | | DBCO | No stated | Narrative | No Stated | No stated |
| 32. | Rowe, M. *et al.* (2012) - The role of blended learning in the clinical education of healthcare students: A systematic review. | The aim of this paper is to determine the impact of blended learning in the clinical education of healthcare students. | Y | EEI | Systematic literature review | Narrative | 2000-2010 | 7 |
| 33. | Shivetts (2011) - E-learning and blended learning: The importance of the learner: A research literature review. | The purpose of this literature review is to explore what recent research and literature tells us about e-learning and blended learning environments, and to explore the importance of the role of the student in these environments. | | Topics | No stated | Narrative | No Stated | No stated |
| 34. | Smith *et al.* (2017) - A Critical review of the use of Wenger's Community of Practice (CoP) Theoretical Framework in online and blended learning research, 2000-2014. | This paper reviews extant empirical work grounded in this framework to investigate online/blended learning in higher education and in professional development. | Y | MFP | Critical review | Critical | 2000-2014 | 60 |

| | Authors & Title | Purpose | Research questions stated? | Main themes | Authors' classification | Coders' classification | Years included | Number of Studies Included |
|---|---|---|---|---|---|---|---|---|
| 35. | Sophonhiranrak *et al.* (2015) - Factors Affecting Creative Problem Solving in the Blended Learning Environment: A review of the literature. | The aim of this study is to examine the factors affecting creative problem solving (CPS) in blended learning environment for finding the important factors to design and monitor learning context. | | MFP | No stated | Narrative | 2004-2014 | 20 |
| 36. | Suprabha & Subramonian (2015) - Blended learning approach for enhancing students learning experiences in a knowledge society. | The purpose of the study was to get a deeper understanding of the characteristics, methodological and pedagogical perspectives of blended learning in an Indian context. | | DBCO | No stated | Narrative | No Stated | No stated |
| 37. | Torrisi-Steele & Drew (2013) - The literature landscape of blended learning in higher education: the need for better understanding of academic blended practice. | This paper uncovers the need for further research into understanding not only why academics may choose to engage in blended learning, but also, once engaged, why some choose to integrate technology to create transformative blends while others choose minimally impacting blends. | | DBCO | Literature landscape | Narrative | No Stated | 827 |
| 38. | Vasileiou (2009) - blended learning: The transformation of higher education curriculum. | The paper will analyze and discuss the selection of strategies to increase interactivity and active learning, learner characteristics, learner support and operational issues. | | DBCO | No stated | Narrative | No Stated | No stated |
| 39. | Vo *et al.* (2017) - The effect of blended learning on student performance at course-level in higher education: A meta-analysis. | The present paper analyzes the impact of blended learning (BL) on the academic achievement of higher education students. | Y | EEI | Meta-analysis | Meta-analysis | 2001-2015 | 40 |
| 40. | Weightman *et al.* (2017) - A systematic review of information literacy programs in higher education: Effects of face-to-face, online, and blended formats on student skills and views. | "The objectives of this review were (1) to update these findings with the inclusion of more recent primary research; (2) to further enhance the summary of existing evidence by including studies of blended formats (with components of both online and face-to-face teaching) compared to single format education; and (3) to explore student views on the various formats employed. | | EEI | Systematic literature review | Systematic qualitative review | 1995-2016 | 33 |

BDCO: barriers, drivers, challenges, and opportunities; EEI: effect, effectiveness, and impact; MFP: models, frameworks, and practices

# APPENDIX E

## LIST OF EXCLUDED STUDIES FROM CHAPTER 5 ORDERED BY REASON OF EXCLUSION AND AUTHORS

| Exclusion reason | | Authors & Year | Title |
|---|---|---|---|
| Not a literature review | 1. | Al-Abri *et al.* (2017) | Comprehensive classification of collaboration approaches in E-learning. |
| | 2. | Bhattacharya & Sharma (2007) | India in the knowledge economy - An electronic paradigm. |
| | 3. | Garrison & Kanuka (2004) | Blended learning: Uncovering its transformative potential in higher education. |
| | 4. | Giardina (2010) | Designing for successful diffusion - a faculty-based approach. |
| | 5. | Halverson, L. R. *et al.* (2012) | An analysis of high impact scholarship and publication trends in blended learning. |
| | 6. | Osler II & Wright (2016) | Neuro-holistic learning: an integrated kinesthetic approach to cognitive learning using collaborative interactive thought exchange in a blended environment to enhance the learning of young African-American males. |
| | 7. | Power & Gould-Morven (2011) | Head of gold, feet of clay - the online learning paradox. |
| | 8. | Ramakrisnan *et al.* (2012) | Blended learning: A suitable framework for e-learning in higher education. |
| | 9. | Shi-Jer *et al.* (2013) | Design and verification of an instructional model for blended TRIZ creative learning. |
| | 10. | Soylev (2017) | MOOCs 2.0: The social era of education. |
| | 11. | Suhail & Lubega (2011) | Optimization technique for implementation of blended learning in constrained low bandwidth environment. |
| | 12. | Tham & Tham (2013) | Challenges facing blended learning in higher education in Asia. |
| Not a focused on blended learning | 1. | Azhari & Ming (2015) | Review of e-learning practice at the tertiary education level in Malaysia. |
| | 2. | Asare (2014) | Looking beyond the residential education and distance education debate, what matters in education is. |
| | 3. | Bernard, R. M. *et al.* (2014) | Detecting bias in meta-analyses of distance education research: Big pictures we can rely on. |
| | 4. | Garrison *et al.* (2010) | The first decade of the community of inquiry framework: A retrospective. |
| | 5. | Hauck & Stickler (2006) | What does it take to teach online? |
| | 6. | Henrie *et al.* (2015) | Measuring student engagement in technology-mediated learning: A review. |
| | 7. | Ketterer (2006) | Re-conceptualizing intimacy and distance in instructional models. |

| Exclusion reason | | Authors & Year | Title |
|---|---|---|---|
| | 8. | Lai, Kwok-Wing (2011) | Digital technology and the culture of teaching and learning in higher education. |
| | 9. | Lai, Kwok-Wing. *et al.* (2013) | Blending student technology experiences in formal and informal learning. |
| | 10. | Lloyd & Bahr (2016) | What matters in higher education: A meta-analysis of a decade of learning design. |
| | 11. | Maiz Olazabalaga *et al.* (2016) | Research on MOOCs: Trends and methodologies. |
| | 12. | McCutcheon *et al.* (2015) | A systematic review evaluating the impact of online or blended learning vs. face-to-face learning of clinical skills in undergraduate nurse education. |
| | 13. | McHugh *et al.* (2010) | Preventing healthcare-associated infection through education: Have surgeons been overlooked? |
| | 14. | Msweli (2012) | Mapping the interplay between open distance learning and internationalisation principles. |
| | 15. | Mwakyusa & Mwalyagile (2016) | Impediments of e-learning adoption in higher learning institutions of Tanzania: An empirical review. |
| | 16. | O'Flaherty & Phillips (2015) | The use of flipped classrooms in higher education: A scoping review. |
| | 17. | Olpak *et al.* (2016) | Determination of perception of community of inquiry. |
| | 18. | Rayner (2014) | A review of the value of prior learning in first year biology. |
| | 19. | River *et al.* (2016) | A systematic review examining the effectiveness of blending technology with team-based learning. |
| | 20. | Schichtel (2009) | A conceptual description of potential scenarios of e-mentoring in GP specialist training. |
| | 21. | Seery (2015) | Flipped learning in higher education chemistry - emerging trends and potential directions. |
| | 22. | Yousef *et al.* (2015) | The state of MOOCs from 2008 to 2014: A critical analysis and future visions. |
| | 23. | Zainuddin & Halili (2016) | Flipped classroom research and trends from different fields of study. |
| Nor focused on higher education | 1. | Chiappe *et al.* (2016) | Open Assessment of Learning: A meta-synthesis. |
| | 2. | Horvitz (2017) | Future Directions for Research on Online Technical Education. |
| | 3. | Nederveld & Berge (2015) | Flipped learning in the workplace. |
| | 4. | Wang, Y. *et al.* (2015) | Revisiting the blended learning literature: Using a complex adaptive systems framework. |

# APPENDIX F

## TRANSPARENCY ASSESSMENT RESULTS SHEET

| | Author & Year | Type of review | S01 | | | S02 | | | | S03 | | | | S04 | | S05 | | S06 | | Number of factors | Percentage | Quartile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | | | |
| 1. | Abu Hassana & Woodcock (2013) | Narrative | Y | | | | | | | | | | | | | | | Y | | 2 | 14% | Q4 |
| 2. | Al-Azawei *et al.* (2016a) | Scoping | Y | | | Y | Y | Y | | Y | Y | | Y | | | | Y | Y | | 9 | 47% | Q3 |
| 3. | Alammary *et al.* (2014) | Narrative | Y | | | Y | Y | Y | | | | | | | | | | | | 4 | 18% | Q4 |
| 4. | Alebaikan & Troudi (2010) | Narrative | Y | | | | | | | | | | | | | | | | | 1 | 6% | Q4 |
| 5. | Alkraiji & Eidaroos (2016) | Descriptive | Y | | | Y | Y | Y | | Y | | | Y | | | Y | Y | Y | Y | 10 | 60% | Q2 |
| 6. | Arbaugh *et al.* (2009) | Narrative | Y | | | Y | Y | Y | | | | | | | | | Y | | | 5 | 26% | Q3 |
| 7. | Arbaugh *et al.* (2010) | Narrative | Y | | | Y | Y | Y | | | | | | | | | Y | Y | | 6 | 35% | Q3 |
| 8. | Arbaugh (2014) | Narrative | Y | | | Y | Y | Y | | | | | | | | | | | | 4 | 18% | Q4 |
| 9. | Berk (2013) | Narrative | Y | | | | | | | | | | | | | | | | | 1 | 6% | Q4 |
| 10. | Bernard, R. *et al.* (2014) | Meta-Analysis | Y | Y | | Y | Y | Y | Y | Y | Y | | | | Y | Y | Y | Y | Y | 13 | 78% | Q1 |
| 11. | Bliuc *et al.* (2007) | Scoping | Y | | | Y | Y | Y | | Y | | | | | | | Y | | | 6 | 31% | Q3 |
| 12. | Boelens *et al.* (2017) | Descriptive | Y | | | Y | Y | Y | Y | Y | Y | | Y | | | Y | Y | Y | Y | 12 | 68% | Q2 |
| 13. | Bogdan *et al.* (2017) | Descriptive | Y | Y | | Y | Y | Y | | | | | | | | | | | | 5 | 24% | Q4 |
| 14. | Boone (2015) | Narrative | Y | | | | | | | | | | | | | | | | | 1 | 6% | Q4 |
| 15. | Brown (2016) | Narrative | Y | | | Y | Y | Y | | Y | Y | | | | | | | | | 6 | 26% | Q3 |
| 16. | Caravias (2015) | Narrative | Y | | | Y | Y | Y | | | | | | | | | | | | 4 | 18% | Q4 |
| 17. | Crawford, R. & Jenkins (2015) | Narrative | Y | | | | | | | | | | | | | | | | Y | 2 | 14% | Q4 |
| 18. | Drysdale *et al.* (2013) | Descriptive | Y | Y | | Y | | Y | | Y | | | | | | Y | Y | Y | Y | 9 | 57% | Q2 |
| 19. | Duhaney (2012) | Narrative | Y | | | | | | | | | | | | | | | | | 1 | 6% | Q4 |
| 20. | Gikandi *et al.* (2011) | Narrative | Y | Y | | Y | Y | Y | Y | Y | Y | | | | Y | Y | Y | Y | Y | 13 | 78% | Q1 |
| 21. | Halverson, L. R. *et al.* (2014) | Descriptive | Y | Y | | Y | Y | Y | Y | Y | Y | | | Y | | Y | Y | Y | | 12 | 69% | Q2 |

| | Author & Year | Type of review | S01 | | | S02 | | | | S03 | | | | S04 | | S05 | | S06 | | Number of factors | Percentage | Quartile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | | | |
| 22. | Robles Haros *et al.* (2016) | Narrative | Y | | | Y | Y | Y | | Y | | | | | | | | Y | | 6 | 31% | Q3 |
| 23. | Harris *et al.* (2009) | Narrative | Y | Y | | Y | Y | Y | | Y | | | | | | Y | | | | 7 | 36% | Q3 |
| 24. | Israel (2015) | Narrative | Y | | | | | | | | | | | | | | | | | 1 | 6% | Q4 |
| 25. | Keengwe & Jung-Jin (2012) | Narrative | Y | Y | | Y | Y | Y | | Y | | | | | | | | | | 6 | 28% | Q3 |
| 26. | Lamport & Hill (2012) | Narrative | Y | Y | | | | | | | | | | | | | | | | 2 | 11% | Q4 |
| 27. | Loncar *et al.* (2014) | Descriptive | Y | | | Y | Y | Y | | Y | Y | | Y | | | Y | Y | | Y | 10 | 56% | Q2 |
| 28. | Ma'arop & Embi (2016) | Narrative | Y | Y | | Y | Y | Y | | Y | Y | | | | | | Y | | | 8 | 40% | Q3 |
| 29. | Margulieux *et al.* (2016) | Theoretical | Y | | | Y | | Y | | Y | Y | | | | | Y | Y | | | 7 | 39% | Q3 |
| 30. | Means *et al.* (2013) | Meta-Analysis | Y | Y | | Y | Y | Y | Y | Y | Y | | | | Y | Y | Y | Y | Y | 13 | 78% | Q1 |
| 31. | Pavla *et al.* (2015) | Narrative | Y | | | Y | Y | Y | | Y | | | | | | | | | | 5 | 22% | Q4 |
| 32. | Rowe, M. *et al.* (2012) | Narrative | Y | Y | | Y | Y | Y | | Y | | | | | | Y | Y | | | 8 | 44% | Q3 |
| 33. | Shivetts (2011) | Narrative | Y | Y | | | | | | | | | | | | | | | | 2 | 11% | Q4 |
| 34. | Smith *et al.* (2017) | Critical | Y | | | Y | Y | Y | | Y | Y | | | | | Y | Y | Y | Y | 10 | 60% | Q2 |
| 35. | Sophonhiranrak *et al.* (2015) | Narrative | Y | Y | | Y | Y | Y | | Y | Y | | | | | Y | Y | | | 9 | 49% | Q3 |
| 36. | Suprabha & Subramonian (2015) | Narrative | Y | | | | | | | | | | | | | | | | | 1 | 6% | Q4 |
| 37. | Torrisi-Steele & Drew (2013) | Narrative | Y | Y | | Y | Y | Y | | | | | | | | | | | | 5 | 24% | Q4 |
| 38. | Vasileiou (2009) | Narrative | Y | Y | | | | | | | | | | | | | | | | 2 | 11% | Q4 |
| 39. | Vo *et al.* (2017) | Meta-Analysis | Y | Y | | Y | Y | Y | Y | Y | Y | | Y | | | Y | Y | Y | Y | 13 | 74% | Q2 |
| 40. | Weightman *et al.* (2017) | Systematic qualitative | Y | Y | | Y | Y | Y | Y | Y | Y | | Y | Y | Y | Y | Y | Y | Y | 15 | 90% | Q1 |

(Y: Yes)

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