ISCTE Business School
Department of Marketing, Operations, and General Management

Exploring university students' engagement in learning through gamification, transmedia and virtual reality

Fernando José de Aires Angelino

Thesis specially presented for the fulfilment of the degree
of Doctor in Management, with specialization in Marketing

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December 2019

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December 2019

Para os meus filhos Ana, Maria e João.

Para a Quina, companheira de uma vida.

"I have been impressed with the urgency of doing.
Knowing is not enough; we must apply.
Being willing is not enough; we must do."

Leonardo Da Vinci

Abstract

The advent of the 5th Internet generation and the evolution of university students' behaviour leads professors, educators and researchers to search for and investigate new tools to engage students in course topics and content. The purpose of this thesis is to explore university students' engagement for learning through gamification, transmedia and virtual reality. Although several studies have been conducted, as far as we know, the current thesis is the first to employ three tools to motivate and engage students: gamification, transmedia and virtual reality.

Thus, the aims of the thesis are: (i) to comprehensively review relationship marketing and service marketing research fields, including gamification, virtual reality and education; (ii) to investigate gamification in higher education through a text mining approach; (iii) to explore transmedia effects in higher education using a mixed approach; (iv) to propose and validate a model portraying the influence of virtual reality experience on student engagement, extending the S-O-R framework. To develop this thesis and seeking to ensure its execution and results, we started with a comprehensive literature review followed by the development of three independent studies based on distinct research methodologies.

From the comprehensive literature review, 115 scientific articles emerge, giving and understanding of the use of new technologies in education and, providing access to other relevant information on the topic.

The first study reveals that through the application of the Kahoot! a gamification-based tool, students expressed positive emotions when asked about its use in the classroom as a learning tool. The results also show that gamification-based tools can be considered an important asset in the teaching-learning process, being able to motivate and engage students in their learning activities.

The second study shows that use of Moodle as a complement to the traditional class allows students to go further in understanding the content of the course and be more engaged with the whole group of colleagues and professors. The level of student engagement and academic success seems to be higher as a result of activities based on information research, sharing and

interaction through online discussion tools (such as the online forum), and analysis and discussion of case studies.

The third study shows that memories are activated and stored through emotions and so, these are two key elements in virtual reality experiences that help students to become more engaged with course content. It also seems that less mindful students can benefit more than mindful ones from using virtual reality tools to become more creative and enhance their memories about the course content.

Based on our findings, some theoretical contributions and managerial implications are also presented.

Keywords: student engagement, higher education, experience economy, virtual reality, gamification, transmedia, S-O-R framework, comprehensive literature review

JEL: M31, I23

Resumo

O surgimento da 5ª geração da Internet e a evolução do comportamento dos estudantes universitários leva professores, educadores e investigadores a pesquisar e investigar novas ferramentas para envolver os alunos nos tópicos e no conteúdo dos cursos. O objetivo desta tese é explorar o envolvimento de estudantes universitários na aprendizagem através da gamificação, transmedia e realidade virtual. Embora vários estudos tenham já sido realizados, segundo sabemos, a tese atual é a primeira a utilizar três ferramentas para motivar e envolver os alunos: gamificação, transmedia e realidade virtual.

Assim, os objetivos da tese são: (i) rever de forma abrangente a investigação nas áreas de marketing de relacionamento e marketing de serviços, incluindo gamificação, realidade virtual e educação; (ii) investigar a gamificação no ensino superior por meio de uma abordagem de mineração de texto; (iii) explorar efeitos transmedia no ensino superior usando uma abordagem mista; (iv) propor e validar um modelo que retrate a influência da experiência em realidade virtual no envolvimento dos alunos, alargando a estrutura S-O-R. Para desenvolver esta tese e procurar garantir a sua execução e resultados, iniciamos com uma revisão abrangente da literatura, seguida pelo desenvolvimento de três estudos independentes, baseados em metodologias distintas de pesquisa.

Da revisão abrangente da literatura, emergem 115 artigos científicos, que permitem entender o uso de novas tecnologias na educação, obter acesso a outras informações relevantes sobre o tema e realizar a revisão da literatura.

O primeiro estudo revela que, através da aplicação do Kahoot!, ferramenta baseada na gamificação, os alunos expressaram emoções positivas, quando questionados sobre o seu uso na sala de aula, como uma ferramenta de aprendizagem. Os resultados também mostram que as ferramentas baseadas na gamificação podem ser consideradas um ativo importante no processo de ensino-aprendizagem, podendo motivar e envolver os alunos nas suas atividades de aprendizagem.

O segundo estudo mostra que o uso do Moodle, como um complemento da aula tradicional, permite que os alunos compreendam o conteúdo do curso e se envolvam com o seu grupo de colegas e professores. O nível de envolvimento e sucesso académico dos alunos parece ser maior face à realização de atividades baseadas em pesquisa de informações, partilha e interação

por meio de ferramentas de discussão on-line (como o fórum on-line) e análise e discussão de estudos de caso.

O terceiro estudo mostra que as memórias são ativadas e armazenadas através das emoções, logo esses são dois elementos-chave nas experiências de realidade virtual que contribuem para aprimorar e ajudar os alunos a envolverem-se mais com o conteúdo dos cursos. Parece também que os alunos menos atentos podem beneficiar mais do que os atentos, ao usar ferramentas de realidade virtual, para se tornarem mais criativos e melhorar as suas memórias sobre o conteúdo dos cursos.

Com base nos nossos resultados, também são apresentadas algumas contribuições teóricas e implicações para a gestão.

Palavras-chave: envolvimento do estudante, ensino superior, economia de experiência, realidade virtual, gamificação, transmedia, estrutura S-O-R, revisão abrangente da literatura

JEL: M31, I23

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For all those who, in a way or another, contributed to helping me achieving the goal of accomplish this thesis, I express my deepest gratitude.

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List of Abbreviations

ALPRS – Adaptive Learning Path Recommendation System

AR – Augmented Reality

ARG – Alternate Reality Games

AV – Augmented Virtuality

AVE – Average Variance Extracted

CAVE – Cave Automatic Virtual Environment

CLR - Comprehensive Literature Review

GBL - Game-Based Learning

HEI - Higher Education Institution

HMD – Head-Mounted Display

ICT – Information and Communications Technology

LMS – Learning Management System

MDA – Mechanics Dynamics Aesthetics

MMORPG – Massively Multiplayer Online Role-Playing Game

MOODLE – Modular Object-Oriented Dynamic Learning Environment

NGO – Non-Governmental Organization

RE – Real Environment

RO – Research Objective

RQ – Research Question

SERVPERF – Service Performance Scale

SERVQUAL – Service Quality Scale

S-O-R - Stimulus-Organism-Response

TAM – Technology Acceptance Model

TPB -Theory of Planned Behaviour

UTAUT – Unified Theory of Acceptance and Use of Technology

VIF – Variance Inflation Factor

VISIR – Virtual Instrument Systems in Reality

VR - Virtual Reality

WOS - Web of Science

Chapter 1

1   Introduction

Technology is developing constantly, with increased relevance for a great many areas. Stakeholders are willing to engage with organisations, and the recent technological advancements allow new ways to do so. In higher education environments, these assumptions are even more pronounced as organisations are dealing with stakeholders with specific characteristics, such as students. Students are mainly from younger generations, such as Millennials or Generation Z, who are digital natives (Mulvey, Lever, & Elliot, 2019). Therefore, it became relevant for organisations to understand this phenomenon in the light of services marketing and relationship marketing. So, the current thesis focuses on the topic of students' engagement in learning environments, which we propose to assess through distinct technological environments such as gamification, transmedia and virtual reality. To do so, we will base our research on Relationship Marketing and Services Marketing connected to the core theoretical background supporting this research. The findings may have a double contribution, to develop theory and to improve some services provided to students by Higher Education Institutions (HEI). As university students are consumers of the service and the experience provided by universities and other higher education institutions, this thesis intends to extend the well-known theories in relationship marketing and service marketing to the context of education.

Students' motivation and engagement in higher education, so they can improve their learning performance, have been the subject of much concern, research and analysis. Indeed, some university support services (i.e. academic services, library), available to students, could improve their management principles and become more "interesting and engaging". According to (Burochovitch & Bzuneck, 2004; Campos & Ramos, 2011) students' motivation decreases as they advance in the school context. Usually, when entering a university classroom, students seem disinterested, disengaged and demotivated, having lost all the motivation and interest of their early school days (Campos & Ramos, 2011).

The major concern of faculty members, when thinking about the obstacles in their courses, is with regard to the level of intellectual challenges needed to master the course content. They

expect students to be motivated and engaged in learning and think critically to overcome the learning challenge. However, students who are not in tune with the true goal of education may not see it this way (Smith-Robbins, 2011). University students tend to consider some current teaching methods as, inadequate and outdated, especially when there is little use of some tools and learning technologies in the "classroom environment" (CIES-ISCTE, 2008). Some lecturers also tend to consider the application of new methodologies as a waste of time, mainly due to an incomplete understanding of them. According to Huang and Soman, (2013), the main reasons for dropouts or low performance include a lack of engagement or boredom, a pattern of growing absenteeism where each absence makes the person less willing to return to classes.

The adoption and practice of game-based techniques or gamification in a university environment - for teaching and learning - may contribute to promoting positive changes in behaviour, with the power to increase engagement, relevance, immersion and assisting in the transfer of learning to the actual situation (Kapp, 2012; Kapp & Coné, 2012). Aligned with this assumption other technologies may also contribute to the educational process by enhancing positive emotions and memories. This is the case of transmedia and the use of virtual reality. The current thesis presents the conceptualization of these terms - gamification, transmedia and virtual reality - giving the first glimpses of how these technologies can be combined with the traditional session in a classroom and contribute to actively motivating students or engaging them more.

1.1   Relevance of the topics and gap

The process of motivating university students has gained interest, particularly with the advent of the Internet and all new avenues using technological tools in addition to the traditional classroom (Eynon, 2004; Lee, Lee, & Jang, 2011; Mokhtari, Reichard, & Gardner, 2009). However, knowledge, implementation and practice of some teaching methodologies supported by technology, remains a challenge for the teaching class (Loughran, 2002; Nilson, 2010). As highlighted in Chapter 2 in the comprehensive literature review (CLR), past research lacks evidence of how the use of tools like gamification, transmedia and virtual reality can effectively engage students, which is more than motivating them (Kayimbaşioğlu, Oktekin, & Haci, 2016; Martín-Gutiérrez, Mora, Añorbe-Díaz, & González-Marrero, 2017; Pence, 2011). Engaged students participate actively in the whole process of searching, sharing and learning new skills and theories about a certain topic. As far as we know, this thesis comprising three studies is a

first attempt to go further in understanding and filling this gap: students' engagement process through different technological tools.

1.2   Research questions and objectives

Learning by using technological tools has become commonplace in many educational institutions around the world. However, there is still some resistance from teachers and educators, either in adopting technology as an important tool for the teaching-learning process or in awareness of its advantages and disadvantages to support their teaching practices.

Nowadays, the way students access information, learn and interact with educational contents is very much based on technology, and so most technology-supported teaching approaches will have the capacity to stimulate students' motivation and engagement in their learning process.

Given the above, this thesis will search for possible answers to the following four overall research questions (RQ):

RQ 1.   Is there evidence in the literature that gamification is an effective tool in education?

RQ 2.   Can the interconnection between the classroom and Learning Management Systems (LMS), such as Moodle, contribute to enhancing the education process?

RQ 3.   How does the exploration of distinct technological tools contribute to greater student interest, participation and engagement?

RQ 4.   Is virtual reality a tool that can create students' engagement in learning through pleasure and the creation of memories?

The overall aim of the current thesis is to explore the influence of gamification, transmedia and virtual reality as tools to motivate and create university students' engagement in the learning activity. In order to fulfil this aim, the following four research objectives (RO) are developed:

RO 1.   To comprehensively review relationship marketing and service marketing research fields, including gamification, virtual reality and education.

RO 2.   To investigate gamification in higher education through a text mining approach.

RO 3.   To explore transmedia effects in higher education using a mixed approach.

RO 4.   To propose and validate a model portraying the influence of VR experience on student engagement, extending the S-O-R framework.

1.3   Research philosophy

A philosophy paradigm is a system of thoughts, which in the case of research aggregates the system of beliefs and assumptions guiding the development of knowledge (Saunders, Lewis, & Thornhill, 2016). The way the research is positioned shapes the research questions and supports the methodological choice, research strategy, data collection and data treatment and discussion (Neuman, 2006). In social sciences, the main research philosophies are positivism, realism, interpretivism and pragmatism.

The positivism of Auguste Comte and John Stuart Mill uses sense perceptions as unique sources of knowledge. In this case, researchers deal with observable social reality and the results of such research can be generalized. Here, researchers tend to use existing theory to develop hypotheses. These hypotheses are tested and confirmed or refuted, leading to the further development of the theory (Remenyi, Williams, Money, & Swartz, 1998).

Realism denotes that there is a reality independent of the mind. In direct realism, researchers consider that what they see is what they have, but in critical realism, what human beings see are sensations, which are representations of what is real (Novikov & Novikov, 2013).

Interpretivism advocates that researchers interpret elements of the study, that is, researchers assume that access to reality is only possible through social constructions such as language, instruments, or shared meanings (Myers, 2008). Researchers interpret the social roles of social actors in accordance with their own set of meanings.

Pragmatics consider that there are several different ways of interpreting the world and undertaking research, no single point of view can ever give the entire picture/understanding of the world and that there may be multiple realities (Saunders et al., 2016). In the current thesis, we follow this last philosophy. Within pragmatism, a mixed approach is used, and several different techniques employed.

Mixed methods can be understood as "a class of research where the researcher mixes or combines qualitative and quantitative research techniques, method, approaches, concepts or language into a single study" (Johnson & Onwuegbuzie, 2004, p. 17). Indeed, the adoption of a mixed-method approach is considered the third methodological movement (comprising the two previous ones, qualitative and quantitative) (Tashakkori & Teddlie, 2010). Pragmatists give value to the use of qualitative and quantitative research methods and consider the use of only

one methodological approach as unhelpful (e.g., Saunders et al., 2016; Tashakkori & Teddlie, 2010).

1.4   Ethical issues

Lavrakas (2008, p. 244) argue that ethical principles are "the standard practices for privacy and confidentiality protection for human subject participants". The studies presented in the current thesis followed this assumption and were conducted from recruitment, to participation, and data collection, to dissemination of findings in a manner that is confidential, private, and respectful.

In order to participate in the studies presented, all participants gave their informed consent voluntarily prior to participating. According to Lavrakas (2008), participants were provided with sufficient information about taking part in the studies, namely their nature and purpose, the risks and benefits associated with participation, what was expected of them and the length of time needed to participate in the study. Anonymity was also ensured, that is, the data collected cannot be associated with any specific participant.

All possible risks that may occur causing emotional, wellbeing, mental or physical health problems or the social and group cohesion of participants (Saunders et al., 2016) were considered. Particularly for the Virtual Reality experience, participants were previously informed about the possibility of nausea or feeling sick and what to do to stop the experiment.

1.5   Thesis structure

The current thesis is composed of six main chapters, in the form of an introduction, a comprehensive literature view, three independents but complementary studies and a section devoted to conclusions, managerial implications, limitations and future research. An in-depth description of each chapter is presented below.

The first chapter presents the introduction. The research questions and objectives are fully described, and fundamental considerations about research philosophy are addressed. Regarding some possible susceptibilities about one of the research methods followed in this work, the ethical aspects observed are also considered in this chapter. A complete description of this thesis and a schematic diagram are presented.

The second chapter deals with the theoretical background. In this chapter, we describe the methodology followed and the results obtained from the comprehensive literature review. This

chapter also presents the main theoretical concepts as well as the relevant foundational theories supporting this research.

The third chapter focuses on the first study. In this chapter the gamification-based tool Kahoot! was tested with students for an entire semester. Students' opinions about the tool itself as well as the advantages and disadvantages of this type of tool in general were collected. All the answers were then analysed with a text-mining tool through text categorization, cluster analysis and sentiment analysis. A discussion of the study is presented.

The fourth chapter is devoted to the second study, based on the engagement of senior university students through transmedia and Moodle LMS. In this chapter, a set of activities was created and implemented through the Moodle LMS, for a group of senior undergraduate students, during a full semester. For data analysis, descriptive statistics and text-mining workflow were followed. The text-mining software (Orange 3.23) is also briefly described. A discussion of the study is presented.

The fifth chapter focuses on the third study, based on university students' engagement through virtual reality. The theoretical background for this study is presented and the methods adopted for data collection, hypothesis formulation and measurements are described. In this study, a virtual reality experience based on the S-O-R framework was set up. For data analysis, structural equation modelling was built, based on SmartPLS3 3.0. A discussion of the study is presented.

The sixth and final chapter contains the discussion, implications and conclusions of this work. Theoretical and managerial questions are highlighted, and limitations and future research paths are also explained and proposed. A schematic diagram of this thesis is presented on the next page (see Figure 1).

Figure 1 - Schematic diagram of the thesis

Chapter 1	» Introduction » Topics and gap » Research questions and objectives » Research philosophy; ethical issues » Thesis structure
Chapter 2	» Comprehensive Literature Review (CLR) » Data analysis from the CLR » Conceptualization » Foundational theories
Chapter 3	» Study 1 » Gamification in Higher Education » Text-mining approach
Chapter 4	» Study 2 » Transmedia and Moodle » Mixed approach
Chapter 5	» Study 3 » Virtual reality » SEM approach
Chapter 6	» Discussion, conclusions and implications » Theoretical contributions » Managerial implications » Limitations and future research

Source: own elaboration

Chapter 2

2 Comprehensive literature review

In this chapter, we develop a CLR which aims to highlight the amount of research produced until now addressing this thesis topic. It is not clear so far what the overall picture is, what results are more reliable, or what the different findings and from those are, which we should use as a guide in developing this thesis. Therefore, we develop a CLR to address this problem by identifying and integrating the findings of all relevant, high-quality studies in gamification and virtual reality in the field of higher education research. In this vein, the purpose of this CLR is to make extensive research that can highlight relevant literature discussing this phenomenon, and from this to be able to frame these recent emergent constructs.

We intend to establish and explore the extent to which existing research has contributed to clarifying this field of knowledge, to understand how the principal authors outline and define it, as well as identifying the different relationships within the emerging construct and how it is interconnected with the remaining marketing literature. Additionally, we hope to indicate future avenues of research for this emerging topic.

2.1 Comprehensive literature review: methodology and procedure

To guarantee the maximum quality and credibility of the literature used in this thesis, we decide to only use cutting-edge research, from the best quality papers published in the best journals. To achieve this aim, we resort to a renowned electronic database to carry out this CLR, Web of Science (WOS). Web of Science is a leading world publisher-independent global citation database, and is a powerful research engine, delivering the best-in-class publication and citation data for confident discovery, access and assessment (WOS, 2019). This multidisciplinary platform connects data indexes to the Web of Science collections, across numerous disciplines, from over 1,7 billion cited references from over 159 million records. Millions of researcher's worldwide trust Web of Science to produce high-quality research, gain insights and make more-informed decisions that guide the future of their institution and research strategy. The content of Web of Science collections is selective and consistent, and an independent and detailed editorial process ensures journal quality (WOS, 2019).

In Web of Science, we apply different research terms to perform the research process. A first query with the phrase "VIRTUAL REALITY" was performed, revealing 42,416 articles on this subject, and a second query with the word "GAMIFICATION", returned 3,871 articles on this subject. Analysing these results, we realised that most of the results achieved belonged to Medicine, Computer Sciences, Engineering, and other fields not related to this thesis topic, and most importantly, not related to the Marketing field. Therefore, we deepened our analysis by performing several other queries.

A second search phase was made on Web of Science for academic work related to virtual reality, this time using the VIRTUAL REALITY and EDUCATION phrases combined, returning 4,739 articles. A second query was performed with the words GAMIFICATION and EDUCATION, revealing 1,367 articles. We were then able to narrow down the amount of research that could be focused on our object of study. Nevertheless, we still found many articles devoted to scientific areas not connected with our investigation. Therefore, we decided to continue to narrow down our scope of search with the aim of finding the most accurate and relevant research about our topic of analysis.

Accordingly, a third search phase was performed. In this third search, we decide to incorporate the relevant Marketing topics, such as Marketing, or Services, which result in the searches expressions we reveal in the text below. The search process was conducted for words in the title, abstract and keywords. The terms were selected based on their relevance for the subject under study. Most of these words are followed by a wildcard to account for distinct possibilities from the root word. The final queries for our search are:

Query 1:

TS=(VIRTUAL REALITY* AND EDUCATION* AND (MARKETING OR SERVICE*))

Query 2:

TS=(GAMIFICATION* AND EDUCATION* AND (MARKETING OR SERVICE*))

The results from using these two queries reveal a total of 281 articles for query 1 and 150 articles for query 2. These results show relevant information and indicate there is a lack of research in these domains, which highlights the relevance and appropriateness of this thesis. In order to move forward with the process of narrowing down this CLR process, the results achieved from the previous two queries were filtered to return only papers in English in peer-review journals. At this stage, we were able to reach our group of papers, 128 for query 1 and 69 for query 2. However, and even if we improve our queries with specific terms of marketing and related issues, we still need to understand the range of scientific areas in which these articles appear. So, we consider the dispersion of the papers among the different journals publishing them. This dispersion analysis shows that, although the queries used are focused on marketing terms, papers appeared in a wide range of journals from a distinct set of scientific areas. The 197 papers we have compiled from our criteria reveal that most of them still were not focused only on Marketing and Educational environments but largely also on Computer Science and Engineering, and Medicine and Health Sciences. We can see the distribution of the most frequent categories of Web of Science in Figure 2 for query 1, and Figure 3 for query 2.

Figure 2 - Distribution of articles per WOS categories: Query 1

Source: own elaboration

Figure 3- Distribution of articles per WOS categories: Query 2
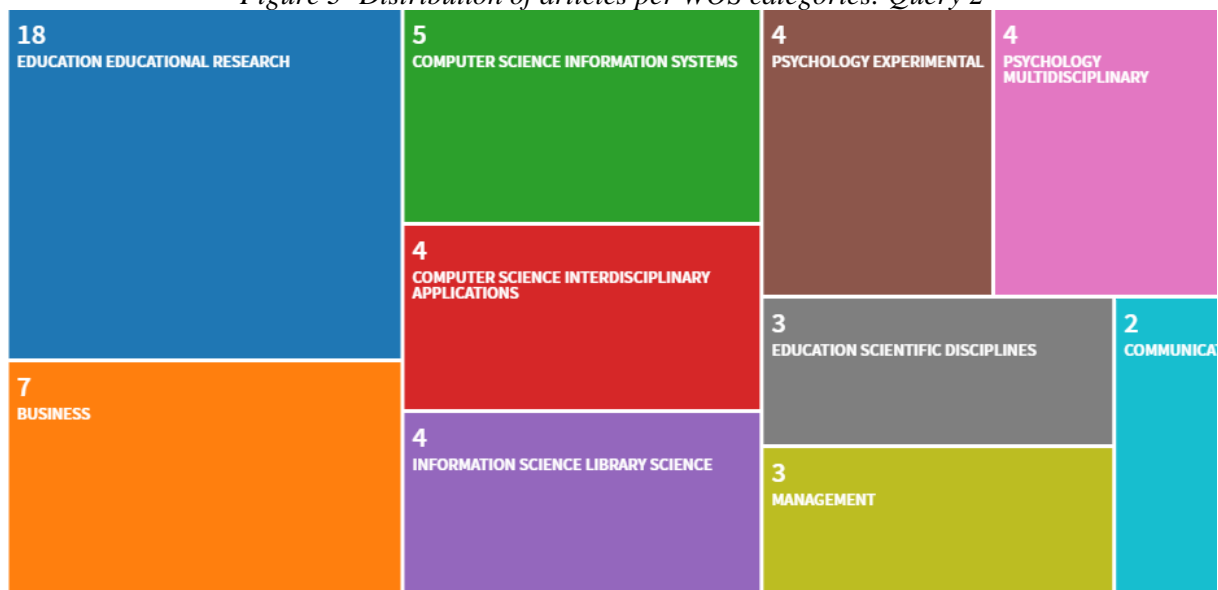
Source: own elaboration

As we can confirm in the above figures, the WOS categories which these articles come from are distinct for both queries. As seen in Figure 2, showing the distribution for query 1 with the phrase VIRTUAL REALITY, most of the highlighted Web of Science categories are related to Computer Sciences, Surgery and Educational Research. On the other hand, when we analyse the distribution from query 2 with the word GAMIFICATION, we conclude that most of the Web of Science categories are related to Educational Research and Computer Sciences, but also to Business and Management. Once again, these results show relevant information, as we can deduce that there is a difference in the research outputs if we are referring to Virtual Reality or Gamification. On one hand, Virtual Reality is more present in the research devoted to medicine and health sciences, and other scientific areas, while Gamification already starts to appear in studies connected to business and management. Once again, these results highlight the relevance and appropriateness of this thesis.

After title reading, we have our final set of 115 articles to be used in this CLR, resulting from the two queries used in this search (67 from query 1 and 48 from query 2). From this set of papers, we find that the first article published in the group of articles resulting from query 1, with the phrase virtual reality, is from 1999 (see Table 1), and that the majority of articles are from the last five years (2015 onwards).

Table 1 - Publication year for articles from the first query with Virtual Reality phrase

Year	Quantity
2019	8
2018	9
2017	12
2016	3
2015	11
2014	2
2013	2
2012	2
2011	4
2010	2
2009	2
2008	2
2006	2
2003	1
2002	1
2000	3
1999	1
Total	**67**

Source: own elaboration

These results are very different from the results achieved from query 2, in which we use the word Gamification. As we can see in Table 2, the first article to be published in this set of articles is from 2014, and most of the articles are from the last three years. In fact, we can see here some relevant differences between the results of Virtual Reality and Gamification. Articles devoted to Virtual Reality are more common and have appeared since 1999. On the other hand, articles devoted to Gamification are much more recent as we only find articles from the past five years (from 2014). These results indicate both topics as being very recent in the literature, with little research devoted to them, highlighting the need for further studies and the relevance of this thesis. The findings of this comprehensive process contribute to highlighting the gap in this field of research by pointing out the need for more research dealing with students' engagement in course content through gamification, transmedia and virtual reality tools.

Table 2 - Publication year for articles from the second query with Gamification term

Year	Quantity
2019	14
2018	8
2017	12
2016	6
2015	5
2014	3
Total	**48**

Source: own elaboration

Continuing with the analysis of this set of final papers, we highlight another important and relevant result, linked to the journals where the articles of our final pool of papers were published. Once again, the division between both queries showed differences in the publishing of articles and research development between Virtual Reality and Gamification. In table 3 we show the journals which have published more than one paper from those resulting from our query 1, devoted to Virtual Reality. As we can see, some journals, such as Computers and Education, and Computers in Human Behaviour have more articles published. Some journals specifically devoted to the Marketing sphere also appear, such as the Journal of Interactive Marketing and Journal of Consumer Research. Nevertheless, most journals still focus on other scientific areas such as computers and technology or medicine. Moreover, this pool of papers only includes 27 papers out of a total 67, meaning that most of the journals have only published one article on this subject.

Table 3 - Journals with most published articles from Query 1 – Virtual Reality

Journal	Quantity
COMPUTERS & EDUCATION	4
COMPUTERS IN HUMAN BEHAVIOR	3
MULTIMEDIA TOOLS AND APPLICATIONS	3
IEEE TRANSACTIONS ON LEARNING TECHNOLOGIES	3
ELECTRONIC LIBRARY	2
SUSTAINABILITY	2
RURAL SPECIAL EDUCATION QUARTERLY	2
JOURNAL OF INTERACTIVE MARKETING	2
JOURNAL OF SURGICAL EDUCATION	2
VIRTUAL REALITY	2
TOURISM MANAGEMENT	1
JOURNAL OF CONSUMER RESEARCH	1
Total	**27**

Source: own elaboration

We now analyse the final pool of articles and the journals where they have been published resulting from Query 2, devoted to Gamification. Once again, we show the journals which have published more than one paper from the final pool of papers resulting from query 2 (see table 4). Analysing the result, we can see some differences in relation to the previous analysis for query 1. Some journals such as the Journal of Interactive Marketing and Computers in Human Behaviour, have more published articles. Others such as the Journal of Marketing Education and International Journal of Engineering Education, have fewer articles. In both analyses of the queries and the results of journals with more articles published, we decided also to highlight some journals that have only one article published in order to show that some journals devoted to business, management and marketing are already publishing this type of topics.

Table 4 - Journals with most published articles from Query 2 - Gamification

Journal	Quantity
JOURNAL OF INTERACTIVE MARKETING	5
COMPUTERS IN HUMAN BEHAVIOR	4
JOURNAL OF MARKETING EDUCATION	2
INTERNATIONAL JOURNAL OF ENGINEERING EDUCATION	2
TEACHING AND TEACHER EDUCATION	1
COMPUTERS & EDUCATION	1
INTERNATIONAL JOURNAL OF MARKETING COMMUNICATION AND NEW MEDIA	1
TOURISM MANAGEMENT	1
INTERNATIONAL JOURNAL OF BANK MARKETING	1
Total	**18**

Source: own elaboration

Analysing the above table 4, we see that the journals with most articles published from this second pool of articles are no longer from computer sciences or medicine but from the interaction between technology and marketing, marketing and its interactive environments and education in marketing. From these results, we can conclude on a significant difference, as this second pool of articles from query 1 is already more devoted to the scientific areas studied here.

The following Table 5 lists all the articles included in this CLR. This shows not only the journals where this research was published but also the authors, year of publication and other information.

Table 5 - List of papers included in the comprehensive literature review

Paper Number	Author(s) and Year of Publication	Paper Title	Journal
1	(Ma, 2019)	Effects of immersive stories on prosocial attitudes and willingness to help: testing psychological mechanisms	MEDIA PSYCHOLOGY
2	(Tecau et al., 2019)	Responsible Tourism-Integrating Families with Disabled Children in Tourist Destinations	SUSTAINABILITY
3	(Pappa & Papadopoulos, 2019)	A Use Case of the Application of Advanced Gaming and Immersion Technologies for Professional Training: The GAMEPHARM Training Environment for Physiotherapists	ELECTRONIC JOURNAL OF E-LEARNING
4	(Y. Wu, Chen, & Lin, 2019)	Elucidating the impact of critical determinants on purchase decision in virtual reality products by Analytic Hierarchy Process approach	VIRTUAL REALITY
5	(Sun, Hu, & Xu, 2019)	Navigation modes, operation methods, observation scales and background options in UI design for high learning performance in VR-based architectural applications	JOURNAL OF COMPUTATIONAL DESIGN AND ENGINEERING
6	(Petit, Velasco, & Spence, 2019)	Digital Sensory Marketing: Integrating New Technologies Into Multisensory Online Experience	JOURNAL OF INTERACTIVE MARKETING
7	(Cooper, Park, Nasr, Thong, & Johnson, 2019)	Using virtual reality in the classroom: preservice teachers' perceptions of its use as a teaching and learning tool	EDUCATIONAL MEDIA INTERNATIONAL
8	(Fernández, Rey, & Murias, 2019)	THE INTERVIEW AS GUIDANCE RESOURCE IN THE PROCESSES FOR YOUTH EUROPEAN MOBILITY	BORDON-REVISTA DE PEDAGOGIA
9	(Martín-Del-Pozo, Muñoz-Repiso, & Martín, 2019)	Video Games and Collaborative Learning in Education? A Scale for Measuring In-Service Teachers' Attitudes towards Collaborative Learning with Video Games	INFORMATICS-BASEL
10	(Başal & Kaynak, 2019)	Perceptions of pre-service English teachers towards the use of digital badges	INNOVATIONS IN EDUCATION AND TEACHING INTERNATIONAL

Paper Number	Author(s) and Year of Publication	Paper Title	Journal
11	(Robson, 2019)	Motivating Professional Student Behavior Through a Gamified Personal Branding Assignment	JOURNAL OF MARKETING EDUCATION
12	(R. Silva, Rodrigues, & Leal, 2019)	Play it again: how game-based learning improves flow in Accounting and Marketing education	ACCOUNTING EDUCATION
13	(Rodrigues, Oliveira, & Rodrigues, 2019)	Main gamification concepts: A systematic mapping study	HELIYON
14	(Orhan Göksün & Gürsoy, 2019)	Comparing success and engagement in gamified learning experiences via Kahoot and Quizizz	COMPUTERS & EDUCATION
15	(Lopez Carrillo et al., 2019)	Using Gamification in a Teaching Innovation Project at the University of Alcala: A New Approach to Experimental Science Practices	ELECTRONIC JOURNAL OF E-LEARNING
16	(Araujo, Barroso, Gomes, & Cardoso, 2019)	Gamification in the Tourism Sector: Systematic analysis on Scopus database	INTERNATIONAL JOURNAL OF MARKETING COMMUNICATION AND NEW MEDIA
17	(Baydas & Cicek, 2019)	The examination of the gamification process in undergraduate education: a scale development study	TECHNOLOGY PEDAGOGY AND EDUCATION
18	(Mavroeidi, Kitsiou, Kalloniatis, & Gritzalis, 2019)	Gamification vs. Privacy: Identifying and Analysing the Major Concerns	FUTURE INTERNET
19	(Hakak et al., 2019)	Cloud-assisted gamification for education and learning - Recent advances and challenges	COMPUTERS & ELECTRICAL ENGINEERING
20	(Bayuk & Altobello, 2019)	Can gamification improve financial behavior? The moderating role of app expertise	INTERNATIONAL JOURNAL OF BANK MARKETING

Paper Number	Author(s) and Year of Publication	Paper Title	Journal
21	(De Guimarães, Severo, Nóbrega, & Tondolo, 2019)	Antecedents of student retention: the influence of innovation and quality of teaching in Brazilian universities	INTERNATIONAL JOURNAL OF INNOVATION AND LEARNING
22	(Dele-Ajayi, Strachan, Pickard, & Sanderson, 2019)	Games for Teaching Mathematics in Nigeria: What Happens to Pupils' Engagement and Traditional Classroom Dynamics?	IEEE ACCESS
23	(H. J. Kim & Kim, 2018)	Implementation of young children English education system by AR type based on P2P network service model	PEER-TO-PEER NETWORKING AND APPLICATIONS
24	(Dyer, Swartzlander, & Gugliucci, 2018)	Using virtual reality in medical education to teach empathy	JOURNAL OF THE MEDICAL LIBRARY ASSOCIATION
25	(Bum, Mahoney, & Choi, 2018)	A Comparative Analysis of Satisfaction and Sustainable Participation in Actual Leisure Sports and Virtual Reality Leisure Sports	SUSTAINABILITY
26	(Suh & Prophet, 2018)	The state of immersive technology research: A literature analysis	COMPUTERS IN HUMAN BEHAVIOR
27	(Dirin & Laine, 2018)	User Experience in Mobile Augmented Reality: Emotions, Challenges, Opportunities and Best Practices	COMPUTERS
28	(P. V. T. da Silva, Budel, & Ross, 2018)	A CONTINUING EDUCATION SPECIALIZED TRAINING SERVICE: AN EXPERIENCE IN VIRTUAL LEARNING ENVIRONMENT EUREKA	REVISTA IBERO-AMERICANA DE ESTUDOS EM EDUCACAO
29	(Veselovsky, Pogodina, Ilyukhina, Sigunova, & Kuzovleva, 2018)	FINANCIAL AND ECONOMIC MECHANISMS OF PROMOTING INNOVATIVE ACTIVITY IN THE CONTEXT OF THE DIGITAL ECONOMY FORMATION	ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES
30	(Pickering, Ridenour, Salaysay, Reyes-Gastelum, & Pierce, 2018)	EATI Island - A virtual-reality-based elder abuse and neglect educational intervention	GERONTOLOGY & GERIATRICS EDUCATION

Paper Number	Author(s) and Year of Publication	Paper Title	Journal
31	(H. Kim, Shin, Kim, & Kim, 2018)	VR-CPES: A Novel Cyber-Physical Education Systems for Interactive VR Services Based on a Mobile Platform	MOBILE INFORMATION SYSTEMS
32	(Leclercq, Hammedi, & Poncin, 2018)	The Boundaries of Gamification for Engaging Customers: Effects of Losing a Contest in Online Co-creation Communities	JOURNAL OF INTERACTIVE MARKETING
33	(Canals & Minguell, 2018)	GaMoodlification: Moodle at the service of the gamification of learning	CAMPUS VIRTUALES
34	(Eppmann, Bekk, & Klein, 2018)	Gameful Experience in Gamification: Construction and Validation of a Gameful Experience Scale [GAMEX]	JOURNAL OF INTERACTIVE MARKETING
35	(Nousiainen, Kangas, Rikala, & Vesisenaho, 2018)	Teacher competencies in game-based pedagogy	TEACHING AND TEACHER EDUCATION
36	(Calderón, Boubeta-Puig, & Ruiz, 2018)	MEdit4CEP-Gam: A model-driven approach for user-friendly gamification design, monitoring and code generation in CEP-based systems	INFORMATION AND SOFTWARE TECHNOLOGY
37	(Anouncia & Kalyanaraman, 2018)	A study on computing and e-learning in the perspective of distributed models	INTERNATIONAL JOURNAL OF GRID AND UTILITY COMPUTING
38	(Schwade & Schubert, 2018)	The ERP Challenge: Developing an Integrated Platform and Course Concept for Teaching ERP Skills in Universities	INTERNATIONAL JOURNAL OF HUMAN CAPITAL AND INFORMATION TECHNOLOGY PROFESSIONALS
39	(Torres-Toukoumidis, Romero-Rodríguez, Pérez-Rodríguez, & Björk, 2018)	Integrated Theoretical Gamification Model in E-Learning Environments (E-MIGA)	REVISTA COMPLUTENSE DE EDUCACION
40	(Yim, Chu, & Sauer, 2017)	Is Augmented Reality Technology an Effective Tool for E-commerce? An Interactivity and Vividness Perspective	JOURNAL OF INTERACTIVE MARKETING
41	(Fombona, Pascual-Sevillano, & González-Videgaray, 2017)	M-learning and Augmented Reality: A Review of the Scientific Literature on the WoS Repository	COMUNICAR

Paper Number	Author(s) and Year of Publication	Paper Title	Journal
42	(Muñoz-Cristóbal, Gallego-Lema, Arribas-Cubero, Martínez-Monés, & Asensio-Pérez, 2017)	Using virtual learning environments in bricolage mode for orchestrating learning situations across physical and virtual spaces	COMPUTERS & EDUCATION
43	(Bragge, Kallio, Seppälä, Lainema, & Malo, 2017)	Decision-Making in a Real-Time Business Simulation Game: Cultural and Demographic Aspects in Small Group Dynamics	INTERNATIONAL JOURNAL OF INFORMATION TECHNOLOGY & DECISION MAKING
44	(Navarro, Climent, & Palacio, 2017)	Social Economy post-graduate studies at Spanish universities. A pending task?	CIRIEC-ESPANA REVISTA DE ECONOMIA PUBLICA SOCIAL Y COOPERATIVA
45	(Bower, Lee, & Dalgarno, 2017)	Collaborative learning across physical and virtual worlds: Factors supporting and constraining learners in a blended reality environment	BRITISH JOURNAL OF EDUCATIONAL TECHNOLOGY
46	(Pechenkina, 2017)	Developing a typology of mobile apps in higher education: A national case-study	AUSTRALASIAN JOURNAL OF EDUCATIONAL TECHNOLOGY
47	(Jung & tom Dieck, 2017)	Augmented reality, virtual reality and 3D printing for the co-creation of value for the visitor experience at cultural heritage places	JOURNAL OF PLACE MANAGEMENT AND DEVELOPMENT
48	(Durl, Trischler, & Dietrich, 2017)	Co-designing with young consumers - reflections, challenges and benefits	YOUNG CONSUMERS
49	(Fokides, 2017)	PRE-SERVICE TEACHERS' INTENTION TO USE MUVES AS PRACTITIONERS - A STRUCTURAL EQUATION MODELING APPROACH	JOURNAL OF INFORMATION TECHNOLOGY EDUCATION-RESEARCH

Paper Number	Author(s) and Year of Publication	Paper Title	Journal
50	(Hoffmann et al., 2017)	Comparison of Canadian and Swiss Surgical Training Curricula: Moving on Toward Competency-Based Surgical Education	JOURNAL OF SURGICAL EDUCATION
51	(He et al., 2017)	vConnect: perceive and interact with real world from CAVE	MULTIMEDIA TOOLS AND APPLICATIONS
52	(Lamb, DiFiori, Jayaraman, Shames, & Feeney, 2017)	Gamified Twitter Microblogging to Support Resident Preparation for the American Board of Surgery In-Service Training Examination	JOURNAL OF SURGICAL EDUCATION
53	(K. Kim & Ahn, 2017)	The Role of Gamification in Enhancing Intrinsic Motivation to Use a Loyalty Program	JOURNAL OF INTERACTIVE MARKETING
54	(Oleksy & Wnuk, 2017)	Catch them all and increase your place attachment! The role of location-based augmented reality games in changing people - place relations	COMPUTERS IN HUMAN BEHAVIOR
55	(Séraphin, Butcher, & Korstanje, 2017)	Challenging the negative images of Haiti at a pre-visit stage using visual online learning materials	JOURNAL OF POLICY RESEARCH IN TOURISM LEISURE AND EVENTS
56	(Su, 2017)	Designing and Developing a Novel Hybrid Adaptive Learning Path Recommendation System (ALPRS) for Gamification Mathematics Geometry Course	EURASIA JOURNAL OF MATHEMATICS SCIENCE AND TECHNOLOGY EDUCATION
57	(F. Xu, Buhalis, & Weber, 2017)	Serious games and the gamification of tourism	TOURISM MANAGEMENT
58	(Çakıroğlu, Başıbüyük, Güler, Atabay, & Yılmaz Memiş, 2017)	Gamifying an ICT course: Influences on engagement and academic performance	COMPUTERS IN HUMAN BEHAVIOR
59	(Macfarlane & Tomlinson, 2017)	Critiques of Student Engagement	HIGHER EDUCATION POLICY

Paper Number	Author(s) and Year of Publication	Paper Title	Journal
60	(Jurado & Echeverria Meza, 2017)	An Exploratory Study in the Use of Gamer Profiles and Learning Styles to Build Educational Videogames	INTERNATIONAL JOURNAL OF ENGINEERING EDUCATION
61	(Gañán, Caballé, Clarisó, Conesa, & Bañeres, 2017)	ICT-FLAG: a web-based e-assessment platform featuring learning analytics and gamification	INTERNATIONAL JOURNAL OF WEB INFORMATION SYSTEMS
62	(Durl et al., 2017)	Co-designing with young consumers - reflections, challenges and benefits	YOUNG CONSUMERS
63	(Garcia-Fernandez, Fernandez-Gavira, Jesus Sanchez-Oliver, & Grimaldi-Puyana, 2017)	Gamification and mobile applications to entrepreneurship: an educational proposal in higher education	IJERI-INTERNATIONAL JOURNAL OF EDUCATIONAL RESEARCH AND INNOVATION
64	(Lin & Yang, 2016)	AUGMENTED REALITY BASED LEARNING APPLIED TO GREEN ENERGY	JOURNAL OF MATERIALS EDUCATION
65	(C. Fernandez, Esteban, Conde, & Garcia, 2016)	Improving Motivation in a Haptic Teaching/Learning Framework	INTERNATIONAL JOURNAL OF ENGINEERING EDUCATION
66	(T.-C. Huang, Shu, Yeh, & Zeng, 2016)	Get lost in the library? An innovative application of augmented reality and indoor positioning technologies	ELECTRONIC LIBRARY
67	(Ketyi, 2016)	From Mobile Language Learning to Gamification: an Overlook of Research Results with Business Management Students over a Five-Year Period	PORTA LINGUARUM
68	(Garcia Gaitero, Costa Roman, & Real Garcia, 2016)	TRIANGULATION OF SUCCESSFUL SOURCES IN TEACHING: LEARNING STYLES, GAMIFICATION AND SELF-REGULATED LEARNING	JOURNAL OF LEARNING STYLES
69	(Canhoto & Murphy, 2016)	Learning From Simulation Design to Develop Better Experiential Learning Initiatives: An Integrative Approach	JOURNAL OF MARKETING EDUCATION

Paper Number	Author(s) and Year of Publication	Paper Title	Journal
70	(Gopinath Bharathi, Singh, Tucker, & Nembhard, 2016)	Knowledge discovery of game design features by mining user generated feedback	COMPUTERS IN HUMAN BEHAVIOR
71	(Hofacker, de Ruyter, Lurie, Manchanda, & Donaldson, 2016)	Gamification and Mobile Marketing Effectiveness	JOURNAL OF INTERACTIVE MARKETING
72	(C. Fernandez et al., 2016)	Improving Motivation in a Haptic Teaching/Learning Framework	INTERNATIONAL JOURNAL OF ENGINEERING EDUCATION
73	(Portman, Natapov, & Fisher-Gewirtzman, 2015)	To go where no man has gone before: Virtual reality in architecture, landscape architecture and environmental planning	COMPUTERS ENVIRONMENT AND URBAN SYSTEMS
74	(Yoon, Choi, & Oh, 2015)	User attributes in processing 3D VR-enabled showroom: Gender, visual cognitive styles, and the sense of presence	INTERNATIONAL JOURNAL OF HUMAN-COMPUTER STUDIES
75	(Ludlow, 2015)	Virtual Reality: Emerging Applications and Future Directions	RURAL SPECIAL EDUCATION QUARTERLY
76	(Hartley, Ludlow, & Duff, 2015)	Second Life (R): A 3D Virtual Immersive Environment for Teacher Preparation Courses in a Distance Education Program	RURAL SPECIAL EDUCATION QUARTERLY
77	(Cho, Yim, & Paik, 2015)	Physical and social presence in 3D virtual role-play for pre-service teachers	INTERNET AND HIGHER EDUCATION
78	(Bertram, Moskaliuk, & Cress, 2015)	Virtual training: Making reality work?	COMPUTERS IN HUMAN BEHAVIOR
79	(Bogacheva & Voiskounsky, 2015)	Virtual Worlds of MMORPG: Part I. Definition, Description, Classification	PSYCHOLOGY-JOURNAL OF THE HIGHER SCHOOL OF ECONOMICS

Paper Number	Author(s) and Year of Publication	Paper Title	Journal
80	(Avellis, Agrimi, Surico, Di Ciano, & Grasso, 2015)	User's Needs in Education and Training Domain of Apulian ICT Living Labs	INTERNATIONAL JOURNAL OF EDUCATION AND INFORMATION TECHNOLOGIES
81	(Avellis, Agrimi, Di Ciano, Grasso, & Surico, 2015)	E-LEARNING ISSUES IN EDUCATION & TRAINING DOMAIN OF APULIAN LIVING LABS	JOURNAL OF E-LEARNING AND KNOWLEDGE SOCIETY
82	(Muñoz-Cristóbal et al., 2015)	Supporting Teacher Orchestration in Ubiquitous Learning Environments: A Study in Primary Education	IEEE TRANSACTIONS ON LEARNING TECHNOLOGIES
83	(S. Ali, 2015)	Key library service dimensions for serving the needs of higher education students in Namibia	PERFORMANCE MEASUREMENT AND METRICS
84	(Siemens, Smith, Fisher, Thyroff, & Killian, 2015)	Level Up! The Role of Progress Feedback Type for Encouraging Intrinsic Motivation and Positive Brand Attitudes in Public Versus Private Gaming Contexts	JOURNAL OF INTERACTIVE MARKETING
85	(Dicheva, Dichev, Agre, & Angelova, 2015)	Gamification in Education: A Systematic Mapping Study	EDUCATIONAL TECHNOLOGY & SOCIETY
86	(Doumanis & Smith, 2015)	A Framework for Research in Gamified Mobile Guide Applications using Embodied Conversational Agents (ECAs)	INTERNATIONAL JOURNAL OF SERIOUS GAMES
87	(N. Kaur & Geetha, 2015)	Play and learn DS: interactive and gameful learning of data structure	INTERNATIONAL JOURNAL OF TECHNOLOGY ENHANCED LEARNING
88	(Piñeiro-Otero & Costa-Sánchez, 2015)	ARG (Alternate Reality Games). Contributions, Limitations, and Potentialities to the Service of the Teaching at the University Level	COMUNICAR

Paper Number	Author(s) and Year of Publication	Paper Title	Journal
89	(Tian et al., 2014)	Transforming Health Care: Empowering Therapeutic Communities through Technology-Enhanced Narratives	JOURNAL OF CONSUMER RESEARCH
90	(Billingsley & Scheuermann, 2014)	Using Virtual Technology to Enhance Field Experiences for Pre-Service Special Education Teachers	TEACHER EDUCATION AND SPECIAL EDUCATION
91	(Koivisto & Hamari, 2014)	Demographic differences in perceived benefits from gamification	COMPUTERS IN HUMAN BEHAVIOR
92	(Harman et al., 2014)	Scholarly interest in gamification: a citation network analysis	INDUSTRIAL MANAGEMENT & DATA SYSTEMS
93	(S. Kim, 2014)	Decision Support Model for Introduction of Gamification Solution Using AHP	SCIENTIFIC WORLD JOURNAL
94	(Anstadt, Bradley, & Burnette, 2013)	Virtual Worlds: Relationship Between Real Life and Experience in Second Life	INTERNATIONAL REVIEW OF RESEARCH IN OPEN AND DISTRIBUTED LEARNING
95	(Tawfik et al., 2013)	Virtual Instrument Systems in Reality (VISIR) for Remote Wiring and Measurement of Electronic Circuits on Breadboard	IEEE TRANSACTIONS ON LEARNING TECHNOLOGIES
96	(Maheu, Pulier, McMenamin, & Posen, 2012)	Future of Telepsychology, Telehealth, and Various Technologies in Psychological Research and Practice	PROFESSIONAL PSYCHOLOGY-RESEARCH AND PRACTICE
97	(Macfadyen & Dawson, 2012)	Numbers Are Not Enough. Why e-Learning Analytics Failed to Inform an Institutional Strategic Plan	EDUCATIONAL TECHNOLOGY & SOCIETY
98	(Takács, 2011)	Immersive interactive reality: Internet-based on-demand VR for cultural presentation	VIRTUAL REALITY

Paper Number	Author(s) and Year of Publication	Paper Title	Journal
99	(Alterman, Jones, Heidel, Daley, & Goldman, 2011)	The Predictive Value of General Surgery Application Data for Future Resident Performance	JOURNAL OF SURGICAL EDUCATION
100	(Packman & Meredith, 2011)	Technology and the evolution of clinical methods for stuttering	JOURNAL OF FLUENCY DISORDERS
101	(Cheng & Wang, 2011)	Applying a 3D virtual learning environment to facilitate student's application ability - The case of marketing	COMPUTERS IN HUMAN BEHAVIOR
102	(Guttentag, 2010)	Virtual reality: Applications and implications for tourism	TOURISM MANAGEMENT
103	(Cheong, 2010)	The effects of practice teaching sessions in second life on the change in pre-service teachers' teaching efficacy	COMPUTERS & EDUCATION
104	(Gustavsson et al., 2009)	On Objectives of Instructional Laboratories, Individual Assessment, and Use of Collaborative Remote Laboratories	IEEE TRANSACTIONS ON LEARNING TECHNOLOGIES
105	(Shuhuai, Xingjun, Haiqing, & Jialin, 2009)	From information commons to knowledge commons Building a collaborative knowledge sharing environment for innovative communities	ELECTRONIC LIBRARY
106	(Katsionis & Virvou, 2008)	Personalised e-learning through an educational virtual reality game using Web services	MULTIMEDIA TOOLS AND APPLICATIONS
107	(Holobar, Divjak, Prelog, Korošec, & Zazula, 2008)	A distributed virtual reality-based system for neonatal decision-making training	COMPUTER APPLICATIONS IN ENGINEERING EDUCATION
108	(Bouras & Tsiatsos, 2006)	Educational virtual environments: design rationale and architecture	MULTIMEDIA TOOLS AND APPLICATIONS
109	(Saxena, 2006)	E-learning resource management knowledge	TECHNOLOGIES FOR E-LEARNING AND DIGITAL ENTERTAINMENT, PROCEEDINGS

Paper Number	Author(s) and Year of Publication	Paper Title	Journal
110	(Mikropoulos, Katsikis, Nikolou, & Tsakalis, 2003)	Virtual environments in biology teaching	JOURNAL OF BIOLOGICAL EDUCATION
111	(Parkinson & Hudson, 2002)	Extending the learning experience using the Web and a knowledge-based virtual environment	COMPUTERS & EDUCATION
112	(Riva, 2000)	From telehealth to E-health: Internet and distributed virtual reality in health care	CYBERPSYCHOLOGY & BEHAVIOR
113	(Thrush & Bodary, 2000)	Virtual reality, combat, and communication	JOURNAL OF BUSINESS AND TECHNICAL COMMUNICATION
114	(Economou, Mitchell, & Boyle, 2000)	Requirements elicitation for virtual actors in collaborative learning environments	COMPUTERS & EDUCATION
115	(Vouk, Bitzer, & Klevans, 1999)	Workflow and end-user quality of service issues in Web-based education	IEEE TRANSACTIONS ON KNOWLEDGE AND DATA ENGINEERING

Source: own elaboration

2.2   Data analysis from the comprehensive literature review

Based on the above pool of papers, we decided to perform a content analysis of these papers to find the latent topics in the literature review through a text-mining technique. This type of technique is widely used to reveal latent topics in the text using scholarly documents (Abbas, Zhang, & Khan, 2014; Guerreiro, Rita, & Trigueiros, 2016; Loureiro, Guerreiro, Eloy, Langaro, & Panchapakesan, 2019; Loureiro, Romero, & Bilro, 2019; Moro, Cortez, & Rita, 2015). To perform this technique, we resort to a text-mining software (MeaningCloud) and based on this tool perform a text clustering technique. We use this due to its potential to process and aggregate a large amount of unstructured text to extract relevant information (Fan, Wallace, Rich, & Zhang, 2006). In fact, we know that this technique is able to create groups (clusters) by analysing the text of the articles (Fan et al., 2006; Srivastava & Sahami, 2009). This tool perceives a text as being in one group of concepts (known as clusters) rather than another (Spinakis & Chatzimakri, 2005), and then the text-mining system classification for cluster sizes is employed to select the suitable number of clusters (Punj & Stewart, 1983).

After the cluster analysis, we need to decide how many clusters we should use in this CLR, and we decide to stop accepting new clusters when the size is to small (Milligan & Cooper, 1985), which means using a cut-off value for the acceptable size of clusters. In this case, we decide to use a cut-off value = 300 scores, leaving us only with the largest clusters. Based on this, we were able to find two distinct clusters, one for each query made. In this analysis, we kept our decision not to group the results for both queries, as we still want to be able to compare the results from query 1 (Virtual Reality) and query 2 (Gamification) and to find similarities and differences in this analysis. Table 6, presents the results for the first query, concerning virtual reality.

Table 6 - Cluster analysis for query 1 – Virtual Reality

Clusters	Score
Virtual Reality VR	3,524.43
Virtual Environments	2,082.39
Teaching Methodologies	1,929.97
Education and Training Program	833.18
Immersive Virtual Experience	721.46
Special Education	693.32
Aspects of Orchestration and Experience	507.4
Real World	497.65
Student Engagement	497.02
Virtual Instrument Systems in Reality and Learning environments	341.24

Source: own elaboration

As we can see in these results, the main clusters above the cut-off score of 300 are those related to Virtual Reality and Virtual Environments. This result is expected, as we have this specific topic as our primary search theme. If we continue to analyse the clusters for this group of papers, the second largest group of topics is found to be related to Education and Teaching, followed by Users Experience (both as immersive virtual experience and other aspects of experience). In our opinion, this last result is somewhat unexpected and very interesting and clearly needs to be further explored. Finally, we want to show the student engagement cluster, which combined with the above-mentioned topics also warrants further investigation.

The same analysis can be made for the second query and Table 7 presents the results for the query regarding Gamification.

Table 7 - Cluster analysis for query 2 – Gamification

Clusters	Score
Experience and Context Analysis	887.30
Teaching Methodologies	657.70
Platform to Support	525.80
Mobile Applications	436.74
Game Elements	382.96
Learning Management System (LMS) and Learning Environments	375.76
Perceived Benefits	364.34
DBA \ courses in Marketing	344.95
Student Engagement	340.20
Intrinsic Motivation	329.22

Source: own elaboration

These results show that the main clusters above the cut-off score of 300 are related to Experience and Context Analysis, which is in line with the results from the cluster analysis for query 1, and in our opinion should be better explored in subsequent investigations. Another set of results is related to platforms, applications and game elements. These results can be expected, as we have the gamification topic as our primary search theme. Continuing our analysis, the clusters in this group of papers show that another large group of topics is related to Learning environments and Teaching Methodologies, and courses in Marketing. Finally, we observe the clusters of student engagement and intrinsic motivations. Based on these results and knowing that they are considerably in line with the results for cluster analysis of the papers emerging from query 1, we argue that further developments should try to understand the relevance of these topics for the subject studied here.

Based on analysis of these clusters, we claim that a more in-depth investigation, including further conceptual development and empirical testing, is required to assess and validate these results and determine what they can contribute to knowledge about university students engagement in learning through gamification, transmedia and virtual reality. The next section reports and disseminates the above results, also summarising the main research streams connected to these clusters. Nevertheless, and as mentioned, a new stream of research is still needed to clarify this specific research area.

2.3 Conceptualisation

2.3.1 Virtual reality and virtual environments

The "Reality-Virtuality Continuum" suggested by Milgram & Kishino (1994) has been the basis for classifying the wide variety of realities. This classification ranges from real to virtual environments at the extremes of the continuum. Real Environments (RE) represent reality itself. This considers direct or indirect (through a video display) views of a real scene (Milgram & Kishino, 1994) – see Figure 4.

Virtual environment means a completely computer-generated environment where users can interact solely with virtual objects in real-time. Pure mixed reality users are placed in the real world and digital content is totally integrated into their surroundings, so they can interact with both digital and real contents and these elements can also interact.

Figure 4 - Reality–Virtuality Continuum

Source: Milgram and Kishino (1994)
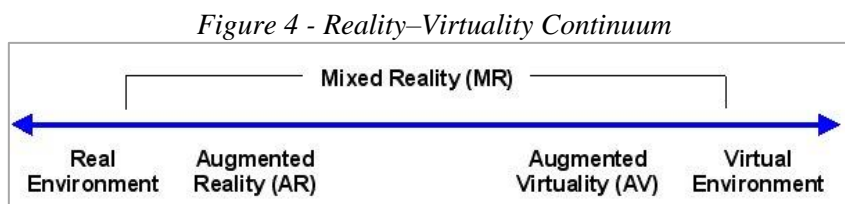
Virtual reality (VR) has been conceptualized as a computer-generated simulation of a situation that incorporates the user, who perceives this via one or more of the senses (mainly vision and hearing) and interacts with it in a manner that appears to be real (e.g., Jung & tom Dieck, 2017; Loureiro, Guerreiro, Eloy, Langaro, & Panchapakesan, 2019). VR experiences are delivered via a variety of hardware, such as head-mounted displays (HMDs), projection of sensory inputs in cubic immersive space (CAVE), desktop monitors or large screens, and hand-held mobile computing devices (smartphones, tablets) (Wu et al., 2019). These can be complemented with other devices for both simulations and tracking. Augmented virtuality (AV), combines and augments virtual environments with the superimposing real world content and scenes – virtual objects are augmented with data elements directly from the real world ((Bartolini et al., 2018; Bekele & Champion, 2019; Flavián, Ibáñez-Sánchez, & Orús, 2019).

A distinct type of VR is augmented reality (AR), which combines real-life and computer-generated information to deliver an interactive, unified experience of the real-world environment (Petit et al., 2019).

2.3.2 Gamification, game elements, learning environments and platforms

Among the interpretations and definitions of gamification shared within the academic community, the one that seems to gather the most consensus comes from (Deterding, Dixon, Khaled, & Nacke, 2011) who define gamification as the use of game design and game elements in non-game contexts. Situations that are not usually associated with a gaming environment can be analysed and experienced as if the participant is involved in playing a game. The authors (Robson, Plangger, Kietzmann, McCarthy, & Pitt, 2015, p. 2), state that "*gamification is the application of lessons from the gaming domain to change behaviors in non-game situations*". Both these definitions may also point the way to the use of gamification in distinct surroundings, such as Higher Education Institutions (HEI).

Efforts to modify behaviours and promote engagement and motivation among HEI students have been a constant challenge for many scholars and researchers around the globe. Some behavioural changes by participants in gamified environments have been observed in various studies (Koivisto & Hamari, 2014; Turan, Avinc, Kara, & Goktas, 2016; Barata, Gama, Jorge, & Gonçalves, 2017). Several results reinforcing the positive aspects of gamification's application at the HEI level have been published (Yildirim, 2017; Subhash & Cudney, 2018). As is usual in the academic community, the results of other studies do not show positive aspects of the use of gamification at the HEI level (Dichev & Dicheva, 2017; Frost, Matta, & MacIvor, 2015; Hanus & Fox, 2015; Kyewski & Krämer, 2018).

However, levels of motivation and engagement among individuals participating in gamified scenarios seem to increase, leading to improved performance and positive results, as recently registered by several authors (Walsh, 2014; Ibanez, Di-Serio, & Delgado-Kloos, 2014; Azmi, Ahmad, Iahad, & Yusof, 2017; Looyestyn et al., 2017; Nurul & Mohamad, 2018; Lopez Carrillo, Calonge Garcia, Rodriguez Laguna, Ros Magan, & Lebron Moreno, 2019).

One way to create, implement, control and evaluate gamified activities in HEIs is by adopting one Learning Management System (LMS) and adapting some of its functionalities to specific

needs and goals. An LMS provides a series of features, both synchronous and asynchronous, that support the learning process, enabling its planning, implementation, and evaluation. Most LMS's already offer gamification elements providing several opportunities to easily configure and use them within teaching activities(Azmi & Singh, 2015; Canals & Minguell, 2018; Codish & Ravid, 2015).

Learning Management Systems have become an important asset in education at all levels, since they provide students and teachers with a set of interactive resources, integrating a wide range of pedagogical and course administration tools to support the teaching-learning process (Croitoru & Dinu, 2016; Pérez-Pérez, Serrano-Bedia, & García-Piqueres, 2019). For an LMS to be an effective tool for teaching and learning, it requires constant attention and supervision since the interaction and usage levels of these platforms tend to increase, as do their users' various needs.

In the area of education, if wanting to promote the teaching-learning process, there are many other supportive methods and tools to turn to. One of these methods is transmedia play, which consists of the use of media tools to support the teaching-learning process and where students may search for, gather and share information from various media sources. According to (Kalogeras, 2013) transmedia play "*uses a student-centered social constructivist approach to learning, where learners (enabled by technology) actively engage, interact, collaborate, and co-create.*" (as cited in Dickinson-Delaporte, Gunness, & McNair, 2018, p. 1).

2.3.3   Teaching methodologies and education

Teaching means that someone should be interested in learning so, in order to have a good teaching approach one should also learn about "learning", thus ensuring that learning takes place in the classroom. Therefore, when we observe some of the work and research did by educational psychologists – behaviourist, constructivist and cognitive psychologists - (Agarkar, 2019; Illeris, 2009; Schunk, 2012), several different definitions of learning arise, such as those presented by Pritchard (2009, p. 2) – Learning is … "*A change in behaviour as a result of experience of practice*"; "*The acquisition of knowledge*"; "*To gain knowledge of, or skill in, something through study, teaching, instruction or experience*"; "*A process by which behaviour is changed, shaped or controlled*"; "*The individual process of constructing understanding based on experience from a wide range of sources*".

Among the various challenges faced by teachers and instructors, the biggest one is to be able to capture and retain students' attention, in such a way they can assimilate the teachings and concepts even after they leave the classroom. To make this possible, all classroom experience should be re-evaluated and new innovative ideas that make the teaching-learning process more effective should be tested and implemented (Kalyani & Rajasekaran, 2018; Kim, Kim, Lee, Spector, & DeMeester, 2013).

Teachers can choose from various teaching methodologies and apply those that best suit the needs and circumstances where the teaching-learning process takes place. When choosing teaching methodologies, teachers also need to reflect on how they intend to conduct their classes - in a more *teacher-centered approach*, where teachers are the main authority or, a more *student-centred approach*, where teachers and students play a similar active role in the learning process (Lasry, Charles, & Whittaker, 2014; Sesen & Tarhan, 2011).

Some examples of teacher-centred methods of instruction are the "*flipped classrooms*" where students prepare for their in-class assignments at home, watching pre-recorded lessons. Another example is the "*direct instruction*" method, the more traditional method based on teaching through lectures (Baepler, Walker, & Driessen, 2014; O'Flaherty & Phillips, 2015). Regarding student-centred methods of instruction, some examples are *"problem-based learning"* where students are asked to solve problems in a collaborative way. A similar method is *"project-based learning"*, repeatedly confused with the previous method, but with the difference that here it is the student who has to present a problem or question to investigate (Hmelo-Silver, 2004; Jalani & Sern, 2015).

The emergence of new teaching and learning tools and technologies is also a permanent challenge for educators at all levels of education, creating a need for permanent updating on their functioning, usefulness and application in the classroom. This leads to an increase in research on how students learn and respond to different teaching methods (Nilson, 2010).

This has been the case with Gamification (Çakıroğlu et al., 2017; Hamari, Koivisto, & Sarsa, 2014; Martí-Parreño, Méndez-Ibáñez, & Alonso-Arroyo, 2016; Sailer & Homner, 2019; Subhash & Cudney, 2018), Transmedia (Dickinson-Delaporte et al., 2018; Raimúndez-Urrutia & Azzato Sordo, 2017; Raybourn, 2014; Sánchez-Martínez & Albaladejo-Ortega, 2018) and Virtual Reality (Bhattacharjee, Paul, Kim, & Karthigaikumar, 2018; M. Fernandez, 2017; Janssen, Tummel, Richert, & Isenhardt, 2016; O'Connor & Domingo, 2017), which have received increasing attention and research in the field of education and particularly in higher

education, proving to be valid tools both in supporting the teaching-learning process and in arousing increased interest and involvement among students. As claimed by (Englund, Olofsson, & Price, 2017; Kim et al., 2013), the successful use and implementation of some of these educational technologies, since they are mostly dependent on, and integrated in various technological supports, means teachers who want to use them must have, some knowledge of how to integrate them into their teaching process.

Technology alone is not enough to change the learning environment - for that to happen, there must also be an intense intervention so that technology accompanies the teaching and learning strategies, seeking to ensure students' acquisition of knowledge based on digital resources (Marcelo, Yot, & Mayor, 2015).

In addition, the use of technology in education raises several barriers for educators not only because of the time needed to learn how to use the technology, but also the implementation of teaching methods and pedagogical approaches that could benefit from the use of that technology. Educators need better understanding of some of the benefits of using technology, especially those that promote greater interest and autonomy among students (Alonso, Plaza, & Orfali, 2019; Govender & Govender, 2014; H. Lee, Feldman, & Beatty, 2012; Sinclair & Aho, 2017).

2.3.4   Experience, user experience and motivation

One of the first to claim the importance of experience is Abbott (1955, p.40) saying that "what people really desire are not products but satisfying experiences". In the 1980s, theories emerge on experiential marketing (e.g., Hirschman & Holbrook, 1982; Holbrook & Hirschman, 1982). Hirschman & Holbrook, 1982 and; Holbrook & Hirschman, (1982) devote their study to hedonic versus utilitarian consumption, where hedonic consumption represents the multisensory and emotional aspects of consumers' interactions with goods and services, whereas utilitarian consumption is associated with goods and services which are necessary for survival, to fulfil basic needs. Yet, the roots of customer experience research may start in the 1960's when Howard & Jagdish (1969) showed the interest in research on the topic. In the 1980's and 1990s, the buying behaviour process, satisfaction, and loyalty emerge.

The 1970's and 1980s are dedicated to the buying behaviour process, customer satisfaction and service quality. Satisfaction emerges with cognitive and emotional components (e.g., Oliver,

1980; Westbrook & Oliver, 1991), followed by the importance of customer delight (e.g., Loureiro & Kastenholz, 2011; Loureiro, Miranda, & Breazeale, 2014; Oliver, Rust, & Varki, 1997).

The effects of satisfaction on loyalty or intention behaviour are extensively confirmed in various studies (e.g., Anderson, Fornell, & Mazvancheryl, 2004; Bolton & Drew, 1991; Gupta & Zeithaml, 2006; Loureiro, Dias Sardinha, & Reijnders, 2012).

The 1990's feature models and scales to measure service quality. For instance, SERVQUAL and SERVPERF, the discussion about the process to measure quality and the best way to use the scales were very prominent (e.g., Cronin & Taylor, 1992, 1994; Parasuraman, Zeithaml, & Berry, 1988). Relationship marketing is a new field in marketing, concentrating on developing strong relationships with customers (e.g., Berry, 1995; Sheth & Parvatiyar, 1995).

The 21st century has developed customer relationship management which gave rise to customer experiences and engagement (Brodie, Hollebeek, Jurić, & Ilić, 2011; Calder, Isaac, & Malthouse, 2016; Hollebeek, Glynn, & Brodie, 2014) and examining how firms can benefit from customer engagement (Kumar & Pansari, 2016). Possibly, the next steps on this journey will be further studies on the relationship between brands (or non-human mechanisms) and humans through the recent seeds provided by a conceptualization of what could be a cool brand/device (Warren, Batra, Loureiro, & Bagozzi, 2019).

Hence, the conceptualization of consumer experience has two major perspectives: brand experience and experience economy. The first become well-known through Brakus, Schmitt, & Zarantonello (2009) and their scale of four dimensions: sensory, affective, behavioural and intellectual. Sensory is related to aesthetics and sensory perceptions. Affective relies on affect and emotions. Behavioural is connected with actions when using the brand. Finally, intellectual reflects the fact that the brand stimulates curiosity.

The second perspective is developed by Pine & Gilmore (1998) and considers that experiences occur when firms use services as stages and transform events in memorable experiences. Pine & Gilmore (1998) present the realms of the experience using two axes. In one axis there is active or passive participation, whereas educational and escapism are on the active side. Educational represents the stimulation to learn something new and escapism means immersion in a different time or place. When observing (see Figure 5) these two facets belong to different parts of the yy axis, that is, educational is absorption (being focused) and escapism is immersion

(being completely in a different place) (Billingsley & Scheuermann, 2014; Jung & tom Dieck, 2017; Loureiro et al., 2014).

Regarding entertainment, this facet is located in passive and absorption axes suggesting that the activities are fun to watch Finally, aesthetics (passive and immersion) represents the setting where the experience occurs.

Figure 5 - Realms of experience economy
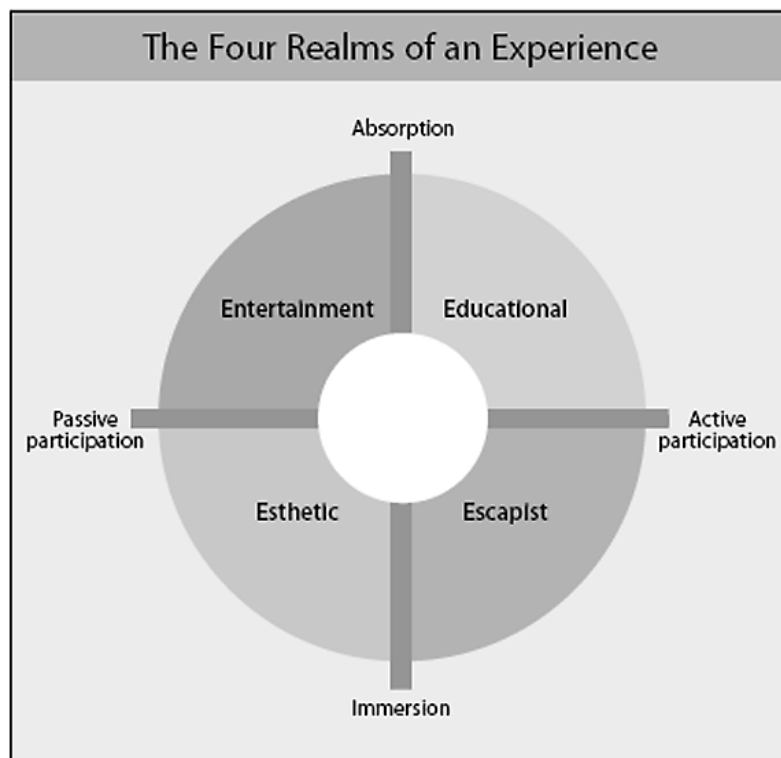
Source: Pine & Gilmore (1998)

In the current thesis experience economy is the selected perspective of experience employed in the context of the study. This is explained in the argumentation for the formulation of hypotheses. Consumer experience is a process that flows from pre-purchase (the search and selection process, that is, all aspects of the customer's interaction with the brand, product category, and environment before deciding to purchase), to purchase (regarding all consumer interactions with the brand during the purchase event) and to post-purchase (when the consumer actually appraises the good or service), being iterative and dynamic. The process includes past purchase which influences the experience during selection and consumption of the experience

(Lemon & Verhoef, 2016). In the studies presented in this thesis, participants underwent the experiences described for the first time. Although the studies are not directly associated with the purchase process, we can argue that the experiences occur during the consumption phase.

In sum, experiences are events aimed at motivating consumers, for the whole purchase process, which in the case of university students should motivate them to have positive emotions, and memories in the learning process (e.g., Dirin & Laine, 2018; He et al., 2017; Petit et al., 2019; Silva et al., 2018). As explained in sub-section (2.4.1) students may have intrinsic and extrinsic motivational factors, and among them we can point out all the stimuli received from an educational experience.

2.3.5   Students engagement

Stakeholders must become engaged in actively cooperating with organizations to plan, develop, co-create or improve what already exists (Loureiro, Romero e Bilro, 2019). Organizations, whether companies, NGO's or higher education institutions need to know how to stimulate innovation through their stakeholders' engagement (Huggins & Thompson, 2015; Ramaswamy & Ozcan, 2018; Shams & Kaufmann, 2016). The literature has already studied the link between distinct stakeholders' engagement, such as consumers, suppliers, shareholders or students, from different perspectives.

Researchers have been attempting to understand engagement between firms and consumers (e.g., Bilro, Loureiro, & Guerreiro, 2019; Brodie et al., 2011; Hollebeek et al., 2014; S.M.C. Loureiro, Bilro, & Japutra, 2019; Nobre & Ferreira, 2017; Pansari & Kumar, 2017; Sprott, Czellar, & Spangenberg, 2009). Research in this domain is not new, as it has been discussed in areas such as psychology or sociology (Garczynski, Waldrop, Rupprecht, & Grawitch, 2013; Morimoto & Friedland, 2013). Moreover, technological advances have provided people with global communications platforms that promote interaction to exchange information and knowledge (Chen, Harper, Konstan, & Li, 2010; Dessart, Aldás-Manzano, & Veloutsou, 2019). In these online environments, consumers may seek important information to make relevant decisions and/or achieve something in their lives. So consumer engagement can be described as a cognitive and affective commitment to an active relationship with the brand as personified by the technology to communicate a specific firm value (Mollen & Wilson, 2010).

Concerning students, relative consensus emerges in the literature concerning motivation as one of the driving sources for engagement (Ketyi, 2016; Macfarlane & Tomlinson, 2017; Robson, 2019). In fact, motivation can affect students' behaviour or action in a specific environment (Appleton, Christenson, & Furlong, 2008; Skinner, Kindermann, Connell, & Wellborn, 2009). The effect of motivation on students is that the more they are motivated to learn, the more likely it is they will be engaged in learning activities (Beachboard, Beachboard, Li, & Adkison, 2011; De Guimarães et al., 2019; C. Kim, Park, Cozart, & Lee, 2015). Motivation can be seen as a two-fold concept: (i) controlled motivation, and (ii) autonomous motivation (Ryan & Deci, 2000b, 2000a). First, controlled motivation appears in student behaviours to respond to external stimuli, such as commenting on peers' discussion board postings to earn a mark for participation (Deci & Ryan, 2000; Ryan & Deci, 2000b). In autonomous motivation, student behaviour is consistent with other values and needs (Ryan & Deci, 2000b). Considering these two distinct types of motives, we can see that students with autonomous motivation are more willing to engage in online discussions than students with controlled motivation. Students with autonomous motivation may behave more actively (Xie, Debacker, & Ferguson, 2006; Xie, Durrington, & Yen, 2011), maybe more individualistic and collaborative, or sustain their actions in cognitive engagement (Xie & Ke, 2011).

Although not consensual in the literature, student engagement can be defined as their psychological investment and behavioural involvement in learning activities (Appleton et al., 2008). Moreover, student engagement is often defined as a multidimensional construct and is usually defined as having three dimensions: behavioural engagement, cognitive engagement, and emotional or affective engagement (Fredricks, Blumenfeld, & Paris, 2004; Jimerson, Campos, & Greif, 2003). If we look more deeply into the literature, most research about this topic is found to relate the behavioural engagement with students' participation, observation of rules in the classroom and involvement in learning activities (Jeremy D. Finn & Voelkl, 1993; Fredricks et al., 2004; Jimerson et al., 2003). Behavioural engagement in online contexts can usually be through discussions or replies to peers. In fact, several authors argue that the number of discussions among peers can be perceived as an indicator of behaviour engagement (Goggins & Xing, 2016). In line with this, research also observed an exciting relationship between discussions among students and achievements (Ramos & Yudko, 2008). Nevertheless, this relationship tends to exist only when discussions are needed.

Concerning emotional engagement, research defined this as students' psychological response to academic environments, such as the feeling of boredom or enjoyment from learning activities (Finn & Zimmer, 2012). It can also be influenced by the relationship with tutors or lecturers and their peers (Fredricks et al., 2004). In the online context, emotional engagement can be linked to students' interests or enjoyment in being part of online conversations and based on social interactions with tutors and colleagues.

Finally, cognitive engagement can be perceived as the idea of expending extra effort to understand multifaceted concepts and/or to master upscaled skills (Finn & Zimmer, 2012; Fredricks et al., 2004). The relevance of this third dimension of cognitive engagement was also perceived and noted in distinct online contexts (e.g., Garrison, Anderson, & Archer, 2000; Putman, Ford, & Tancock, 2012; Zhu, 2006). Cognitive engagement in online discussions can be stated as the attention and the effort that students spend on interacting through discussions, posts or comments with their peers or tutors (Garrison et al., 2000). It involves the use of multifaceted concepts and/or students' upscale skills, such as analysing, critiquing, or reasoning (Putman et al., 2012; Zhu, 2006).

2.4 Foundational theories

2.4.1 Foundation theories in gamification and transmedia

Following Kapp (2012, p. 10), "*Gamification is using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems*", whereas Zichermann & Cunningham (2011, p.14) consider gamification as "*the process of game-thinking and game mechanics to engage users and solve problems*". Huotari and Hamari (2012, p. 20) give a definition from a marketing perspective as "*a process of enhancing a service with affordances for gameful experiences in order to support user's overall value creation*". Yet, the most common definition is provided by Deterding, Khaled, Nacke, and Dixon (2011, p.2), as "*the use of game design elements in non-game contexts*". Thus, gamification is an umbrella term focusing on the use of game elements instead of full-fledged games to improve user experience and engagement in non-game contexts (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011), including education.

The concept of "transmedia storytelling" was first introduced by Henry Jenkins in his book "*Convergence Culture: Where Old and New Media Collide*" (Jenkins, 2006). Transmedia

storytelling means telling a story through multiple media and preferably, with a degree of audience participation, interaction or collaboration. In transmedia storytelling, engagement with each successive media heightens the audience's understanding, enjoyment and affection for the story. In order to implement transmedia, the embodiment of the story in each media should be satisfying, while the enjoyment of all media must be greater than the sum of its parts (Pratten, 2015).

Gamification and transmedia have in common the fact that both may contribute to enriching a certain experience and can contribute to engaging consumers, such as university students. These concepts have their foundation in motivational theories which include self-determination theory, flow theory and self-regulation theory. Self-determination theory of motivations stresses that individuals have intrinsic and extrinsic motivation to achieve a certain goal. Indeed, individuals are motivated to grow and evolve because of three needs - competence, connection and autonomy. The theory also points out that extrinsic motivators need to be continuous because individuals become addicted to them (Deci & Ryan, 2000). Self-regulation refers to the ability to moderate the thoughts and emotions that govern human behaviour (Leventhal, Nerenz, & Steele, 1984). Therefore, this second theory emerges as a complement of the first. Indeed. self-regulation has direct linkages to motivation (Bandura, 1991), that is, the motivation to achieve success is linked to self-discipline and adherence to the strategies that encourage goal achievement. Finally, the flow theory proposed by (Csikszentmihalyi, 1990) indicates that flow is an optimal psychological state that individuals experience when engaged in an activity that is challenging, often resulting in immersion and concentrated focus on a certain task.

2.4.2   Foundation theories in virtual reality studies in marketing

According to (Loureiro, Guerreiro, Eloy, Langaro, & Panchapakesan, 2019), there are four main foundation theories supporting the studies on VR: self-expansion, TPB, UTAUT and S-O-R. The first (self-expansion theory) lies in the assumption that consumers desire and are able to accomplish their goals, and so self-expansion is related to psychological models of self-efficacy, intrinsic motivation, self-actualization, and self-improvement motivation. Thus, the self is created through relationships with close others and these relationship partners can draw out otherwise hidden aspects of the self to create greater wholeness (e.g., Aron & Aron, 1997; Aron, Norman, & Aron, 1998).

TPB (Theory of Planned Behaviour) claim that that subjective norms, attitude toward behaviour, and perceived behavioural control, together shape a consumer's behavioural intentions and actual behaviours (e.g., Ajzen, 1991). Here, subjective norms are the person's beliefs about whether other people approve or disapprove of the behaviour. Attitude means the degree to which a person has a favourable or unfavourable evaluation of the behaviour of interest. Perceived behavioural control refers to a consumer's perception of the ability (ease or difficulty) of performing the behaviour of interest. Finally, behavioural intentions are the motivational factors that influence a given behaviour. A strong behavioural intention may lead to actual behaviour.

The last two tend to be used more often (Loureiro Guerreiro, Eloy, Langaro, & Panchapakesan, 2019). Thus, UTAUT (Unified Theory of Acceptance and Use of Technology) (e.g., Venkatesh, Morris, Davis, & Davis, 2003) is a unified model of the well-known TAM model suggested by Davis, Bagozzi, & Warshaw, (1989). TAM (Technology Acceptance Model) comprises the perceived usefulness (the degree to which a consumer believes that using a technological system enhances their performance) and perceived ease-of-use (the degree to which consumers believe that using a technological system implies effort) as two main drivers of attitude and behavioural intentions. UTAUT provides a unified view to explain users acceptance of new technology and acts as a baseline for new technologies inside organizations (Venkatesh et al., 2003). Later, UTAUT is extended to the consumer use context (Venkatesh, Thong, & Xu, 2012), by including Hedonic Motivation, Price Value and Habit, and UTAUT2 emerged (see Table 8).

Table 8 - Antecedents of behavioural intentions and actual behaviour based on TAM and UTAUT2

Construct	Concept
Performance expectancy	Benefit received from using technology in performing activities
Effort expectancy	The ease of using technology
Facilitation conditions	Individuals' perceptions that technical structures exist to support the use of technology
Social influence	When relatives and peers believe the individual should adopt the technology
Subjective norm in TAM	The perception of social influence to adopt the technology or not

Hedonic motivation	The experience of fun and pleasure when using the technology
Price value	The trade-off between perceived benefits and the cost of using the technology
Habit	The extent that individuals tend to execute behaviours automatically; the habit of using the technology
Perceived behavioural control	Perceived ease or difficulty of performing the behaviour; feel in control of the situation
Attitude	Favourable or unfavourable evaluation or appraisal of the behaviour in question

Source: Loureiro & Guerreiro (2018)

S-O-R framework is the theoretical foundation of the study on VR experience in this thesis. Mehrabian and Russell (1974) proposed the S(Stimulus)-O(Organism)-R(Response) framework from the perspective of environmental psychology. Then, S-O-R was introduced in a retail context by Donovan and Rossiter (1982). In retail - both online and offline - the stimulus is operationalized as the atmospheric cues, the organism as consumers' emotional and cognitive states, and the response as approach or avoidance behaviours (e.g., intention behaviour, re-patronage, or store search) (e.g., Baker, Grewal, & Parasuraman, 1994; Roschk, Loureiro, & Breitsohl, 2017; Wu, Cheng, & Yen, 2008). S-O-R has provided the theoretical basis also in m-commerce Huang, (2017) and emerging technologies including VR (Kim, Lee, & Jung, 2018) or the tourism context (Loureiro et al., 2014). Environmental stimuli or atmospheric cues or even the stimuli provided by an experience initiate the perceptual, physiological, feeling, and thinking activities, and cause a change in the consumer's cognitive and emotional state (Roschk et al., 2017; Sherman, Mathur, & Smith, 1997). The thinking and feeling activities (Organism) intervene in the relationship between the stimulus and the consumer's responses (Roschk et al., 2017).

In sum, the CLR provides the seeds for the three studies presented in the next three chapters. The first study is devoted to gamification in higher education and describes an experiment with a gamification-based tool, developed with a group of undergraduate students, during a full semester. The second study focuses on transmedia supported by Moodle and developed during a full semester with a group of senior students. The third study is devoted to exploring antecedents of students' engagement using virtual reality as a tool.

In the three studies, some tools and methodologies will be analyzed and presented, as a possible support for students' engagement and motivation throughout the teaching-learning process, in a higher education environment.

Chapter 3

3   Study 1 – Gamification in Higher Education

This study aims to contribute to the understanding of gamification in higher education, since the use of game design elements in non-game contexts (Deterding, et al., 2011) is a growing trend in the literature in different settings, from finance to marketing or education (Azmi et al., 2017; Dicheva et al., 2015). Specifically, higher education is one of the non-game contexts where the implementation and use of gamification techniques are evolving (Laskowski, 2015; Oliver, 2017). Gamification, the application of game-based techniques in non-game environments, has been subject to growing interest among scholars and practitioners regarding its application in several areas, namely in Higher Education. A growing amount of research concerning gamification and its applications to this area has been published since 2013. In this connection, this study aims to conceptualize and then empirically study, through qualitative research followed by a text-mining approach the practical applications and future directions for gamification in higher education environments. Through this research, we intend to contribute with precise inputs regarding how to create students' engagement and motivation towards their learning and academic activities. Moreover, this study also intends to show that much remains to be uncovered in these domains. Specifically, understanding how gamification may contribute to creating stimuli that enhance students' experiences of learning environments and lead to influencing decision-making among actual and prospective students.

3.1   Theoretical background

Gamification is a growing trend in research (Caponetto, Earp, & Ott, 2014; Erenli, 2012; Kasurinen & Knutas, 2018) as well as in educational settings (Azmi et al., 2017; Dicheva et al., 2015). Despite the lack of a standard definition of gamification in the literature, in this chapter, the authors adopted the definition of Deterding et al. (2011) that Gamification is "the use of game design elements in non-game contexts". Higher education is one of those "non-game contexts" where the adoption of gamification techniques is evolving and increasing in distinct educational settings (Faghihi et al., 2014; Galbis-Córdova, Martí-Parreño, & Currás-Pérez, 2017).

According to Smith, et al. (2013), the increase in class sizes and active learning pedagogies suggests that to maintain excellent communication and feedback to students, a new set of tools (online and offline) will need to be developed or improved. Some authors, such as Kapp & Coné, (2012), present different types of definitions regarding learning through games, such as: (i) gamified learning, which is the use of gaming elements integrated into training programmes, aligned with specific goals to promote changes in behaviour; (ii) game-based learning, which is the use of games to teach new knowledge and skills within a self-contained space or environment; (iii) simulation learning, which is a realistic, controlled-risk environment, to allow the practice of specific behaviours and experiences.

Learning games, as stated by Klopfer, Osterweil, and Salen (2009) can have an extensive portfolio of types, applications, and purposes, including: (i) games such as "engines" or authoring platforms, where students use the game to produce an artefact (e.g., a game, a video, a visual text); (ii) games as content or content systems, where games are used to deliver understanding about a particular subject or content area; (iii) games as simulations or manipulating systems, where games are valued as dynamic systems where students can test theories about how things work; (iv) games as context or trigger systems, where games are used to create an experiential context for understanding around a topic; (v) games as technology gateways or gateway systems, where games are used to give students experience with technology; (vi) games as illustration or reflective systems, where games are used as contexts for student reflection; (vii) games as exemplars of the point of view or POV systems, where games allow students to take on particular identities and associated points of view; (viii) games as code worlds or code systems, where games are used to allow students the practice of writing as the primary mechanics of game play; (ix) games as documentary or documentary systems, where the game works as documentary evidence for student ideas and understanding; (x) games as text or ideological systems, where games are "read" as texts that express certain ideologies, values, beliefs; (xi) games as research or research systems, where students design games as a research activity, producing material to be used in later learning experiences; (xii) games as assessment or assessment systems, where games work as environments for assessing student learning, curricular content or state standards. The game types mentioned above, which support the learning process, provide us with a proper perspective about the potential and "learning power" of gamification strategies.

3.1.1 Definition and some clarification of the term Gamification

Gamification is still wide open to a more commonly accepted definition of the term, and there are still few well-established theoretical frameworks or unified discourses (Hamari et al., 2014). According to the Oxford dictionary, gamification is the application of typical elements of game playing (e.g. point scoring, competition with others, and rules of play) to other areas of activity (Oxford, 2019). Other authors define gamification as the use of game design elements in non-game contexts (Deterding, et al., 2011; Priya & Kalpana, 2014; Xu, 2011), as the incorporation of game elements into non-game settings, or using game mechanics, dynamics, and frameworks to promote specific behaviours (Domínguez et al., 2013; Lee & Hammer, 2011; Sheldon, 2012; Stott & Neustaedter, 2013). Additionally, Kapp and colleagues consider gamification more comprehensively and define it as the concept of using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems (Kapp, 2012; Kapp, Blair, & Mesh, 2014; Kapp & Coné, 2012).

Looking at gamification from an educational perspective the term should not be confused with game-based learning (GBL) or serious games since these focus on creating games (and game-based experiences) which impart an educational benefit by using games and simulators. Educational gamification is the direct opposite and, seeks to add game-like concepts to a learning process (Glover, 2013).

The usage of gamification to promote learning goals is mainly possible due to the fact that most of its elements are based on educational psychology and cover several techniques that designers of instruction and lecturers have been using for years (such as assigning points to activities, giving feedback, encouraging collaboration on projects, promotion of teamwork, among others). The main difference is that gamification adds additional layers of encouragements, putting together all those elements into an engaging game space that motivates and educates learners (Kapp, 2012).

3.1.2 Gamification toolbox

Gamification for educational purposes, as proposed by Lee and Hammer (2011), implies the use of a game-like rule system, player experiences and cultural roles to shape learners' behaviour within the cognitive, emotional and social areas. Gamification is an important concept to use to promote learning engagement, but it should not be considered as a unique solution or, in isolation from other methods and tools (Glover, 2013). The MDA framework, as stated by Zichermann and Cunningham (2011), shows (i) Mechanics (define how games operate as a system, converting inputs into specific outputs), (ii) Dynamics (guide how the player and the game mechanics interact during the game), and (iii) Aesthetics (how the game makes the player feel during interaction, when the game mechanics and dynamics interact and create emotions).

Within game mechanics and game dynamics, Iosup and Epema (2014) identify seven core tools for gamification. The three core mechanics are: (i) point systems – the units of value internal to the game, that quantify student performance; (ii) levels, access, and power – ways to encourage students to play, achieve and excel their goals and expectations; (iii) leader-boards – used to compare and display achievements and results among players. Identified in the four core dynamics are: (i) badges and other status displays – ways to show achievement and achieve objectives; (ii) onboarding – the act of bringing a novice into the system (the gaming environment); (iii) social engagement loops – designs that make players return to the game; (iv) unlocking content – powerful dynamic tool for controlling the evolution of the course.

According to Kapp (2012), other elements that work individually or collectively are also necessary to create the game-playing experience (the gamified environment). These are: (i) Goals, with their introduction adding purpose, focus, and measurable outcomes; (ii) Rules, which can be perceived as a set of defined rules; (iii) Conflict, competition or cooperation – games involve all these dimensions (otherwise they would not be games); (iv) Time – relates to game design and gameplay, acting as a strong motivator for player activity and action; (v) Feedback – provides information to learners to guide them toward the correct outcome; (vi) Storytelling – provides relevance and meaning to the experience and context for the application of tasks; (vii) The curve of interest – flow and sequence of events that occur over time, maintaining the player's interest; (viii) Replay – gives the player permission to fail and try again.

3.1.3   Some considerations before the implementation of Gamification

Before considering the implementation of learning experience through gamification, Glover (2013) proposes several questions to consider (similar to a brief checklist): (i) is motivation actually a problem?; (ii) are there behaviours to encourage/discourage? (iii) can a specific activity be gamified? (iv) am I creating a parallel assessment route? (v) would it favour some learners over others? (vi) what rewards would provide the most motivation for learners? (vii) will it encourage learners to spend disproportionate time on some activities? (viii) are rewards too easy to obtain?

These questions are guiding topics to consider before implementing gamification in any educational or learning initiative. Huang and Soman (2013) propose a five-step process when thinking about implementing gamification in education: (i) understanding the target audience and the context; (ii) defining learning objectives; (iii) structuring the experience; (iv) identifying resources; (v) applying gamification elements. According to the same authors, "*the accuracy and efficiency of applying gamification to the education program will depend on the thoroughness of implementing these steps*" (Huang & Soman, 2013 p. 15). Hamari et al.(2014), after performing a literature review of 24 peer-reviewed empirical research papers on gamification, concluded that in most cases gamification produces positive effects and benefits, and reported positive results for some of the motivational issues. Regarding the context where gamification is applied, the areas of education or learning are the most common and show mostly positive results in terms of increased motivation and engagement, in the learning tasks together with some enjoyment of them.

Moreover, the use of some e-learning platforms (such as Moodle) seems appropriate, since these platforms already provide mechanisms to collect, measure and validate student activities (Borys & Laskowski, 2013; Llopis-Amorós, Roger-Monzó, & Castelló-Sirvent, 2019). Despite not being a suitable method for every learning situation nor even easy to create and implement, gamification is a serious approach to accelerate the experience curve of learning, teaching complex subjects, and systems thinking (Kapp, 2012). According to Kapp (2012 p. 22), the implementation of gamification in the academic world should be given great consideration as the professionals in the area (learning professionals, educators, and faculty members) have many of the skills, knowledge and abilities to promote these tools among students. Therefore, "*they must focus on providing an engaging and goal-oriented solution to the training and teaching dilemma*".

3.2 Gamification in Higher Education - students opinion through text-mining

For better understanding of this phenomenon, we decided to develop an empirical study concerning the application of gamification in higher education environments. To do so, we apply and measure gamification through an experimental design study. The specific set applied in this study means it can be classified as observational, as we want participants to follow their naturalistic behaviours, and that participants undergo the same experimental protocol. This study took place in 2019 at an HEI located in great Lisbon area. To operationalize this study, we subject a set of undergraduate students to various moments of gamification over the course of a semester, in a specific curricular unit. To do so, researchers resort to the use of a well-known platform called Kahoot!, a Norwegian platform launched in 2013: "*Kahoot! is a game-based learning platform that makes it easy to create, share and play fun learning games or trivia quizzes in minutes. Users can play Kahoot! on any mobile device or computer with an internet connection.*" (Kahoot, 2019). Figure 6 shows an example of this product screenshot.

Figure 6 - Screenshot of Kahoot!
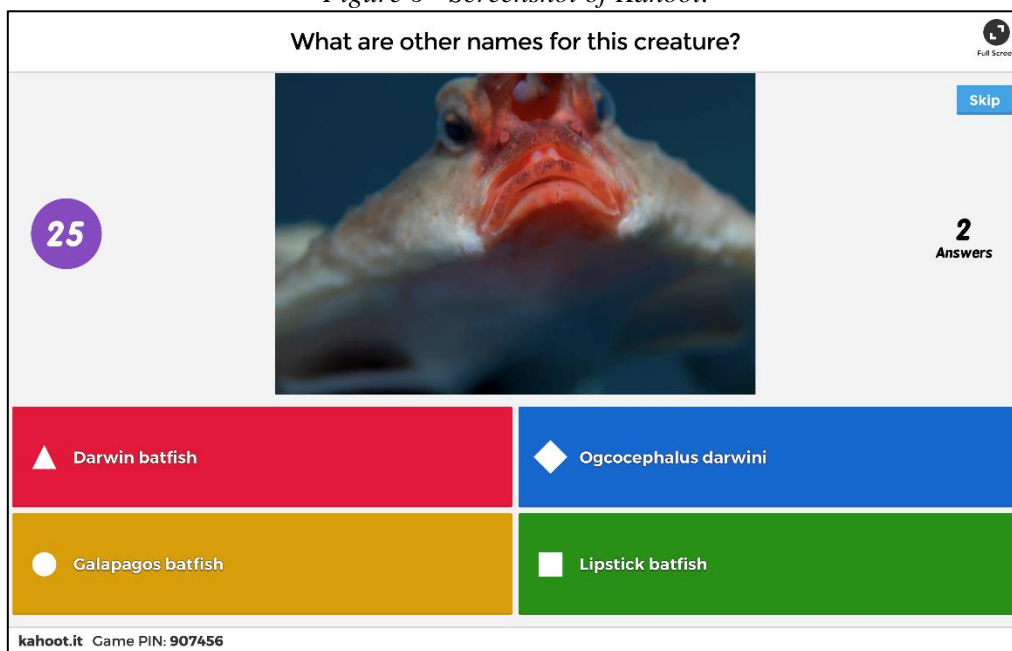
Source: Kahoot! Press-Kit 2019

At the end of the semester, students were asked to give their opinion about the experience of using Kahoot! in the classroom through one single open-ended question. At no moment during the semester, was it explained to students why they were using Kahoot! inside the classroom.

At the end of the semester and, after explaining to students that the goal of the questions asked was only to assess their true opinion about the advantages and disadvantages of this type of gamification-based tool in the learning environment, they were asked the following question: "*What is your opinion about the use of Kahoot! inside the classroom? Which are the main advantages and disadvantages that you see in using this type of Gamification tools?*". The question was put through an electronic form, and anonymity was guaranteed. From a group of 91 students that were exposed to this experience during the semester, we were able to collect 73 valid answers, after blank responses or other non-suitable answers were eliminated, which corresponded to an 80,2% success rate. The participants profile gender was 56,3% female and the age groups were 18-25 years (91,8%) and 25-34 years (8,2%). As mentioned earlier, we decided not to have a control group, as this study was intended to be more observational than an experiment.

3.3 Data analysis

After collecting students' answers, it was decided to analyse the content of this data through a text-mining technique. Text-mining techniques allow researchers to extract meaningful knowledge from unstructured text, such as comments, opinions or reviews (Fan et al., 2006). Resorting to this type of technique, researchers are able to analyse information and processes from an unstructured text to extract relevant data that can be translated into actionable knowledge (Fan et al., 2006; Zhang, Zeng, Li, Wang, & Zuo, 2009). The text mining techniques usually include distinct actions such as text categorisation, text clustering, or sentiment analysis, among others (Li & Wu, 2010; Srivastava & Sahami, 2009). For the purpose of this study, we resort to MeaningCloud software, which is a powerful and user-friendly way to extract meaning from all types of unstructured content, from conversations to internal documents, allowing researchers to perform text analysis, text classification, or sentiment analysis (MeaningCloud, 2019b). Several studies have resorted to this software in different scientific domains (Bilro et al., 2019; A. Kaur & Chopra, 2016; Martínez et al., 2016). This type of tools can analyse a vast amount of data through NLP, natural language processing. NLP is a methodology that allow machines to interpret the relevant elements of the human language sentence and produces an interpretation of the text so that it can be analysed (Berezina, Bilgihan, Cobanoglu, & Okumus, 2016; Godbole, Bhattacharya, Gupta, & Verma, 2010; Loureiro Guerreiro, Eloy, Langaro, & Panchapakesan, 2019; Mostafa, 2013).

The first stage of this research was to undertake a topic analysis. To do so, we perform a topic extraction on the above-mentioned software. Table 9 shows the 10 most mentioned topics discussed by the students in their response.

Table 9 – 10 most mentioned topics

Topic	Frequency
class	58
student	35
classroom	29
match	21
subject	10
competition	10
Kahoot	10
people	10
question	9
interactive	9

Source: own elaboration

The main topics in students' answers were those connected to the classes themselves, such as class, student, classroom or subject. These are followed by topics connected to match, competition or interactive. These results are in line with the expected outcome. Therefore, students perceive gamification firstly as an educational tool, and only after that they mention the aspects more connected to the game or the competition itself. Based on these first results, students are seen to understand the use of this type of tool more as an element of education rather than an element of entertainment.

Following this analysis, and still based on the results from topics extraction, we move on to analysis of the most mentioned words. To analyse and group the set of words used most, we resort to a WordCloud, which is a visual representation of text data, used to depict keyword metadata or to visualize the free form of text. For the purpose, HTML5 WordCloud was used. As we can see in figure 7, the most mentioned word by the respondents is Class, followed by Student.

Figure 7 – Wordcloud of the most mentioned words
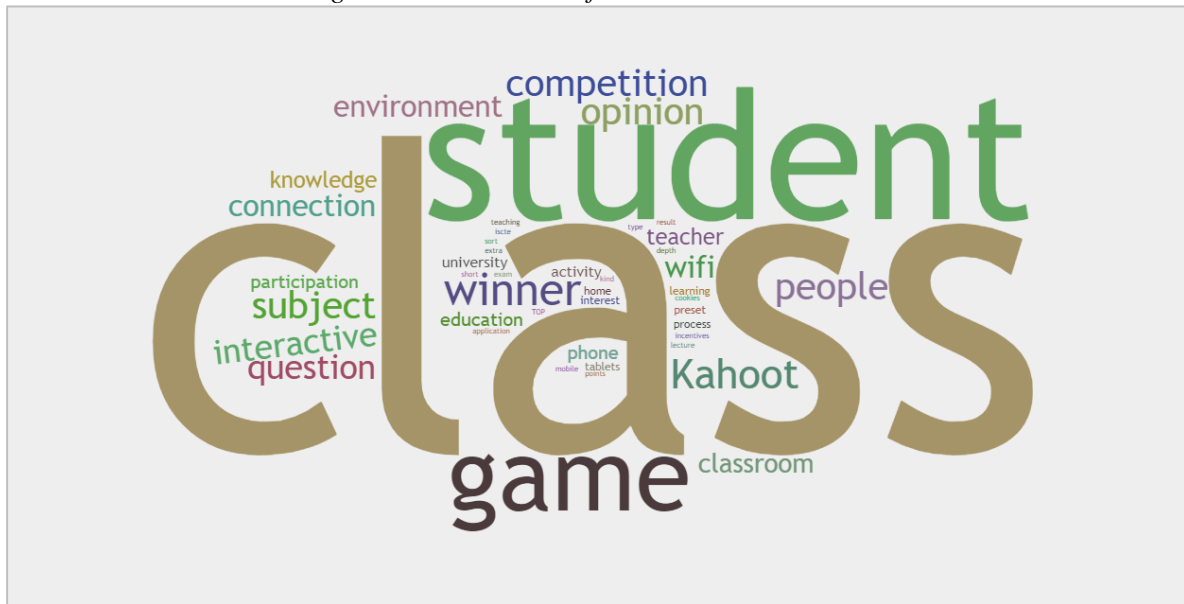
Source: own elaboration

Other words, such as game, competition or winner are also highly ranked. However, as shown in Figure 7, respondents focus their opinion on words connected to education, such as class, students or subjects. Once again, respondents seem to understand that the purpose of this type of tool is related to education rather than entertainment.

Moving on to our text-mining analysis, we perform a deep categorization of the available text. Deep categorization "*assigns one or more categories of a predefined taxonomy to different snippets of a text. By applying a powerful semantic rule technology, it provides maximum accuracy in the classification while allowing the fastest and most efficient definition of models*" (MeaningCloud, 2019a). This deep categorization revealed that the main categories of respondents' answers are about education, educational assessment, technology and computing, video gaming and mobile games. Once again, the text categories are seen to be in line with the previous analysis, with a clear focus on educational environments (see Table 10).

Table 10 – Text categories

Categories
Education
Business and Finance>Industries
Technology and Computing>Consumer Electronics
Science>Environment
Education>Educational Assessment
Business and Finance>Business
Video Gaming
Video Gaming>Mobile Games
Technology and Computing>Computing

Source: own elaboration

To complement this analysis, it became relevant to carry out cluster analysis, so we can classify our object (in this case, the text *corpus*) into relative groups that are similar to each other (i.e., clusters) (Li & Wu, 2010; Punj & Stewart, 1983). The software used not only creates clusters but also attributes a score to each cluster. Based on that, we can identify the clusters with higher scores. As we had a large group of clusters, for the purpose of this analysis we decide to use only those with higher scores and establish a cut-off for clusters with a score of 150 or higher. The higher clusters can be seen in table 11.

Table 11 – Word clusters

Cluster	Score
Good tool	602.60
Good way	602.55
Paying attention	531.20
Knowledge	370.08
Game	284.24
Fun way to learn	255.64
Stop paying attention	250.24
Outweigh the disadvantages	245.31
Wifi	244.80
Feel	243.10
Motivation	231.84
Good Idea	231.03
Competitive environment	198.76
Way of learning	188.90
Serious	174.45
Interactive way	168.70
Limited time	154.72
Way to teach	154.28

Source: own elaboration

The clusters with the highest scores are seen to be 'Good tool' (602.60), 'Good way' (602.55) and 'Paying attention' (531.20). Based on these results, we can argue that students understand this type of gamification tools as a good approach to adopt in educational environments, namely inside classrooms. Still based on these results, students also highlight that it is a fun way to learn (255.64) and that it outweighs the disadvantages (245.31). Some students also refer to a more practical aspect of using this type of technology in class, which is that internet Wi-Fi should always be available so as not to detract from the overall experience (244.80). Another relevant issue arises, such as interactive way (168.70), or motivation (231.84). These results are very much in line with what common sense tells us about these new generations. In fact, today's students are part of an over-stimulated generation. To be able to bring this type of tools to educational environments may represent a way to motivate and create positive interactions with them.

Finally, and to understand the sentiment level of students facing this type of gamification tools, we make a global sentiment analysis. The global sentiment analysis maps the overall sentiments expressed in the text (i.e., students' answers) (Cambria, Schuller, Xia, & Havasi, 2013; Liu, 2015). To do so, we resort once again to MeaningCloud software, which analyses the sentiment expressed in each comment or answer and attributes a polarity scale, from Positive + (P+) to Negative + (N+). As seen in Table 12, most answers express positive sentiments (72.60%), and only 8.22 % of the answers reveal negative sentiments.

Table 12 – Sentiment analysis results

	Sum	%	P-N %
P+	8	10,96%	72.60%
P	45	61,64%	
NEU\NONE	14	19,18%	19.18%
N	6	8,22%	8.22%
N+	0	0,00%	
Total	**73**	**100,00%**	**100,00%**

Source: own elaboration

Based on these results, the great majority of respondents (students subject to a gamification experience in class during a semester, and later asked their opinion about it) are found to have a positive sentiment about this type of practice. Moreover, less than 10% of respondents revealed negative sentiments towards the experience, and around 20% reveal neutral sentiments. This type of observation can lead us to argue that the overall experience for this set

of students was positive or very positive and that in fact, students are willing to engage in this type of educational environments that resort to gamification tools.

3.4 Discussion of study 1

In this section, the main results and insights arising from this study will be presented and discussed. Nowadays, new ways to address the teaching-learning process, especially those based on more technological tools and "environments", might not only be challenging for students and educators but are also a way to stimulate students' attention, motivation and engagement.

Considering these aspects, we decided to run this simple but effective experiment, trying to reach some conclusions that could, to some extent, support our thinking regarding a more gamification-based teaching methodology, that could be rated by students.

As previously mentioned, a gamification-based approach raises several aspects that require previous assessment of not only the conditions conducive to its implementation, but also the available resources that could contribute to its success. For this study, students with their smartphones in a classroom with wi-fi coverage, was all it took to implement this short experiment.

Throughout a full semester, students were exposed to several moments of interaction and participation through the gamification-based tool Kahoot! without expecting to be questioned or having to evaluate use of the tool, and therefore could participate free from any preconceived ideas.

Kahoot! is a very simple and interactive online tool, one that could even be considered as an entertainment tool, but our data extraction and analysis revealed, when used in a classroom setting, it becomes a tool with educational power. It can stimulate students' participation and interest and the results of this experiment enforce this.

Students considered it as a "good tool" and a "good way" to "pay attention" and, most of all, a "fun way to learn" which is also an interesting condition to promote learner satisfaction and engagement (Borrás-Gené, Martínez-Núñez, & Martín-Fernández, 2019; Whitton & Langan, 2019).

Through the global sentiment analysis, we were able to identify and measure the students' general feeling about this gamification tool, as a support of their learning process. Most of the

sentiments expressed (72,60%) were positive, revealing that the use of this type of tool and its direct application in a learning environment can contribute to greater interest and motivation among students. The global sentiment analysis is an interesting way to facilitate understanding of how users feel about something, their emotional states and whenever their opinions, answers or comments can be expressed freely, without any limitations or restrictions (Altrabsheh, Cocea, & Fallahkhair, 2014; Liu, 2015).

The main objective of this study was not to analyse the Kahoot! tool but to highlight the importance of this type of gamification-based tool as a way to stimulate students' participation and interest in the contents and subjects taught, through a more active and engaging attitude.

Despite the simplicity of this experimental approach, we believe that the aims of this study have been achieved. However, further research and trials need to be performed, so that new tools and new methods can be explored in order to contribute to improving the teaching-learning process in use. In terms of future research, gamification is a didactic strategy that favours students' engagement with subjects and courses.

Future research should also devote some time and attention to comparing experimental groups and control groups. Due to the challenges presented by such research, several differences are likely to arise from these groups (Ortiz, Chiluiza, & Valcke, 2016). Lastly, further research can also consider students' emotional, cognitive, social and motivational dimensions. For instance, these types of educational experiences of gamification need students' motivation to complete the challenges.

A considerable supply of technology-based teaching tools and methods are now available to assist in the teaching-learning process. Some of these tools and methods will also be subject to further analysis in this thesis.

Choosing to use only one tool in the classroom for the full semester, might be considered as a limitation of this study since many other gamification-based tools could be tested simultaneously. In this way, it would be possible to identify a mix of tools which, when used together, would facilitate the teaching-learning process.

Another limitation of this study is the small sample of students that used the tool and, expressed their opinions about it. It would be better to have a larger group of students, at various educational levels, to test the same tool with the same kind of challenges and interactions, providing richer data analysis and conclusions.

Chapter 4

4 Study 2 – Transmedia, Moodle and interaction

This study aims to explore transmedia effects in higher education using a mixed approach, through the involvement and participation of a group of 81 undergraduate senior students (63% female and 37% male) in various activities, mainly based on the Moodle LMS. This group of undergraduate senior students, from the Accounting and Finance degree course, participated in this study during the second semester of the school year 2018-19.

The study took place during the course lectures of the "Innovation and Business Strategy" unit, under the syllabus topic of "Innovation". In previous years of this course, Moodle has been used only to share documents and learning materials with students – no other sort of interaction with students was ever adopted.

The way students learn in higher education is changing and this change will be supported and enhanced by integrating new tools and pedagogies that engage students through various learning scenarios, such as transmedia storytelling (Raimúndez-Urrutia & Azzato Sordo, 2017; Tombleson, Wolf, Gallant, Archer, & Desai, 2016). The transmedia approach has proved its worth in higher education learning environments, as its application has been able to stimulate engagement at cognitive, affective and behavioural levels (Dickinson-Delaporte et al., 2018). Transmedia implementation into a classroom must provide students with various tasks and the necessary guidance for them to select and try different media environments, living their transmedia learning experience (Freeman, Gambarato, & Tárcia, 2019; Jenkins, 2010).

If student engagement facilitates and promotes academic achievement, a major concern in many higher education institutions, it is important to explore methods that could enhance and strengthen students' engagement at all levels of education. All the time and effort spent by students in educational activities is directed to their academic success (Fredricks et al., 2004; Williams & Whiting, 2016).

A Learning Management System (LMS) is also considered an important asset in education at all levels since it allows students and teachers to access a set of interactive resources that integrate a wide range of pedagogical and course administration tools built to support the teaching-learning process. An LMS provides a series of features, both synchronous and asynchronous, that support the learning process, enabling its planning, implementation, and

evaluation (Croitoru & Dinu, 2016; Kamarulzaman, Madun, & Abdul Ghani, 2010; Pérez-Pérez et al., 2019).

The option to adopt and explore a new data mining tool like Orange (Demsar et al., 2013; Demsar & Zupan, 2013; Demšar, Zupan, Leban, & Curk, 2004), trying to obtain insights from unstructured text data collected through the Moodle forum, might be seen as an advantage here, allowing more efficient analysis of that data (Mohit, Charan Kumari, Choudhary, & Kumar, 2017; Saranya, Rajamani, & Saranya, 2017).

4.1 Research Design and Methodology

This study was mainly supported by the Moodle LMS in its 3.3 version. An area of the curricular unit of "Innovation and Business Strategy" was set up in a way that students could self-enrol given a specific password.

A topic for the syllabus subject of Innovation was set up within the course area, where all issues and activities related to this study would be presented and available to students. Within this topic, a general forum module was set up to enable all course participants, to have discussions in an asynchronous mode and be aware of all forum post notifications.

Throughout the semester, students were asked to perform various activities concerning innovation (i.e. analysis, presentation and discussion of case studies regarding innovative firms; an essay about Portuguese innovations; active participation in the general forum; share contents and comment on a Facebook page).

At the end of the study, students answered a short questionnaire, to collect their opinions about all the activities performed on the subject of innovation, as well as how they were addressed and conducted.

4.1.1 Case studies about innovative Portuguese firms

Case-study is a teaching method that enables the simultaneous combination of theoretical and practical aspects, offering students the opportunity to improve their skills and critical thinking. Some studies have shown that the academic results of students who are involved in the case--study method are significantly better than those who do not use this learning methodology. Through case-study analysis and discussion, students can retain more knowledge, improve their

emotional engagement and thus achieve better individual learning performance (Andreassen & Holmsen, 2018; Nkhoma, Sriratanaviriyakul, & Quang, 2017; Razzouk & Johnson, 2013)

To perform this group activity, nine case-studies about Portuguese firms were selected. The cases were distributed through a draw to groups of 3 to 4 students and a set of exploratory questions given to each working group.

The exploratory questions used were:

> 1. What products and/or services are developed by the company?
>
> 2. What initiatives/activities are created by the company to promote a culture of innovation among its employees?
>
> 3. What is the importance of Innovation for the company, considering the sector of activity in which it operates?
>
> 4. How does the Company promote and conduct innovation (RDI activities - Research, Development, and Innovation)?
>
> 5. How does innovation contribute to the creation of new products or services?
>
> 6. What are the benefits of a corporate culture that encourages creativity and innovation?
>
> 7. In promoting a culture of innovation, what role should top management play?

After reading the cases, searching for additional information and answering the proposed exploratory questions, students delivered through Moodle a written report with their answers and conclusions, for further discussion and analysis in class.

Twelve reports were received.

4.1.2 Writing an essay about Portuguese innovations

To perform this group activity (groups of 3 to 4 members), the students had to search for and select a Portuguese-based product or service innovation, and write a short essay presenting the company or creator of the product or service; the identified need that led to creation of that product or service; the challenges overcome and the most differentiating aspects of each product or service compared to the competition; its advantages and disadvantages for users and the general public.

This activity not only stimulated students to search for Portuguese-based innovations from various sources (e.g., web-based search; school library; b-on database) but also gave them a better understanding of the levels of difficulty and complexity inherent to innovating and creating a new product or service. Eleven essays were received.

4.1.3 Facebook page about Innovation

A Facebook page on the topic of innovation was created and disseminated among students so that they could contribute by posting information or comments on existing posts, about topics of general interest and related to innovation.

The outcome of participation on this Facebook page was residual, and due to some technical and time constraints, it was not possible to create a page on the topic of innovation in another social network.

4.1.4 Moodle forum module

Moodle offers 5 different forum formats with distinct features, which allow participants to have asynchronous conversations. One of those types is the "*standard forum displayed in a blog-like format*" where all the participants can start a discussion about anything, at any time since all posts are always available to all the participants, stimulating them to participate and share.

This type of forum was created in Moodle, to promote discussions about Innovation and Leadership, where students could individually participate by commenting on some of the topics, sharing their insights and opinions.

The following five discussion topics and activities were posted on the forum:

[Invention *vs* Innovation – what are the differences?] - Comment in this forum, giving examples, what are the main differences between Invention and Innovation?

[What is Innovation?] - Comment in this forum, in a sentence or a word, what do you mean by Innovation!?;

[Innovation and R&D – comment on the following sentence] - "*Innovation cannot just remain within the reach of the R&D department, an innovation team or a small strategic planning group. Innovation needs to be embedded in the DNA of the organization's operations and culture, to be a normal part of daily operations.*" (Bessant & Tidd, 2015);

[Features of an innovative profile…] - After reading the article "*5 Characteristics of an Innovative Professional*" (Freitas, 2018), what other characteristics, personality traits or attitudes do you consider to be equally important for an innovative personal profile?

[Leadership and innovation in organizations] - How can an organization leader encourage innovation within the organization - what measures, attitudes, or actions can be taken to stimulate creativity and innovation? Watch this short video and leave your comments. (video URL: https://www.youtube.com/watch?v=5fBsONPWcqM)

A total of 2,337 records were registered on the online forum.

4.1.5   Final questionnaire to collect students' perceptions

At the end of the semester and course lectures, students were asked to complete a short questionnaire to gather their opinions on how the course was conducted, as well as some overall suggestions for future improvements. An online questionnaire based on Google Forms (see Appendix A), was created and made available to students.

Nineteen answers were received.

4.2   Data analysis

This section will present the results from the activities carried out in this study – an analysis of the forum activity and participation and a descriptive analysis of the final questionnaire answered by students.

Analysis of forum participation will be carried out through text-mining and descriptive statistics and the questionnaire will be analysed through descriptive statistics.

Both activities were part of the set of student-participated activities throughout one semester, in the course unit of "Innovation and Business Strategy", included in the syllabus topic of "Innovation".

4.2.1   Descriptive analysis of forum participation

To analyse participation in the forum, two sets of data were collected: 1) the Moodle forum log file containing the records of all forum interactions and 2) the forum contributions and comments made by students.

The log file gives us detailed information about the interactions in the forum, the type of actions performed and identification of the participant. The forum posts also provide individual textual data about participants' opinions on each forum topic.

The forum was the activity students participated in most, either by commenting on existing posts or posting new content – a total of 73 students participated in this activity, with an average of 30 general actions per student – with general participation referring to the total amount of activities carried out in the forum by each participant, also including the simple actions of visualizing the discussions or the discipline module.

The table below shows the original posts, when they were created and the number of responses to each post (see Table 13).

Table 13 – Forum posts, original and translated text and number of responses

Post ID (*Discussion ID*)	Original post (PT)	Translated post (GB)	Post date	Number of responses
202696	Inovação *vs* Invenção - quais as diferenças?	Invention vs Innovation – what are the differences?	12-Mar-2019	63
202694	O que é a Inovação ?	What is Innovation?	12-Mar-2019	66
202732	Inovação e I&D - comente a afirmação: "A Inovação não pode continuar apenas ao alcance do departamento de I&D, de uma equipa de inovação ou de um pequeno grupo de planeamento estratégico. A Inovação precisa de estar embebida no DNA das operações e cultura da organização, ser uma parte normal das operações diárias." (Bessant & Tidd, 2015)	Innovation and R&D – comment on the following sentence: "Innovation cannot just remain within the reach of the R&D department, an innovation team or a small strategic planning group. Innovation needs to be embedded in the DNA of the organization's operations and culture, to be a normal part of daily operations." (Bessant & Tidd, 2015)	13-Mar-2019	45
204622	Caraterísticas de um perfil empreendedor: Após a leitura do artigo "5 características de um profissional inovador" (Freitas, 2018), que outras caraterísticas, traços de personalidade ou atitudes, considera serem igualmente importantes, para um perfil pessoal inovador?	Features of an innovative profile… - After reading the article "5 Characteristics of an Innovative Professional" (Freitas, 2018), what other characteristics, personality traits or attitudes do you consider to be equally important for an innovative personal profile?	20-May-2019	41
204625	Liderança e inovação nas organizações - De que forma é que os Líderes de uma organização podem estimular a Inovação no seio da mesma - que medidas, posturas ou ações podem ser tomadas para estimular a criatividade e a inovação? Assista a este pequeno vídeo e deixe os seus comentários.	Leadership and innovation in organizations - How can an organization leader encourage innovation within the organization - what measures, attitudes, or actions can be taken to stimulate creativity and innovation? Watch this short video and leave your comments.	20-May-2019	35

Source: own elaboration

The post ID numbers, used for post identification, are automatically assigned by Moodle as well as the identification of each user (User ID).

Table 14 contains the samples of every possible forum action description.

Table 14- Forum actions description samples

Forum actions	Action description example
Discipline module created	*The user with id '6309' created the 'forum' activity with course module id '336788'.*
Discipline module updated	*The user with id '6309' updated the 'forum' activity with course module id '336788'.*
Discipline module viewed	*The user with id '7230' viewed the 'forum' activity with course module id '336788'.*
Discussion created	*The user with id '6309' has created the discussion with id '204622' in the forum with course module id '336788'.*
Discussion viewed	*The user with id '7288' has viewed the discussion with id '202696' in the forum with course module id '336788'.*
Some content has been posted	*The user with id '7288' has posted content in the forum post with id '277435' in the discussion '204625' located in the forum with course module id '336788'.*
Subscribers viewed	*The user with id '6309' has viewed the subscribers list for the forum with course module id '336788'.*
Topic created	*The user with id '4766' has created the post with id '274255' in the discussion with id '202696' in the forum with course module id '336788'.*
Topic deleted	*The user with id '8015' has deleted the post with id '277989' in the discussion with id '204622' in the forum with course module id '336788'.*
Topic updated	*The user with id '6309' has updated the post with id '277040' in the discussion with id '204625' in the forum with course module id '336788'.*

Source: own elaboration

The Table 15 is an original screen capture of the forum records data table – username has been hidden for privacy reasons.

Table 15 – Screen capture of forum records data table

Data e hora	Nome completo do utilizador	Utilizador afetado	Contexto do evento	Componente	Nome do evento	Descrição	Origem	Endereço IP
3 de junho de 2019 às 21:49	▓ ▓▓▓▓	-	Fórum: Fórum Geral ...	Fórum	Módulo de disciplina visualizado	The user with id '7258' viewed the 'forum' activity with course module id '336788'.	web	95.95.63.82
3 de junho de 2019 às 18:32	▓▓ ▓▓	-	Fórum: Fórum Geral ...	Fórum	Discussão visualizada	The user with id '7221' has viewed the discussion with id '202732' in the forum with course module id '336788'.	web	92.250.100.36
3 de junho de 2019 às 18:31	▓▓ ▓▓▓▓	-	Fórum: Fórum Geral ...	Fórum	Discussão visualizada	The user with id '7221' has viewed the discussion with id '202696' in the forum with course module id '336788'.	web	92.250.100.36
3 de junho de 2019 às 18:31	▓ ▓▓▓▓	-	Fórum: Fórum Geral ...	Fórum	Módulo de disciplina visualizado	The user with id '7221' viewed the 'forum' activity with course module id '336788'.	web	92.250.100.36

Source: own elaboration

Since all the responses to each post were unique (one per each student) and knowing that 73 students logged in to this activity, the ratio of participation by post is calculated as follows ((number of participants / 73) × 100) – see (Table 16).

Table 16 – Ratio of students' participation by post

Discussion ID	Number of participants	Student's participation *ratio*
202696	63	86.3%
202694	66	90.4%
202732	45	61.6%
204622	41	56.2%
204625	35	47.9%

Source: own elaboration

The log file (data sample) shows a total of 2,337 records of interactions from participants, performed between 6th of March and 19th June 2019 (a total of 106 days) - an average of approximately 584 actions per month and an average of approximately 22 daily actions. The forum module remained active and visible throughout the 106 days of the activity.

Table 17 shows the statistical record of the actions performed in the forum, during all the days it remained active.

Table 17 - Type and number of Moodle forum actions

Forum actions	March	%	April	%	May	%	June	%	Total	%
Discipline module created	1	0%	0	0%	0	0%	0	0%	1	0%
Discipline module updated	6	1%	0	0%	0	0%	2	0%	8	0%
Discipline module viewed	188	20%	23	9%	97	22%	132	19%	440	19%
Discussion created	3	0%	0	0%	2	0%	0	0%	5	0%
Discussion viewed	530	55%	212	84%	230	52%	377	55%	1,349	58%
Some content has been posted	114	12%	8	3%	57	13%	87	13%	266	11%
Subscribers viewed	0	0%	0	0%	0	0%	1	0%	1	0%
Topic created	107	11%	8	3%	52	12%	83	12%	250	11%
Topic deleted	3	0%	0	0%	0	0%	3	0%	6	0%
Topic updated	4	0%	0	0%	3	1%	4	1%	11	0%
Total of actions:	956	100%	251	100%	441	100%	689	100%	**2,337**	100%

Source: own elaboration

The forum actions description starting with "*Discipline (...)*", and mentioned in Table 17 above, are all related to the creation, updating or visualization of the forum activity itself. Actions started with the word "*Discussion (...)*", refer to the creation or visualization of forum posts. The action of "*Some content has been posted*" shows the record of each forum post interaction, either the creation, deletion or update of content, by participants. "*Subscribers viewed*" is only an action of visualizing the number of subscribers. Actions starting with "*Topic (…)*" are related to the creation, deletion or update of each forum post, by participants.

The higher number of interactions that took place in March with 107 topics created and June with 83 topics created, was mainly due to students' availability regarding other disciplines' requirements for different projects and assignments.

The high levels of participation registered in March and June, as noticed, were also due to students having a more "relaxed" agenda and the amount of work required by the discipline of Business Simulation – students themselves mentioned this during the semester.

When we analyse the ratio between the total of monthly actions *vs* recorded monthly days of activity per month, we obtain the following results: for the month of March (956 actions / 23 days of activity ≈ 42 activities per day); for the month of April (251 actions / 21 days of activity ≈ 12 activities per day); for the month of May (441 actions / 21 days of activity = 21 activities per day); for the month of June (689 actions / 19 days of activity ≈ 36 activities per day). These results are in line with students' complaints about their lack of time to devote to all tasks.

When we look at the forum activity rates based on the days of the week (see Table 18), considering that the practical classes for Innovation and Business Strategy took place on Mondays and Tuesdays from 16:30 to 18:30 and on Thursdays from 14:30 to 16:30 and theoretical classes took place on Mondays from 13:30 to 14:30, it is interesting to notice the number of actions taken outside the scheduled periods, even at weekends.

Table 18 - Weekdays of forum access

Weekday

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Friday	565	24.2	24.2	24.2
	Monday	391	16.7	16.7	40.9
	Saturday	173	7.4	7.4	48.3
	Sunday	234	10.0	10.0	58.3
	Thursday	422	18.1	18.1	76.4
	Tuesday	254	10.9	10.9	87.2
	Wednesday	298	12.8	12.8	100.0
	Total:	2337	100.0	100.0	

Source: own elaboration

This attitude from students seems to reveal some interest and commitment to the activities developed in the forum, even when outside their normal weekly schedule.

Considering the total course timetable mentioned above for the practical classes (from 14:30 to 18:30) and, when we run an hourly analysis *versus* the type of actions performed in the forum, the results also show a significant number of actions performed outside the normal course timetable (see Table 19).

Table 19 - 24-hour period time span – forum actions

Actions / Time span	Topic created	Some content has been posted	Discussion viewed
00:00-01:00	8	10	68
01:00-02:00	5	7	31
02:00-03:00	1	1	9
03:00-04:00	3	5	20
04:00-05:00	1	2	5
05:00-06:00	0	0	1
06:00-07:00	0	0	0
07:00-08:00	0	0	4
08:00-09:00	0	0	5
09:00-10:00	4	6	26
10:00-11:00	4	5	29
11:00-12:00	2	4	22
12:00-13:00	8	9	108
13:00-14:00	12	12	52
14:00-15:00	16	17	66
15:00-16:00	12	12	52
16:00-17:00	19	19	112
17:00-18:00	13	13	113
18:00-19:00	8	8	64
19:00-20:00	22	23	97
20:00-21:00	25	26	135
21:00-22:00	15	15	75
22:00-23:00	47	47	154
23:00-00:00	25	25	101
Totals:	**250**	**266**	**1349**

Source: own elaboration

Looking at the table above, the periods when most actions occur is from 22:00 to 23:00 and from 20:00 to 21:00. The period from 16:00 to 18:00 corresponds approximately to the

scheduled practical classes, where students usually log in to Moodle. Overall, there is a general increase in activity after 19:00.

Whether out of curiosity or interest, accessing and participating in the forum outside normal school hours seems to show some dedication and commitment to participating in or simply viewing the ongoing conversations. These results seem to indicate students' engagement and interest, showing that their monitoring of course materials and activities (i.e. forum), extends far beyond their normal school hours.

The action registering by far the most interest, which seems to reveal students' interest and involvement in the topics discussed, was visualization of the discussions held in the forum. Entering the forum to follow the discussion of various topics, seems to reveal students' interest concerning both the topics covered and monitoring of their classmates' various participations.

An analysis of the total number of forum logs by the hour of the day shows a clear trend of use and access at certain times of the day (see Figure 8).

Figure 8 - Distribution of forum logs per hour of the day
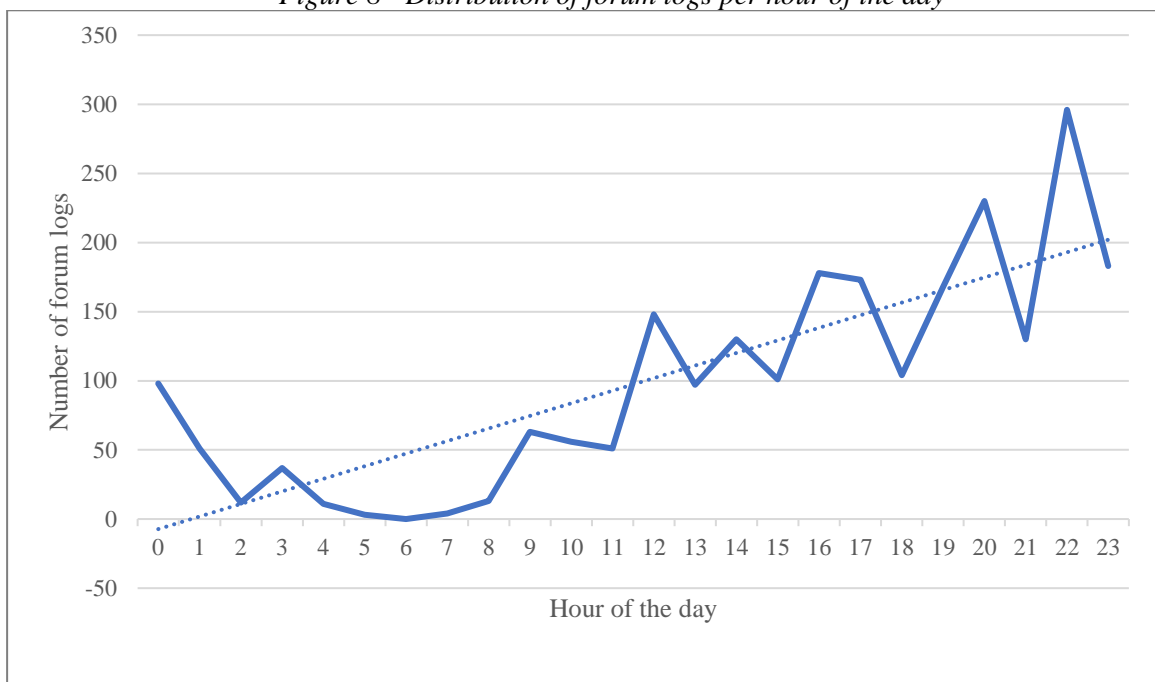
Source: own elaboration

Each action in the forum originates registration of the source IP address – in order to identify the origins of the course accesses through the IP address an analysis for all the unique IP's available in the forum log – 246 unique IP's were identified but geolocation data was only possible for 242 IP's - an online database query at *ipdata.co* available at https://ipdata.co/index.html, was performed, resulting in the identification of 39 different places (see Table 20).

Table 20 - Unique places and number of unique IP's identified in each place

Places	Qty. IP's	Places	Qty. IP's
Águeda	1	Paço de Arcos	1
Alcochete	1	Palmela	1
Alhos Vedros	3	Pinhal Novo	2
Almada	8	Portalegre	2
Alpiarça	1	Portela	1
Amarante	1	Portimão	1
Amora	5	Quinta do Anjo	1
Barreiro	11	Samouco	1
Cabrela	2	Santa Iria da Azoia	1
Caldas da Rainha	1	Santarém	1
Charneca de Caparica	1	Santo André	1
Corroios	5	São João da Talha	1
Costa de Caparica	3	Seixal	3
Ericeira	2	Sesimbra	1
Lagos	1	Setúbal	122
Lavradio	2	Sintra	1
Lisboa	44	Torre da Marinha	1
Moita	3	Trigaches	1
Montijo	2	Valega	1
Moscavide e Portela	1		

Source: own elaboration

Considering the geographical dispersion of points of access (39 different places) to the forum activity, this analysis may also reveal students' engagement and interest in the activities available in the forum, even when they are away from the *campus* in Setúbal. Being involved in an activity or feeling involved in something usually arouses interest and a desire to follow what is going on.

4.2.2 Text mining analysis of the forum contributions

To perform the analysis of forum posts, consisting of unstructured textual information, we resort to different text-mining software (Orange 3.23), a machine learning and data mining suite for data analysis through Python scripting and visual programming, allowing interactive data visualization. This type of software, as previously mentioned, can also process and aggregate considerable amounts of unstructured text in order to extract relevant information (Demsar et al., 2013; Fan et al., 2006; Kobayashi, Mol, Berkers, Kismihók, & Den Hartog, 2018; Radovanovic & Ivanovic, 2008).

Figure 9 - Data mining workflow for forum posts analysis
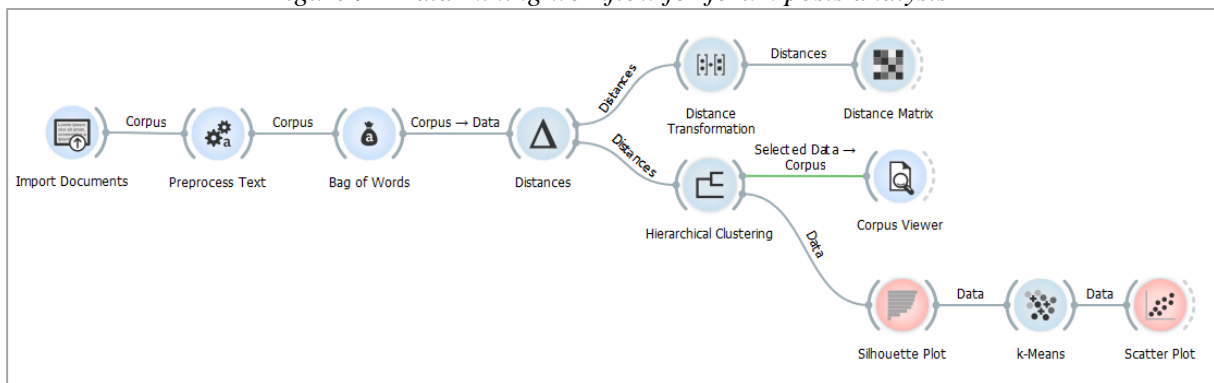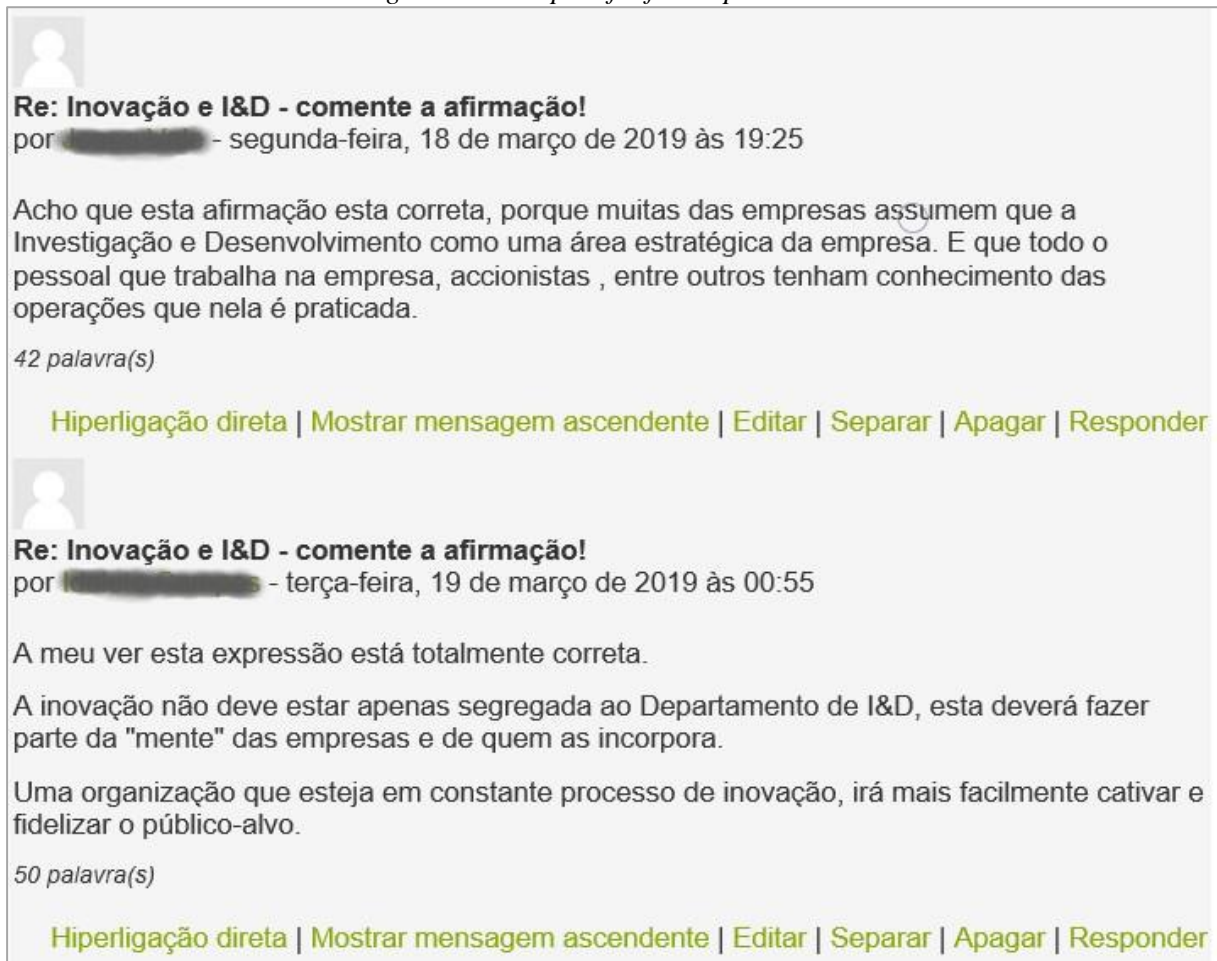
Source: own elaboration

The Orange software consists of a canvas onto which users can place objects and structural components called *widgets*, forming a workflow. These *widgets* offer several basic functionalities, such as reading the data, selecting data features, training predictors, cross-validating them, and so forth. *Widgets* can be interconnected through communication channels in order to perform different analysis and calculations, allowing the user to create new analysis schemata (Demsar & Zupan, 2013; Demšar, Zupan, Leban, & Curk, 2004). Figure 9 shows the workflow built for the analysis of the forum post.

The analysis of threaded discussion forums raises several difficulties, such as the organization of messages in a forum and the output format of the forum data, considering that the number of postings on a single topic can reach several hundred messages. Text mining and data mining techniques offer a viable solution for analysing this type of data (Dringus & Ellis, 2005).

For the purposes of this study and to analyse the forum posts, all the forum post threads were downloaded from Moodle into text-type documents, one for each of the five forum discussions held in the forum (see Figure 10). Username has been hidden for privacy reasons

Figure 10 - Sample of a forum post thread

Source: own elaboration

After data collection, all text type documents forming the *corpus* (*a collection of documents*) went through a data pre-processing step for data preparation and transformation, such as stop words filtering, lowercase the text, remove accents and punctuation and tokenization (Mohit et al., 2017).

After this pre-process phase, the *corpus* data was analysed through the Orange software to perform a text clustering technique, in order to identify and extract some relevant information.

Knowing that the hierarchical clustering method might be subject to decision errors, mainly when the researcher needs to decide the data limits to apply a stopping rule that could lead to a wrong number of *k* clusters in the data (Milligan & Cooper, 1985), even so, and based on raw results of text clustering and data observation, we decided to apply a stopping rule of 90% (height ratio). This percentage of the *corpus* is considered to identify the clusters, resulting in a total of 3 clusters, meaning that in the dendrogram below, showing a hierarchical structure of

documents by their similarity, all the items to the right of the dotted line were selected (see Figure 11).

Figure 11 - Dendrogram with 3 identified clusters for a stopping rule of 90%
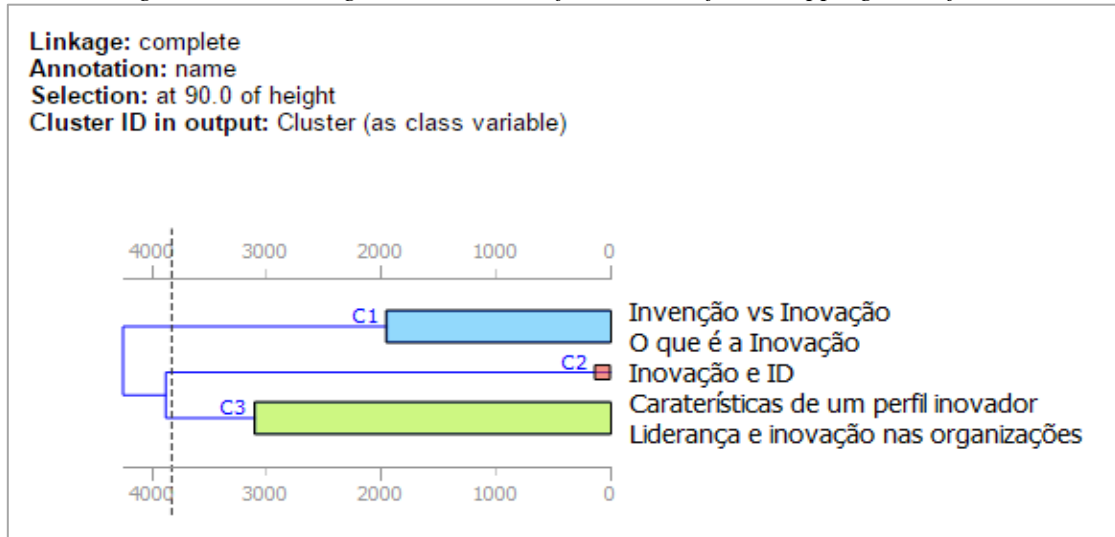
Source: own elaboration

Figure 12 shows the screen view of the Hierarchical Clustering *widget* for a height ratio (stopping rule) of 90% and the 3 identified clusters.

Figure 12 - Hierarchical clustering with 90% cut-off value (Height ratio)

Source: own elaboration

74
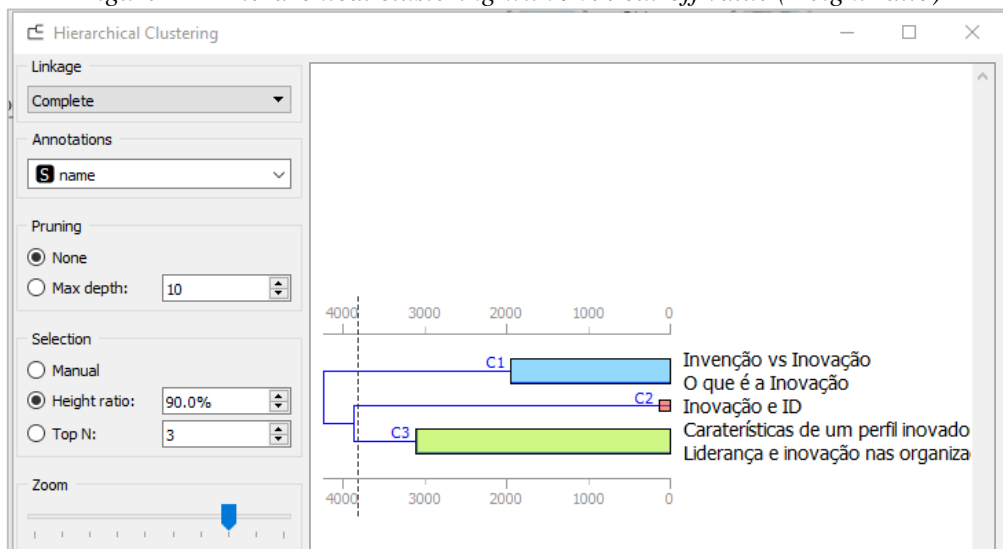
Observing the clustering results and considering the data and purpose of each post, the hierarchical clustering structure seems to make sense, since the discussion topics and contents within each cluster are interrelated. Cluster C2 "*Inovação e ID*" due to the 90% cut-off decision, appears on the verge of integrating another dataset. Since this post asks to comment a given sentence that includes not only the topic "*Innovation*" but also the topic "*Research & Development*", this might explain its formation as a separate cluster. Although it includes the topic of "*Innovation*", it still presents some distance from cluster C1, which includes specific topics about "Innovation".

Through the "Distance Matrix" *widget,* which generates a two-dimensional display of the distances, taken pairwise between the elements of a dataset, a distance matrix was created.

The number of elements in the dataset defines the size of the matrix. The distance matrix can be observed in Table 21.

Table 21 - Distance matrix

	Caraterísticas de um perfil inovador	Inovação e ID	Invenção vs Inovação	Liderança e inovação nas organizações	O que é a Inovação
Caraterísticas de um perfil inovador	0.000	0.912	1.000	0.728	0.793
Inovação e ID	0.912	0.000	0.923	0.814	0.737
Invenção vs Inovação	1.000	0.923	0.000	0.972	0.458
Liderança e inovação nas organizações	0.728	0.814	0.972	0.000	0.756
O que é a Inovação	0.793	0.737	0.458	0.756	0.000

Source: own elaboration

The distance matrix above is the output of the Distance Transformation *widget*, which offers several options for data normalization in order to bring all the variables into proportion with one another. In this case, we applied normalization to the interval [0, 1], meaning that the shorter distances between the various elements, signal those that have greater proximity and similarities to each other.

By analysing the results of the data matrix, we can identify the distances between the elements that also confirm the previously identified 3 clusters. The value of 0.458 between the elements of "*O que é a Inovação*" and "*Invenção vs Inovação*" confirms C1. Cluster C2 for the element of "*Inovação e ID*" presents the lowest value of 0.737 with the element "*O que é a Inovação*" – this probably occurs due to the cut-off decision of 90% which possibly separated these two elements. The value of 0.728 between the elements of "*Liderança e inovação nas*

organizações" and "*Caraterísticas de um perfil inovador*" confirms cluster C3. The value of "0.000" is only possible for the element with itself.

One internal clustering validation measure is through the Silhouette validation index (Rousseeuw, 1987). This measures how well a certain set of data is clustered and estimates the average distance between clusters by plotting a set of measures of the distance between data within one cluster and data in the nearest cluster. A silhouette value close to 1 indicates data close to the centre of the cluster and close to 0 shows data to be on the border between two possible clusters (Ünlü & Xanthopoulos, 2019; Zhao, Sun, Shimizu, & Kadota, 2018).

Figure 13 - Silhouette Plot – consistency within data clusters
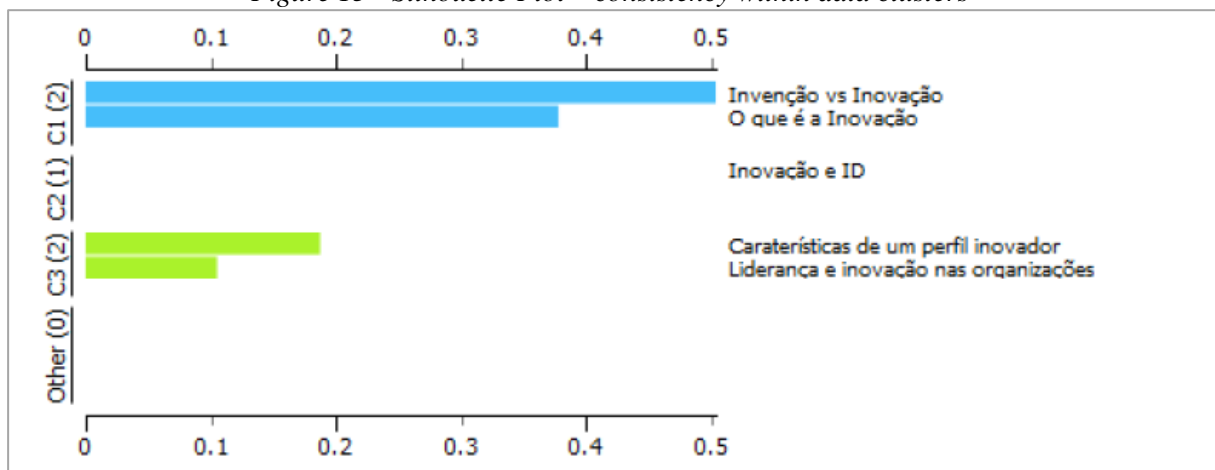
Source: own elaboration

In Figure 13 above, the "Silhouette Plot" *widget* produces a graphical representation of the consistency of the 3 clusters and their average distance values. Cluster C2 – "*Inovação e ID*" presents a 0 value which places it on the border between two possible clusters. This hierarchical positioning of cluster C2 seems to be related to the previous stopping rule decision of 90%, placing this cluster on the edge of a different cluster.

Another way to validate the clustering results and minimize the clustering error is through the *k*-means algorithm, a widely used partitional clustering method, that tests the occurrence of changes and assignation of data points to initial selected centroids (specified by the user and corresponding to the expected number of clusters), until no point changes (Likas, Vlassis, & J. Verbeek, 2003; Xiong, Wu, & Chen, 2009). The *k*-means algorithm allows the identification of optimal solutions with respect to the clustering error (Mohit et al., 2017).

Figure 14 - Scatter Plot - results after the K-Means algorithm, with regression line
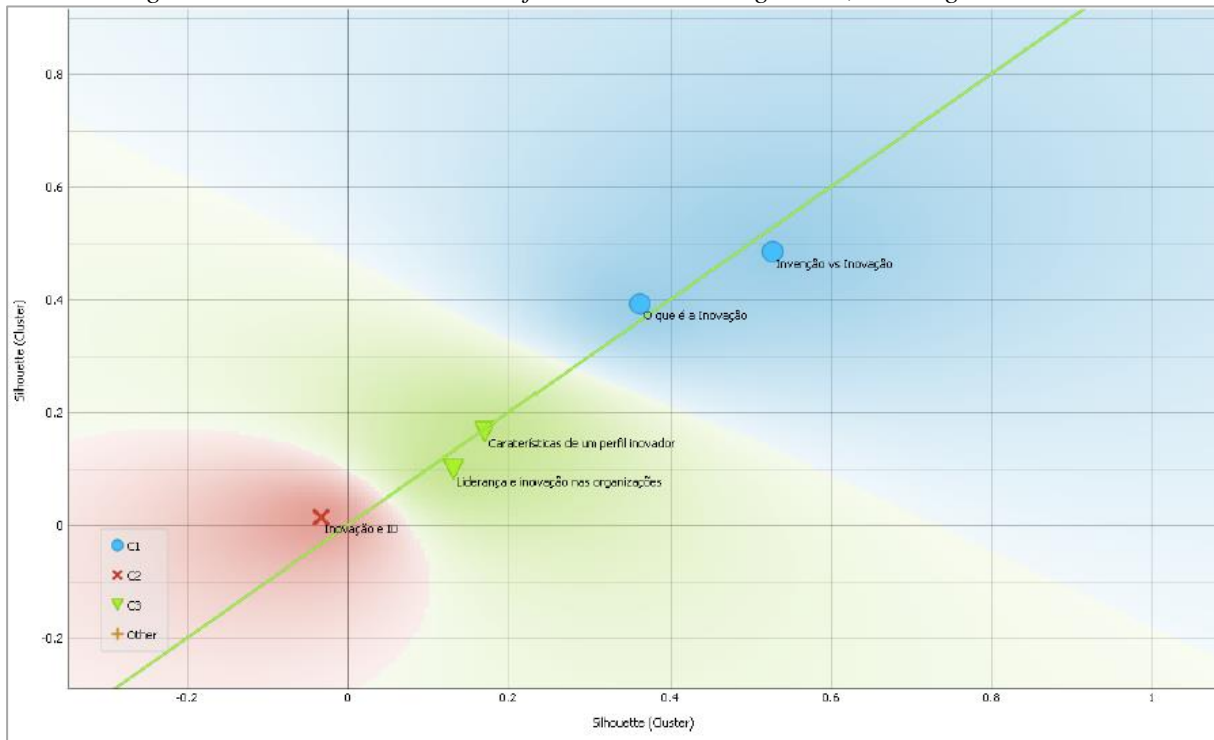
Source: own elaboration

Figure 14 above shows the plotted data results after application of the *k*-means clustering algorithm, displaying three groups of data, corresponding to the 3 previously identified clusters – C1, C2 and C3.

4.2.3 Descriptive statistical analysis of the questionnaire responses

At the end of the semester, a brief online questionnaire with 18 questions was presented to students to obtain their evaluation and suggestions regarding the methods used during teaching of the course, more specifically in the subject related to innovation (see Appendix A).

Due to the proximity of the end of the semester and the fact that students also had to hand in several final assignments and projects required by other courses, only 19 students answered the questionnaire (23% of 81 students) about their experience with Moodle.

Despite the small number of answers, it is still worth highlighting some aspects of the results. For the purpose of this study, all materials (questions and answer options) have been translated into English.

The respondent's profile is available in Table (22).

Table 22 – Respondents' profile

Gender			Age (years)		
Female	11	58%	18 - 21	10	53%
Male	8	42%	22 - 25	8	42%
			26 - 30	1	5%
			> 30	0	0%

Source: own elaboration

All responding students were taking the course for the first time and all students confirm that they use Moodle on a regular basis, throughout the course and in all semesters (see Table 23 – question 1).

When questioned about possible difficulties experienced while using Moodle, 14 students (74%) replied that they experienced no difficulty. Regarding the places where they use Moodle most commonly, 11 students (58%) sometimes use it in the classroom, 10 students (53%) often use it while on campus and 12 students (63%) often use it at home (see Table 24 – question 2).

Sixteen students (84%) answered yes when questioned if Moodle was useful for their study in the course lectures of Innovation and Business Strategy.

For the different activities on Moodle, 11 students (58%) often access to gather information and content, 9 students (47%) sometimes do evaluation tests and quizzes, 10 students (53%) sometimes access to share information, and 14 students (74%) answered that they rarely or sometimes have accessed Moodle to participate in forums (see Table 25 – question 3).

When it comes to expressing an opinion regarding the use of Moodle, students like and value the platform and recognize that it helps them to organise their study subjects better. Twelve students (63%) agree or totally agree that it helps them in collaborative work. About 16 students (84%), had no opinion about whether Moodle improves classroom relationships or increases their interest in the contents taught. Most students do not consider Moodle as a very complicated system to use, showing that they also "care" about it. (see Table 26 – question 4).

Students opinion about their interest or level of difficulty in the tasks and assignments performed during the course also deserves some comments. Regarding the "Innovation Case Studies" task, 12 students (63%) found it quite or very interesting, even though 13 students

(68%) found it a little hard to accomplish (see Tables 27 (question 8) and Table 28 (question 11).

The activity of "Participation in the general forum" for 10 students (52%) was considered quite or very interesting. Despite that, 6 students (32%) were indifferent to this activity. When it comes to expressing an opinion about the difficulty of participating, 9 students (47%) found it a little hard and 5 students (26%) were indifferent.

Interest and participation in the Facebook page was considered indifferent or uninteresting for 12 students (63%), and when questioned about the difficulty of this activity, 10 students (53%) showed indifference or considered it a little hard (21%) or not at all hard (26%) (see Table 27 – question 8 and Table 28 – question 11).

The activity of "Essay on Portuguese innovations" was considered very interesting (53%) or indifferent (21%) and the level of difficulty was distributed between a little hard for 11 students (58%) and indifferent for 5 students (26%). (see Tables 27 (question 8) and Table 28 (question 11).

Regarding the open question about what activities were found least interesting, 10 students (53%) mentioned the Facebook page because they did not use or visit this social network on a regular basis. To the open question about what activities were found most interesting, 12 students (63%) referred to the forum topics and discussions and 5 students (26%) mentioned the cases about Portuguese innovations.

When students were asked to point out the strengths and weaknesses of the approach and methods used to study the subject of innovation within the course of Innovation and Business Strategy, the most outstanding strengths were "*teamwork*" and "*forum participation*". On the other hand, the most salient weaknesses were the "*Facebook page*" and the "*very demanding amount of work required*" to complete the course.

Students opinion about the use of Moodle was generally favourable especially regarding the functionalities available through the platform to support their study and school activities, throughout their academic journeys.

Few suggestions for improvement were received but among the 6 received, the wish for less homework and the suggestion for the discipline of Innovation and Business Strategy to be included in the first year of studies, instead of the last semester of the last year were registered. This suggestion for the last semester of the last year is mainly because they have one very

demanding discipline (*Business Simulation with 21 ECTS's*) in the same semester, which leaves them with very little time to devote to other subjects.

Table 23 – Regular platform usage

Question 1	
"During your course, have you used the Moodle platform regularly? (all semesters)"	**Total**
Yes	19
No	0

Source: own elaboration

Table 24 - Moodle platform usage

Question 2											
"Where and how often do you use the Moodle platform?"	**Never**	**%**	**Rarely**	**%**	**Sometimes**	**%**	**Often**	**%**	**Always**	**%**	**Total**
In the classroom	1	5%	1	5%	11	**58%**	6	32%	0	0%	19
On the IPS campus	1	5%	1	5%	6	32%	10	**53%**	1	5%	19
At home	0	0%	0	0%	3	16%	12	**63%**	4	21%	19

Source: own elaboration

Table 25 - Performed activities in Moodle

Question 3 *"What kind of activities have you done on the Moodle platform?"*	**Never**	**%**	**Rarely**	**%**	**Sometimes**	**%**	**Often**	**%**	**Always**	**%**	**Total**
Access to information and content	0	0%	0	0%	0	0%	11	**58%**	8	42%	19
Testing & Quizzes	3	16%	7	37%	9	**47%**	0	0%	0	0%	19
Information and content sharing	1	5%	5	26%	10	**53%**	3	16%	0	0%	19
Participation in discussion forums	1	5%	7	**37%**	7	**37%**	4	21%	0	0%	19

Source: own elaboration

Table 26 - Opinions about using the platform

Question 4											
"Indicate which option best suits your opinion regarding the use of the Moodle platform:"	**Totally disagree**	**%**	**Disagree**	**%**	**No opinion**	**%**	**Agree**	**%**	**Totally agree**	**%**	**Total**
Facilitates my learning	0	0%	0	0%	1	5%	10	**53%**	8	42%	19
Allows more orientation of CU content	0	0%	0	0%	0	0%	7	37%	12	**63%**	19
Helps me to organise the study subjects better	0	0%	0	0%	1	5%	9	**47%**	9	**47%**	19
Allows more active participation among colleagues	2	11%	4	21%	4	21%	7	**37%**	2	11%	19
Helps me in collaborative work	1	5%	2	11%	4	21%	10	**53%**	2	11%	19
Improves classroom relationships	2	11%	3	16%	8	**42%**	5	26%	1	5%	19
Increases my interest in the contents covered	1	5%	2	11%	8	**42%**	5	26%	3	16%	19
I find it very complicated	7	37%	8	**42%**	3	16%	0	0%	1	5%	19
I do not care	10	**53%**	5	26%	3	16%	0	0%	1	5%	19

Source: own elaboration

Table 27 - Activities level of interest

Question 8 *"In CPE 1 (innovation) what was your level of interest regarding the various activities?"*	**Quite interesting**	**%**	**Very interesting**	**%**	**Indifferent**	**%**	**Uninteresting**	**%**	**Nothing interesting**	**%**	**Total:**
Innovation Case Studies	2	11%	10	**53%**	3	16%	4	21%	0	0%	19
Participation in the general forum	1	5%	9	**47%**	6	32%	2	11%	1	5%	19
Participation in the Innovation-ESCE Facebook page	1	5%	5	26%	7	**37%**	5	26%	1	5%	19
Essay on Portuguese innovations	2	11%	10	**53%**	4	21%	2	11%	1	5%	19

Source: own elaboration

Table 28 - Activities level of difficulty

Question 11 *"In CPE 1 (innovation) how difficult was it in relation to the various activities?"*	**Very much hard**	**%**	**Very hard**	**%**	**Indifferent**	**%**	**Little hard**	**%**	**Nothing hard**	**%**	**Total:**
Innovation Case Studies	0	0%	2	11%	4	21%	13	**68%**	0	0%	19
Participation in the general forum	0	0%	1	5%	5	26%	9	**47%**	4	21%	19
Participation in the Innovation-ESCE Facebook page	0	0%	0	0%	10	**53%**	4	21%	5	26%	19
Essay on Portuguese innovations	0	0%	1	5%	5	26%	11	**58%**	2	11%	19

Source: own elaboration

4.3 Discussion of study 2

Aiming to explore transmedia effects in higher education through a mixed approach, this section highlights the main results of the activities developed during this study, more specifically the forum activity in the strands of descriptive analysis and text-mining, as well as some considerations about students' opinions.

Most of this study was supported by the Moodle platform and the various academic activities developed and carried out by students under the guidance of lecturers. Although this course was taught by three lecturers (theoretical and practical classes), which could originate different pedagogical approaches, classroom environments and student behaviour, the results achieved seem to be consistent with the actions developed during the study.

The use of a Learning Management System such as Moodle, apart from being widely accepted and known by students and providing a diversified set of features, proved essential to carry out this type of study and data collection, maintaining an open channel to communicate in an online environment as well as improving the overall perception of students engagement and motivation regarding certain types of activities (Croitoru & Dinu, 2016; Raimúndez-Urrutia & Azzato Sordo, 2017; Williams & Whiting, 2016).

All the tasks and activities carried out by students during the study, related to the subject of innovation, were not only intended to complement the topics taught, but also to stimulate students' engagement and involvement in other media (Freeman et al., 2019; Raimúndez-Urrutia & Azzato Sordo, 2017). The writing activities "Essay on Portuguese innovations" and "Innovation case studies" for example, considered by students as some of the most interesting ones, required research in various media (internet, social networks and textbooks), in order to accomplish the task successfully (Dickinson-Delaporte et al., 2018).

Participation in the forum, the activity performed most by students, revealed some interesting insights, not only because of the level of participation but also because of all the interest and behavioural engagement in the forum discussions (Kamarulzaman et al., 2010). The considerable levels of participation outside normal school hours, on weekdays and at weekends, makes this type of activity interesting and potentially able to stimulate students' participation

and stronger engagement in various learning activities, based on interaction and information sharing using digital media (Freeman et al., 2019).

The text-mining and text clustering techniques proved to be an important research tool for a rapid, efficient and comprehensive analysis of unstructured text data (forum posts), essentially since the time to explore the Orange data mining suite was possible (Demsar et al., 2013; Mohit et al., 2017).

The objectives of this study may have been achieved, but even so, since this study was focused on a single subject from the course syllabus – Innovation – that can be identified as a limitation due to the reduced number of possible topics to address and develop throughout the semester, for a single course subject.

Another limitation of this study was the fact that due to technical and time constraints, it was not possible to develop and implement other social network pages, as a complement to the Facebook page, since students' levels of interest and participation on different media platforms could be more significant.

The reduced number of suggested topic discussions (5 main topics) in the forum, can also be considered a limitation since the limited diversity of the subjects covered may have led to some disinterest on the part of some students.

Since this study was applied to senior students in their last semester, when they also had their most demanding course and business simulation activity ("*Simulação empresarial*" with 21 ECTS's), this might also be considered as a study limitation as students' greater availability and willingness to participate more actively, could have led to different results.

Chapter 5

5 Study 3 – Engaging university students through virtual reality

Virtual reality (VR) has been increasingly implemented as a tool for simulation and entertainment in several industries, for instance, retailing (Krasonikolakis, Vrechopoulos, & Pouloudi, 2014), tourism (e.g., Kim et al., 2018; Tussyadiah, Wang, Jung, & tom Dieck, 2018) and above all in medical issues (Loureiro, Guerreiro, Eloy, Langaro, & Panchapakesan, 2019).

Several studies are more focused on how consumers experience virtual reality through concepts of engagement, attachment and purchase (e.g., Bilro et al., 2019; Grewal, Roggeveen, & Nordfält, 2017; Itani, Kassar, & Loureiro, 2019; Krasonikolakis et al., 2014; Prentice, Wang, & Loureiro, 2019; tom Dieck et al., 2018), where the S(stimuli)-O(organism)-R(response) framework (Roschk et al., 2017) is greatly employed as the basic theoretical background.

In this vein, more research is needed to understand how VR experience can enhance university students' engagement in learning. Therefore, the current study aims to explore drivers of student engagement in the learning environment through virtual reality. Virtual reality experience, telepresence, pleasantness of the experience and memory are regarded as drivers of student engagement. Telepresence, pleasantness of the experience and memory are considered as mediators between virtual reality experience and student engagement. Mindfulness is explored as a moderator through a multi-group analysis. This study also aims to propose and validate a model portraying the influence of VR experience on student engagement, extending the S-O-R framework.

The contribution of the study is twofold: (i) extending the understanding of drivers of student engagement in the educational context; (ii) analysing mindfulness as a moderator of the different associations in the proposed model.

5.1 Theoretical background and hypotheses development

The proposed model is founded on the S-O-R framework, where VR experiences are regarded as stimuli, telepresence, pleasantness of the experience and memory as an organism and student engagement as the response (Figure 15). Experiences have been studied through two major conceptualizations: experience economy and brand experience. This last perspective from Schmitt (2003) points out that experiences comprise *sensory, emotional, cognitive, behavioural*

*and relational value*s. For Pine and Gilmore (1998), experiences represent the possibility to live in a different situation from the daily routine, being an event, which should be unique and special.

Schmitt (2003) develops a framework with the objective of managing customer experiences, considering five facets: (i) feeling is associated with affective experiences, which occur when customers' feeling and emotions are evoked, (ii) sense experiences occur when the customer has a sensory experience through sight, sound, taste, touch and smell, (iii) thinking is associated with customers' brainpower providing problem-solving experiences, (iv) acting happens when alterations in customers' lifestyle are caused while bringing benefits for both parties, and (v) relate experiences emerge when customers relate something external to their inner selves. Later, Brakus et al. (2009) converted these facets into the scale of four dimensions called: sensory, affective, behavioural and intellectual.

In contrast to Brakus et al. (2009), past studies associate the concept of experience mostly with a utilitarian aspect (Palmer, 2012), which emerges from economic models, and less with a hedonic one. This perspective views experience as a result of consumer knowledge, which allows them to respond better to the stimulus, removing the effect of spontaneity conferred by Brakus et al. (2009) in the way consumers act to experiences.

In the study by Pine and Gilmore (1998, p.98) - experience economy - experiences happen when companies purposely use "*services as the stage and goods as the props*" in such a way that the event becomes memorable. Experiences can provoke an engagement at any physical, emotional, intellectual, or other level. Pine and Gilmore (1998) highlight the four realms of experience: entertainment (passive absorption) means activities are fun to watch, aesthetics (passive immersion) refers to the setting where the experience occurs, escapism (active immersion) represents immersion in a different time or place, and education (active absorption) represents the desire and stimulation to learn something new (Loureiro, 2014).

Contrasting with Pine and Gilmore (1998), Brakus et al. (2009) do not consider the concepts of experience and service as distinct, arguing that every single service contributes to the consumer's experience, independently of its kind. In fact, Brakus et al. (2009, p. 53) defined brand experience *"… as sensations, feelings, cognitions, and behavioral responses evoked by brand-related stimuli that are part of a brand's design and identity, packaging, communications, and environments*", mentioning that it is something subjective.

Experiences depend on consumers, tourists or students' individual interpretation of the event (Knobloch, Robertson, & Aitken, 2017; Lemon & Verhoef, 2016; Schwager & Meyer, 2007). Therefore, even when two individuals consider that a certain experience made them feel happy, their level of happiness will be felt in different ways. Even more, it is very unlikely that the experience will be retained in both memories for the same period of time because it depends on the intensity and strength with which it is handled (Lemon & Verhoef, 2016; Loureiro et al., 2014). Hence, experiences have been associated with behavioural intentions, memories and, emotional attachment (Loureiro, 2014; tom Dieck, Jung, Rauschnabel, 2018; tom Dieck, Jung, & tom Dieck, 2018).

In the current study, the experience lived through virtual reality is expected to influence pleasure and memory creation through telepresence. The concept of telepresence focuses on the fact that VR stirs up the sensation of presence, aggregating interactivity, and vividness (Cummings & Bailenson, 2016). Telepresence provides those who live a certain experience with a vivid memory of the place and an illusion that they are invited to be there (Choi, Ok, & Choi, 2016; Loureiro, Guerreiro, Eloy, Langaro, & Panchapakesan, 2019). A favourable and immersive VR experience will be associated with a sense of being there, a sense that participants are invited to be there. Telepresence is the initial component of organism because it refers to university students' subjective experience and feelings that are present in VR experience. Therefore, we suggest the following hypothesis (see Figure 15):

Figure 15 – Figure model
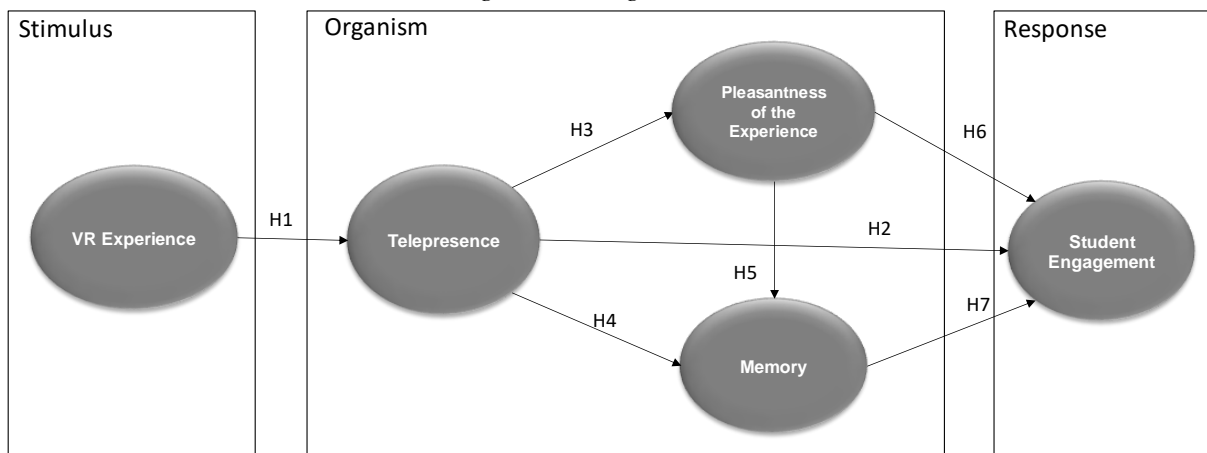
Source: own elaboration

H1: VR Experience is positively associated with Telepresence

Following Choi et al. (2016), telepresence generates an attraction to the place, which in this case is a virtual environment that allows learning. Indeed, customer engagement is a concept that has been growing in interest, particularly after being considered a priority by MSI for the periods from 2010 to 2018 (Marketing Science Institute, 2019). Thus, several definitions have been suggested, such as "…behavioral manifestation toward the brand or firm that goes beyond transactions" (Verhoef *et al.*, 2010, p. 247), or "..the level of an individual customer's motivational, brand-related and context-dependent state of mind characterised by specific levels of cognitive, emotional and behavioural activity in direct brand interactions" (Hollebeek, 2011, p. 790). Briefly, we may claim that engagement is associated with interactivity, a feeling toward and the motivation to think and learn about a certain place (e.g., Bilro et al., 2019; Prentice et al., 2019; tom Dieck et al., 2018). VR technology may facilitate students' engagement. Thereby, we propose that VR facilitates telepresence which is associated with student engagement:

H2: Telepresence is positively associated with Student Engagement

As pointed out previously, telepresence concerns the sensation of presence and vividness and interactivity (Cummings & Bailenson, 2016), which may enhance the sensation of pleasure and facilitate memorization. Indeed, pleasantness of the experience represents positive feelings due to the VR experience and the learning process that such technology increments (Kaltcheva & Weitz, 2006). Thus, we formulate:

H3: Telepresence is positively associated with Pleasantness of the Experience

The pleasantness of the experience and memory may be regarded as positive outcomes of an intense and immersive experience (e.g., Ali, Ryu, & Hussain, 2016; Loureiro, 2014), as it is possible to live through VR. Memories represent the possibility of remembering a certain event (Loureiro, 2014) and can be created through positive or negative emotions and act as a glue to bind the perception of experience to outcomes (Dolcos & Cabeza, 2002; Loureiro, Breazeale, & Radic, 2019; Oh, Fiore, & Jeoung, 2007). As telepresence refers to the use of VR to have the appearance of being present, enriching the experience, then it is expected to contribute to creating memories in consumers' minds. The following hypothesis is formulated:

H4: Telepresence is positively associated with Memory

Given that emotions are needed to create memories (Loureiro, 2014; Ramkissoon, Smith, & Weiler, 2013), we argue that a virtual experience with educational elements that generate a sensation of pleasure in students will influence the creation of memories. Thereby, the following hypothesis is suggested:

H5: Pleasantness of the Experience is positively associated with Memory

Student engagement is the main outcome proposed in the current study. The pleasure of being in a VR environment may develop in students a motivation to be more cognitively, emotionally and behaviourally open to learn (Criado & Such, 2011; Isiaq & Jamil, 2017). In this vein, the following hypothesis emerges:

H6: Pleasantness of the Experience is positively associated with Student Engagement

As emotions contribute to generating memories and may develop the motivation to be engaged, memories of positive events are vehicles that lead students to repeat the experiences and keep them motivated and open to learning more (Itani et al., 2019; Loureiro, 2014; tom Dieck, Jung, Rauschnabel, 2018; tom Dieck, Jung, & tom Dieck, 2018). Therefore, we suggest:

H7: Memory is positively associated with Student Engagement

The way students live the VR experiences, feel emotions, create memories and become more or less engaged in learning may be moderated by the extent to which students are mindful. Mindfulness has been regarded as a state of mind and connected to situational factors and intrapersonal traits (openness to novelty, sensitivity to different places and contexts, awareness of multiple opportunities, possibilities or perspectives, and more receptive attention to current experiences) (Langer & Moldoveanu, 2000; Loureiro, Stylos, & Miranda, 2019; Loureiro, Breazeale, & Radic, 2019). Mindful individuals tend to be more open to new information, have a greater sensitivity to the environment and create new categories in memory that allow them to structure their perceptions in a way that they are more effective in problem-solving (Loureiro et al., 2019a; Loureiro, Stylos, & Miranda, 2019b). Mindful people have high sensitivity and awareness of the environment and pay attention to the current experience (Brown, Ryan, & Creswell, 2007). Mindfulness influences individuals' cognitive, affective and behavioural responses (e.g., Bishop et al., 2004; Kabat-Zinn, 2003; Loureiro, Romero, & Bilro, 2019).

The current study follows the perspective of the Langer Mindfulness Scale (LMS) (Langer, 2004), which comprises four domains: novelty-seeking (represents a student who perceives any experience as an opportunity to learn something new), engagement (the students' ability and

willingness to notice details about their experience and relationship with the environment), novelty producing (describe students that generates new information to understand the current experience), and flexibility (the tendency to accept a change that come from the environment) (Loureiro & Fialho, 2017). Hence, mindfulness would suggest that the student's degree of mindfulness influences the favourable effect of VR experience on telepresence, pleasantness of the experience, memories and even student engagement. The focus on the stimuli of the moment (through the experience using VR) and the flexibility to be open to new experiences of more mindful students may strengthen the relationship among the constructs in the model than in the case of less mindful students. Thus, the following hypothesis emerges:

H8: There are significant differences in the relationships between latent variables in the structural paths between less mindful students and mindful students

5.2   Methodology

The current study collected data from participants (university students), after being exposed to visualization of an immersive virtual reality experience – visualization of a short 360º video - through virtual reality headset equipment, in a controlled environment (room and equipment fully dedicated to the experiment). This experiment took place between June and July 2019, at the School of Business Administration of the Polytechnic Institute of Setubal.

5.2.1   Selection of materials – hardware and software

For this experiment, concerning hardware, two types of equipment had to be available –1) a pc computer with a complex package of features and 2) VR capable headset equipment.

Pc computer specifications:

The installation of an Oculus VR headset on a pc computer is very demanding in terms of memory, processing capacity and graphics card resolution. Therefore, the pc computer used in this experiment had the following characteristics:

OS Name: Microsoft Windows 10 Pro (Version: 10.0.18362 Build 18362);

OS Manufacturer: Microsoft Corporation;

System Manufacturer: LENOVO (System Model: 30BFS3WV00 and System Type: x64-based PC);

Processor: Intel(R) Xeon(R) W-2123 CPU @ 3.60GHz, 3600 Mhz, 4 Core(s), 8 Logical Processor(s);

BaseBoard Manufacturer: LENOVO;

Installed Physical Memory (RAM): 16.0 GB

Hard Drive: Western Digital WD10EZEX-08WN4A0 - 1TB 7.2K RPM SATA 3.5" HDD;

Display Adapter: MSI GeForce GTX 1070

VR headset specifications:

The virtual reality head-set used was the wired Rift model from the Oculus corporation (Oculus Rift) considered as one of the most common types of equipment in virtual reality experiments. For this experiment and regarding software, a previous search, selection, and test of various 360º VR videos as well as some Virtual Reality video players were performed in order to enable the best immersive experience possible.

Thus, the following 360º video and virtual reality video player were chosen:

360º virtual reality video:

The chosen video was the "GoPro VR: Swimming with Wild Dolphins in the Ocean", with a duration of 2:11 minutes and publicly available on YouTube.

Vídeo URL: https://www.youtube.com/watch?v=9_XPYtyiMWE

Virtual reality video player:

The chosen VR Video player was "GizmoVR", available free from the Oculus store, which allowed the 360º video to be viewed in a totally immersive way and without any interference or distortion of the images.

GizmoVR URL: https://gizmovr.com/

5.2.2 Equipment installation and room preparation

The experiment took place in a room used solely for the experiment, and with a spacious area for the installation and setup of the equipment. In terms of equipment installation, the only specific requirements were those related to the VR headset model (Oculus Rift), which requires specific steps to be taken to adjust the viewing space (installation of the sensors and safety zone delimitation). After installation of the system software, the VR app from Oculus and setting up an Oculus account, the pc only needed an Internet connection for software updates.

5.2.3 Questionnaire to collect data for study 3

After viewing the 360º VR video, each participant completed an online questionnaire previously created for this experiment. One hundred and thirty-six observations were collected. The questionnaire is found at the end of the thesis (see Appendix B).

The questionnaire was first prepared in English due to the fact that the measures of the constructs are in English and then translated to Portuguese and back-translated to ensure that both had the same content and information (Sekaran, 1983). A pilot sample of 10 students was contacted to ensure that the content, design, and structure of the questionnaire were clear and to allow for any final adjustments. Measures of the constructs are adapted from different past studies as illustrated in table 29. The questionnaire also contains socio-demographic variables.

Table 29 - Sources of the constructs of the questionnaire

Construct	Source
VR experience (Dimensions: Aesthetics, Education, Entertainment, Escapism)	(Loureiro, 2014; Oh et al., 2007)
Memory	(Loureiro, 2014; Oh et al., 2007)
Pleasantness of the experience	(Kaltcheva & Weitz, 2006)
Telepresence	(Choi et al., 2016)
Student Engagement	(Criado & Such, 2011; Isiaq & Jamil, 2017)
Mindfulness (Domains: novelty seeking, novelty producing, engagement, flexibility)	(Langer, 2004; Loureiro & Fialho, 2017)

Source: own elaboration

The literature contains several scales to measure Mindfulness. For instance, the Kentucky Inventory of Mindfulness Skills, the Mindful Attention Awareness Scale, the Five Factor Mindfulness Questionnaire, or the Langer Mindfulness Scale (LMS). However, LMS emerges as the most suitable because (i) the current study measures individuals' general cognitive state (university student cognitive state) and not the collective cognitive state within an organization; (ii) the scale does not consider a particular context and therefore can be used in different situations, and (iii) there is good test-retest reliability, factor validity, and construct validity demonstrated in other studies and particularly in the scale validation carried out by Langer and others over the years.

5.2.4 Participants' profile

The 136 participants are 58.1% female (and 41.9% male) (see table 30), most of them between 41 and 50 years old. For all of them, it was the first time they used VR equipment and had a VR experience. For the majority, their only occupation is student (86.8%). The number of participants is aligned with the sample size of other studies in which an experiment is a methodological process (e.g., Mobascher et al., 2009; Posada-Quintero et al., 2016). The students are well-distributed among a first-degree course, master course and PhD/DBA course – see Table 30.

Table 30 – Sample profile

Gender	Age	Educational level
Female: 58.1%	18 to 21: 11,8%	Bachelor: 42,6%
Male: 41.9%	22 to 25: 5,1%	Master: 31.6%
	26 to 30: 6,6%	PhD/DBA: 25.8%
	31 to 40: 14,0%	
	41 to 50: 36,0%	
	51 to 60: 20,6%	
	> 60: 5,9%	

Source: own elaboration

All the participants in this study started by visualizing the VR video, through the appropriate equipment, and finished their experience by answering a questionnaire to collect their opinions.

5.3 Data analysis

The partial least squares (PLS) approach is employed to analyse the hypotheses of the current study (SmartPLS3 3.0). PLS enabled the researchers to avoid biased and inconsistent parameter estimates, and it is an effective analytical tool to test interactions by reducing Type II errors and allowing analysis using a small sample (Chin, Marcelin, & Newsted, 2003; Hair, Hult, Ringle, & Sarstedt, 2017).

The model proposed in the current study presents a large number of manifest variables and formative factors and thus PLS is the appropriate approach. The repeated indicators method is applied to test the model with second-order formative factors (Chin et al., 2003; Kleijnen, de Ruyter, & Wetzels, 2007), the VR experience with four factors, that is, education, entertainment, escapism, and aesthetics.

The sample size recommended by the power analysis (Cohen, 1992; Hair et al., 2017) is 124 for a statistical power of 80% (and also 5% level of significance with minimum R^2 equal to 0.10 in the most conservative case), and maximum number of arrows pointing at a latent variable being equal to 3. Hair et al. (2011) suggest a minimum of ten times the biggest set of arrows heading towards any construct, meaning that for our experiment of study 3 it should be 30. Therefore, our sample size of 136 is appropriate.

5.4 Results

5.4.1 Measurement results

A PLS model should be analyzed in two stages. First, the measurement model by evaluating the reliability of the individual measures, convergent validity and discriminant validity of the constructs. Second, the structural model is evaluated. In order to evaluate the adequacy of the measures at the first-order construct level, item reliability, reliability and AVE (average variance extracted) are examined (see Table 31).

Item loadings of scales measuring reflective constructs should be 0.707, as is the case here (Wetzels, Odekerken-Schröder, & Van Oppen, 2009). All Cronbach's alpha values are above

0.7 and all composite reliability values are higher than 0.8 and so the constructs have reliability. All values of AVE are above 0.5, demonstrating convergent validity.

At the second-order construct level, three measures should be analysed: parameter estimates of indicator weights, the significance of weight (t-statistics) and multicollinearity of indicators. Weight represents the contribution of each formative indicator to the variance of the latent variable (Roberts & Thatcher, 2009). A significance level of at least 0.05 (in the case of this study a significant level of at least 0.001) suggests that an indicator is relevant to the construction of the formative index (VR experience), and therefore demonstrates a sufficient level of validity.

The degree of multicollinearity among the formative indicators should be assessed by the variance inflation factor (VIF) (Fornell & Bookstein, 1982). The VIF indicates how much an indicator's variance is explained by the other indicators of the same construct. The common acceptable value for VIF is below 3.33 (Diamantopoulos & Siguaw, 2006), as seen in Table 31.

Table 31 - Measurement model

Construct	Item	Item loading (Reflective measure)	Mean Construct	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Education	EXEDU1	0.897	5.8	0.906	0.906	0.934	0.781
	EXEDU2	0.903					
	EXEDU3	0.804					
	EXEDU4	0.927					
Entertainment	EXENT1	0.873	6.5	0.851	0.852	0.909	0.77
	EXENT2	0.882					
	EXENT3	0.878					
Escapism	EXESC1	0.747	5.6	0.768	0.77	0.852	0.59
	EXESC2	0.78					
	EXESC3	0.768					
	EXESC4	0.777					
Aesthetics	EXEST1	0.777	6.5	0.782	0.787	0.874	0.698
	EXEST2	0.898					
	EXEST3	0.826					
Telepresence	TELE1	0.957	6	a	0.919	0.959	0.921
	TELE2	0.963					
	PLEX1	0.897	6.2	0.942	0.944	0.954	0.775
	PLEX2	0.882					
Pleasantness of the experience	PLEX3	0.893					
	PLEX4	0.894					
	PLEX5	0.872					
	PLEX6	0.844					
Memory	MEM1	0.909	6.1	0.909	0.913	0.943	0.846
	MEM2	0.92					
	MEM3	0.93					
S. Engagement	VIENG1	0.934	5.2	0.897	0.909	0.936	0.83
	VIENG2	0.939					
	VIENG3	0.858					
Mindfulness							
Engagement	-	-	5.4	0.713	0.733	0.836	0.719
Flexibility	-	-	5.3	0.705	0.785	0.779	0.542
Producing	-	-	4.8	0.707	0.765	0.821	0.606
Seeking	-	-	5.7	0.734	0.742	0.832	0.553
Second-order formative constructs	Second-order formative constructs/dimensions		Weight	t-statistics	VIF		
VR Experience	Education		0.385***	9.812	1.345		
	Entertainment		0.264***	10.101	1.908		
	Escapism		0.347***	12.992	1.82		
	Aesthetics		0.273***	12.913	2.165		

Source: own elaboration

AVE: average variance extracted; VIF: variance inflation factor. Note: All latent variables are considered with the different items included in the questionnaire, except for mindfulness, which is introduced into the model with the four dimensions (the overall mean of all items in each dimension). ***$p < 0.001$. a: the construct is composed of two items

Regarding discriminant validity, this is examined through two criteria: Fornell-Larcker and Heterotrait-Monotrait ratio. For the first, the square root of AVE should be greater than the correlation between the construct and other constructs in the model (Fornell & Larcker, 1981). Table 32 shows that this criterion has been met. The last part of the same table shows that the correlations between each first-order construct (education, entertainment, escapism or aesthetics) and the second-order (VR Experience) construct are higher than 0.71, meaning that they have more than half of their variance in common, as expected (MacKenzie, Podsakoff, & Podsakoff, 2011).

Table 32 - Discriminant validity: Fornell-Larcker Criterion

	1	2	3	4	5	6	7	8
1.Education	**0.884**							
2.Entertainment	0.336	**0.877**						
3.Escapism	0.488	0.527	**0.768**					
4.Aesthetics	0.398	0.671	0.596	**0.835**				
5.Memory	0.490	0.661	0.636	0.666	**0.920**			
6.Pleasantness	0.278	0.510	0.409	0.558	0.534	**0.880**		
7.S. Engagement	0.337	0.390	0.562	0.449	0.527	0.278	**0.911**	
8.Telepresence	0.506	0.403	0.701	0.520	0.644	0.420	0.494	**0.960**
	Correlation between first- and second-order construct							
	Education		**Entertainment**		**Escapism**		**Aesthetics**	
VR Experience	0.751		0.759		0.836		0.810	

Source: own elaboration

Note: Values on the diagonal (in bold) represent the square root of AVE. Lower diagonal values indicate factor correlations.

Considering the Heterotrait-Monotrait ratio of correlations (see Table 33), with all results taking values below 0.90 we can claim that the discriminant validity of the constructs has been established.

Table 33 - Discriminant validity: Heterotrait-Monotrait ratio – HTMT

	1	2	3	4	5	6	7	8
1.Education								
2.Entertainment	0.383							
3.Escapism	0.584	0.652						
4.Aesthetics	0.475	0.819	0.763					
5.Memory	0.538	0.751	0.759	0.787				
6.Pleasantness	0.299	0.565	0.474	0.649	0.572			
7.S. Engagement	0.370	0.445	0.675	0.536	0.579	0.304		
8.Telepresence	0.556	0.454	0.833	0.613	0.705	0.449	0.543	

Note: HTMT refers to Heterotrait-Monotrait Ratio

Source: own elaboration

5.4.2 Structural results

In the current study a non-parametric approach, called Bootstrap (5000 re-sampling), is used to estimate the precision of the PLS estimates and support the hypotheses (Hair et al., 2011). All path coefficients are found to be significant at the 0.001 level, except hypothesis H6 (see Table 34).

Table 34 - Table Structural results: direct effect

|	Path Coefficient	Standard Deviation (STDEV)	T Statistics ($|O/STDEV|$)	P Values	
VRExperience -> Telepresence	0.687***	0.046	15.075	0.000	H1: supported
Telepresence -> S. Engagement	0.269***	0.100	2.676	0.008	H2: supported
Telepresence -> Pleasantness	0.420***	0.097	4.323	0.000	H3: supported
Telepresence -> Memory	0.509***	0.103	4.925	0.000	H4: supported
Pleasantness -> Memory	0.320***	0.101	3.173	0.002	H5: supported
Pleasantness -> S. Engagement	-0.033 ns	0.080	0.421	0.674	H6: not supported
Memory -> S. Engagement	0.371***	0.101	3.686	0.000	H7: supported

Note: ***$p<0.001$; ns not significant

Source: own elaboration

Figure 16 also demonstrates structural results. As models yielding significant bootstrap statistics can still be invalid in a predictive sense (Hair et al., 2017), measures of predictive validity (such as R^2 and Q^2) for focal endogenous constructs should be employed. All values of Q^2 (chi-squared of the Stone–Geisser criterion) are positive, so the relations in the model have predictive relevance (C. Fornell & Cha, 1994). The model also shows a good level of predictive

power (R^2) as the modelled constructs explained 49.9% of the variance in memory, 47.2% in telepresence, and 31.9% in student engagement.

Figure 16 - Structural results, R^2 and Q^2
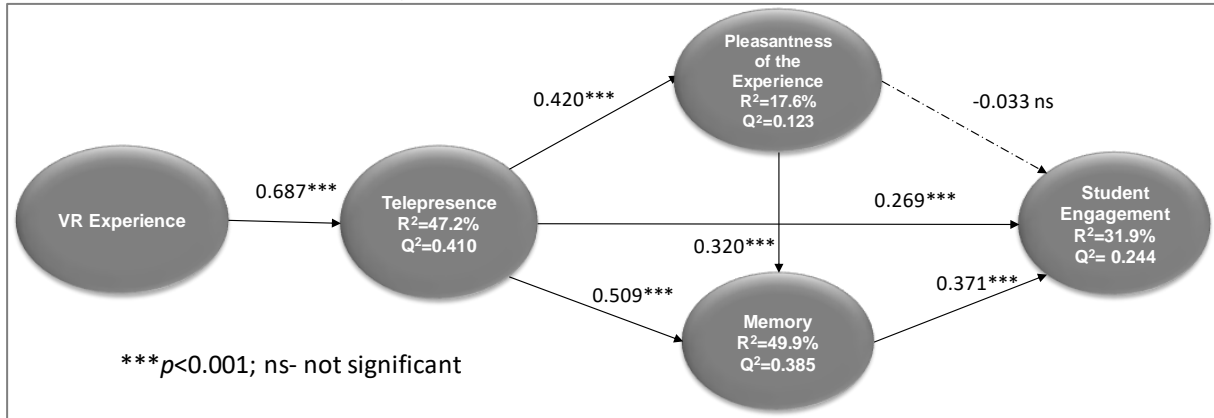
Source: own elaboration

5.4.3 Mediating effects and multigroup-analysis

Concerning the mediating effects of pleasantness, memory and both, we examine the direct and indirect effects and interval of confidence (see Table 35). Therefore, memory is a full mediator between pleasantness and student engagement and a partial mediator between telepresence and student engagement.

Table 35 - Mediation effects

Relationship	Indirect effect	T Statistics (|O/STDEV|)	P Values	Bias Corrected Bootstrap 95% Confidence Level		Direct effect	
	Path Coefficient			Lower	Upper	Path Coefficient	
Telepresence -> Pleasantness -> Memory	0.135	1.862	0.063	0.042	0.280	0.509***	No mediation
Pleasantness -> Memory -> S.Engagement	0.119	2.650	0.008	0.041	0.208	-0.033 ns	**Full mediation**
Telepresence -> Pleasantness -> Memory -> S. Engagement	0.050	1.776	0.076	0.013	0.116	0.269***	No mediation
Telepresence -> Memory -> S.Engagement	0.189	2.791	0.005	0.071	0.361	0.269***	**Partial mediation**
Telepresence -> Pleasantness -> S. Engagement	-0.014	0.377	0.707	-0.073	0.073	0.269***	No mediation

Source: own elaboration

Finally, the multigroup-analysis reveals that overall, there is a slight tendency for the path pleasantness -> memory (β=0.275, p<0.10) be higher for low mindful students than for high mindful students. When analysing the four dimensions of mindfulness individually (see Tables 37, 38, 39 and 40), we may claim that first, for seeking, there is a slight tendency for the path Telepresence -> Pleasantness (β=0.233, p<0.10) to be higher for low seeking students than for high seeking students, Second, overall, there is a slight tendency for the path Pleasantness -> Memory (β=0.261, p<0.10) to be higher for low producing students than for high producing students. The paths of Telepresence -> Pleasantness (β=0.259, p<0.05) and Pleasantness -> S. Engagement (β=0.314, p<0.05) are higher and more significant for low producing students than for high producing students.

Third, for producing, there are no significant differences in the engagement dimensions. Fourth, for flexibility, there is a tendency for the path Telepresence -> S. Engagement (β=0.340, p<0.05) to be higher for low flexible students than for high flexible students. In Table 36 is the Multigroup analysis: mindfulness with Parametric Test.

Table 36 - Multigroup analysis: mindfulness with Parametric Test

	Path Coefficients Original (Mindfulm (1.0) low)	Path Coefficients Original (Mindfulm (2.0) high)	t-Values (Mindfulm (1.0) low)	t-Values (Mindfulm (2.0) high)	p-Values (Mindfulm (1.0) low)	p-Values (Mindfulm (2.0) high)	Path Coefficients-diff (Mindfulm (1.0) Low) Mindfulm (2.0) high)	p-Value (Mindfulm (1.0) low vs Mindfulm (2.0) high)
Experience VR -> Telepresence	0.664	0.688	8.338	11.953	0.000	0.000	0.024	0.587
Memory -> S. Engagement	0.347	0.353	2.134	2.908	0.033	0.004	0.006	0.505
Pleasantness -> Memory	0.425	0.150	4.078	0.992	0.000	0.321	**0.275**	**0.065**
Pleasantness -> S. Engagement	0.014	-0.040	0.106	0.422	0.916	0.673	0.055	0.374
Telepresence -> Memory	0.411	0.580	3.264	4.256	0.001	0.000	0.170	0.827
Telepresence -> Pleasantness	0.457	0.309	5.371	1.966	0.000	0.050	0.148	0.197
Telepresence -> S. Engagement	0.271	0.241	1.882	1.910	0.060	0.057	0.031	0.436

Source: own elaboration

Table 37 - Multigroup analysis: seeking with Parametric Test

	Path Coefficients Original (seeking (1.0)low)	Path Coefficients Original (seeking (2.0)high)	t-Values (seeking (1.0)low)	t-Values (seeking (2.0)high)	p-Values (seeking (1.0)low)	p-Values (seeking (2.0)high)	Path Coefficients-diff (seeking (1.0)low – seeking (2.0)high |)	p-Value (seeking (1.0)low vs seeking (2.0)high)
Experience VR -> Telepresence	0.718	0.632	11.493	8.448	0.000	0.000	0.086	0.183
Memory -> S. Engagement	0.368	0.343	2.181	2.596	0.030	0.010	0.025	0.435
Pleasantness -> Memory	0.344	0.333	3.824	2.023	0.000	0.044	0.011	0.462
Pleasantness -> S. Engagement	0.086	-0.122	0.610	1.054	0.542	0.292	0.208	0.110
Telepresence -> Memory	0.476	0.500	3.733	3.372	0.000	0.001	0.024	0.564
Telepresence -> Pleasantness	0.509	0.276	6.148	1.898	0.000	0.058	**0.233**	**0.083**
Telepresence -> S. Engagement	0.244	0.262	1.574	1.983	0.116	0.048	0.018	0.535

Note: High seeking are students seeking novelty

Source: own elaboration

Table 38 - Multigroup analysis: producing with Parametric Test

	Path Coefficients Original (producing (1.0)low)	Path Coefficients Original (producing (2.0)high)	t-Values (producing (1.0)low)	t-Values (producing (2.0)high)	p-Values (producing (1.0)low)	p-Values (producing (2.0)high)	Path Coefficients-diff (producing (1.0)low – producing (2.0)high |)	p-Value (producing (1.0)low vs producing (2.0)high)
Experience vr -> Telepresence	0.610	0.741	7.355	12.848	0.000	0.000	0.130	0.905
Memory -> S. Engagement	0.292	0.383	1.593	2.921	0.112	0.004	0.092	0.649
Pleasantness -> Memory	0.529	0.268	3.837	2.305	0.000	0.022	**0.261**	**0.080**
Pleasantness -> S. Engagement	0.203	-0.111	1.350	1.502	0.178	0.134	**0.314**	**0.036**
Telepresence -> Memory	0.222	0.630	1.362	5.400	0.174	0.000	0.408	0.978
Telepresence -> Pleasantness	0.590	0.331	7.101	2.589	0.000	0.010	**0.259**	**0.045**
Telepresence -> S. Engagement	0.201	0.238	1.162	1.848	0.246	0.065	0.037	0.559

Note: High producing are students producing novelty (tend to have new ideas, novel contributions)

Source: own elaboration

Table 39 - Multigroup analysis: engagement with Parametric Test

	Path Coefficients Original (engagement (1.0)low)	Path Coefficients Original (engagement (2.0)high)	t-Values (engagement (1.0)low)	t-Values (engagement (2.0)high)	p-Values (engagement (1.0)low)	p-Values (engagement (2.0)high)	Path Coefficients-diff (engagement (1.0)low – engagement (2.0)high |)	p-Value (engagement (1.0)low vs engagement (2.0)high)
Experience VR -> Telepresence	0.693	0.665	12.374	7.125	0.000	0.000	0.028	0.416
Memory -> S. Engagement	0.297	0.583	2.309	2.736	0.021	0.006	0.286	0.878
Pleasantness -> Memory	0.415	0.240	4.225	1.650	0.000	0.100	0.175	0.166
Pleasantness -> S. Engagement	-0.033	-0.046	0.296	0.307	0.768	0.759	0.013	0.459
Telepresence -> Memory	0.342	0.689	2.740	5.188	0.006	0.000	0.347	0.967
Telepresence -> Pleasantness	0.450	0.326	4.624	1.914	0.000	0.056	0.124	0.287
Telepresence -> S. Engagement	0.310	0.086	2.523	0.411	0.012	0.681	0.224	0.179

Note: High engagement students tend to be involved, aware, alert.

Source: own elaboration

Table 40 - Multigroup analysis: flexibility with Parametric Test

	Path Coefficients Original (flexibility (1.0)low)	Path Coefficients Original (flexibility (2.0)high)	t-Values (flexibility (1.0)low)	t-Values (flexibility (2.0)high)	p-Values (flexibility (1.0)low)	p-Values (flexibility (2.0)high)	Path Coefficients-diff (flexibility (1.0) low – flexibility (2.0)high |)	p-Value (flexibility (1.0)low vs flexibility (2.0)high)
Experience VR -> Telepresence	0.673	0.689	9.540	10.278	0.000	0.000	0.016	0.563
Memory -> S. Engagement	0.302	0.431	1.951	3.007	0.052	0.003	0.129	0.731
Pleasantness -> Memory	0.390	0.185	4.296	0.990	0.000	0.323	0.205	0.161
Pleasantness -> S. Engagement	-0.061	-0.015	0.533	0.099	0.594	0.921	0.046	0.576
Telepresence -> Memory	0.478	0.501	4.392	2.916	0.000	0.004	0.023	0.578
Telepresence -> Pleasantness	0.460	0.312	6.001	1.890	0.000	0.059	0.147	0.221
Telepresence -> S. Engagement	0.411	0.071	2.814	0.612	0.005	0.541	**0.340**	**0.034**

Note: High flexibility students tend to be open to new ways of doing things, being open minded.

Source: own elaboration

5.5   Discussion of study 3

The results pointed out in study 3 deserve further discussion in comparison with previous studies and six main aspects are discussed here.

First, following (Pine & Gilmore, 1998, 1999) and Loureiro (2014) experiences may have four realms, that is, educational, entertainment, escapism and aesthetics. These realms have more or less relevance depending on the context. For instance, the study conducted by Loureiro (2014) for rural experience reveals that aesthetics and education are the most important facets in shaping the overall rural experience. A similar finding emerges in Loureiro, Breazeale, & Radic (2019) for rural tourism in Croatia. Although in this last situation education gains weight that was absent from the previous one. This is justified by the importance of aesthetics (the setting of the experience) and education (learning something new) in the rural context, where guests tend to stay to relax and learn new tasks connected to traditional rural activities. For the purpose of the current study, VR is employed to support learning and as expected, educational and escapism are the most significant facets in shaping the overall VR experience. This is a very valuable result because the current study starts to point out the importance of using VR equipment to enhance the learning process, leading university students to be immersed in a different but enriching experience.

Second, the virtual reality experience is positively associated with telepresence, which supports H1. VR experiences are known to be very immersive, where participants - in this case university students - are invited to be in a different context from their daily lives. Telepresence represents how students have a real sensation of the present, being there inside the experience (Cummings & Bailenson, 2016). As shown in this study, university students who have had an educational experience through VR tend to have a sensation of being immersed and living inside the VR context. Past studies have already alluded to the association between VR experiences and telepresence (Loureiro, Guerreiro, Eloy, Langaro, & Panchapakesan, 2019). Here the association is clearly demonstrated in the context of education.

Third, telepresence may be directly associated with student engagement (H2), meaning that the strong sensation of being present positively contributes to engaging students in the learning process through VR. Indeed, VR can even encourage a desire to search for more information

about a certain topic through other sources of information. This aspect highlights the importance of engaging participants in a certain cause, as in past research (e.g., Bilro et al., 2019; Prentice et al., 2019; tom Dieck, Jung, & Rauschnabel, 2018; tom Dieck, Jung, & tom Dieck, 2018).

Fourth, following Loureiro (2014), the current study explores the role of the pleasantness of the experience and memory as mediating between telepresence and student engagement. Although pleasantness of the experience - regarded as the positive feeling and emotions during the experience - is important in the process of creating and maintain the memory in students' minds, this study shows that memory is the true mediator between telepresence and student engagement. Therefore, the mechanism by which memory is created in students' minds through the sensation of being present in the virtual environment becomes a powerful key to engage students.

As expressed in past research, memories are activated and stored through emotions (Itani et al., 2019; tom Dieck et al., 2018; Loureiro 2014), yet the sensation of being in the VR environment also contributes to creating memories and both telepresence and memory are strong drivers of student engagements, which has been demonstrated by the support of hypotheses H3, H4, H5, and H7.

Fifth, the only hypothesis not supported is H6 linking pleasantness of the experience with student engagement. In past studies -such as the one by tom Dieck et al. (2018) for the context of augmented reality- the level of satisfaction contributes to enhancing engagement in science festivals. Nevertheless, their study was conducted in a different environment and does not use VR equipment and the concept of memory is not present. The current study shows the valuable influence of creating favourable memories and this seems to increase the willingness to become engaged more efficiently rather than just having positive emotions or being satisfied. Therefore, memories play an important role in the process of engaging students.

Finally, student mindfulness deserves further attention in future studies in the process of engaging students with learning. Although in the current study only the relationship between pleasantness of the experience -and memory is revealed to be significant, where the path for low mindful students (β=0.425) is higher than for mindful students (β=0.150) for a significant level of 10%, when analysing each of the four dimensions of mindfulness, novelty producing followed by flexibility are those dimensions with most significant differences.

Novelty producing represents students that usually tend to have new ideas, making novel contributions. For those students who are low producing, the strength of the relationships between pleasantness and student engagement and between telepresence and pleasantness are higher than for producing students. Therefore, it seems that students who are not so active in having new ideas need more than producing students to feel pleasure with the experience of becoming engaged. The same occurs in the case of the relationship between telepresence and pleasantness. In the case of students with low flexibility (where flexibility means that students tend to be open to new ways of doing things), the strength of the relationship between telepresence and S. Engagement is also higher than for students with flexibility.

Hence, overall the findings suggest that VR may be more effective in the case of low mindful students leading them to search for more information about a certain topic through the sense of telepresence and the pleasure felt using such equipment. This is particularly important for students who do not often have new ideas and are not very open to new ways of doing things. Indeed, VR may also be important to help less novel producing students to create memories (at a level of $p<0.10$).

Chapter 6

6   Discussion, implications and conclusion

Research on teaching technologies and methods requires constant attention, because the speed at which technology is evolving is significantly faster than the available time and capacity of educators and educational institutions to integrate it into their curricula. In this chapter we will present the conclusions of this thesis, some theoretical and managerial implications and a list of the limitations felt throughout this work. Some questions will also be left as suggestions and possibilities for future research.

6.1   Theoretical contributions

This thesis proposes to show how different technology-based teaching methods could contribute to improving university students' engagement with the contents taught or activities performed. Through gamification, transmedia or virtual reality tools we have built different teaching scenarios and approaches to be able to collect and understand students' reaction, motivation and engagement regarding their experience with these scenarios and teaching methods. The findings may make a double contribution to theory development and possible improvement of some Higher Education Institution (HEI) teaching tools and services available for students.

Regarding our first research question (RQ 1) and the evidence in the literature that gamification is an effective tool in education, we show how gamification has received increasing attention from many researchers, its true potential and the various areas of practical application, collecting evidence of its positive or negative impact in education and in other sectors (Dichev & Dicheva, 2017; Faiella & Ricciardi, 2015; Kasurinen & Knutas, 2018; Laskowski, 2015; Ortiz et al., 2016).

In an attempt to answer this first research question, a first study took place and, following the ideas from Laskowski, (2015) and Oliver, (2017), with an experiment with the gamification-based tool Kahoot! we were able to demonstrate students' interest, participation and engagement during the various classes taught throughout a semester. The results showed,

greatest involvement and interest in participating in the various activities during the class every time the Kahoot! tool was used.

The implementation of gamification-based activities within an educational environment, despite their widely identified advantages, still requires special attention to ensure the best possible outcome from the whole experience for educators and learners. Following Huang & Soman (2013) the definition of learning objectives, understanding the target audience and identifying the available resources that could support the application of gamification elements, are some of the preparatory actions to be taken.

In addition, but no less important, is the knowledge educators need about the best way to apply gamification elements in their classes and, above all, to know the advantages or disadvantages of this application according to the academic results to be achieved. In general, we argue that the results obtained through applying the gamification-based tool Kahoot! seem to be in line with the results achieved by Ares, Bernal, Nozal, Sánchez, and Bernal (2018) and Orhan Göksün and Gürsoy (2019).

Since the application of a single gamification-based tool (such as Kahoot!) has shown positive results in student motivation and engagement, it is also relevant to test different approaches, seeking to identify other effective methods that may contribute to students' interest, engagement and academic success.

This first study also enables us to investigate gamification in higher education using a text mining approach and tools, thus fulfilling our second research objective (RO 2). Through this simple experiment we can collect enough evidence to contribute to a better understanding of how to use gamification in higher education. Since the main theme of this thesis is to explore university students' engagement in learning through different methods, we must try other approaches, leading to our second study.

The second study seeks to answer our second research question (RQ 2): can the interconnection between the classroom and LMS's, such as Moodle, contribute to enhancing the education process? In this study we adopt a more challenging approach, trying to understand if the interaction among different teaching support tools and methods could also contribute to student engagement and good academic results. The approach to a transmedia design, mainly based on Moodle LMS, reveals some interesting insights in accordance with our initial beliefs and

suspicions that the use of the Moodle platform could, in fact, contribute to enhancing the education process through better levels of student motivation and engagement.

The Moodle platform, like other LMS's, offers a wide range of settings and possibilities that allow for different approaches when preparing to implement technology-based teaching methods (Llopis-Amorós et al., 2019). Widely accepted as an easy-to-use platform, based on an open-source philosophy and counting with a large and globally supported community of developers worldwide, Moodle is perhaps one the best tools there is, to facilitate the implementation of various approaches to teaching and curricular tasks based on an online environment (Caminero, Hernandez, Ros, Robles-Gomez, & Tobarra, 2013; Croitoru & Dinu, 2016).

Taking into account a few suggestions from Freeman et al. (2019), some different study activities were set up in Moodle, where students had to search online and offline for necessary data and information which could be used as suitable answers to complete their assignments. By doing this, students explored and critically evaluated different sources of information, through different media (e.g. electronic databases; university library; institutional websites; social networks, etc.), while maintaining a daily connection with other online topics and conversations held within the Moodle online discussion forum.

Despite a widespread interest in virtually all activities and tasks performed in study 2, the results seem to reveal a much higher interest and engagement from students in more dynamic activities and participatory forms of interaction, such as participation and discussion of topics through the online forum on Moodle. Younger generations and digital natives are more open to participating and leaving their contributions, whenever proposals for collaboration and interaction are presented in such a way, where they can take advantage of their own equipment and technology such as their smartphones – a transmedia approach supported on Moodle LMS allows that to happen (Tombleson et al., 2016).

The aim of this second study, as well as our third research objective (RO 3), is to explore transmedia effects in higher education, mainly based on the Moodle LMS, through a mixed approach. We consider that we achieve these goals, since the results reveal evidences of the positive impact of this approach on improving the educational process.

However, we must still look for an answer to our fourth research question (RQ 4), if virtual reality is a tool able to create students' engagement in learning through pleasure and the creation

of memories. Our fourth research objective (RO 4), regarding the proposal and validation of a model portraying the influence of virtual reality experience on student engagement, extending the S-O-R framework, also needs further testing and validation.

Therefore, and aiming to explore drivers of student engagement in the learning environment through virtual reality, we went further in our search for answers regarding university students' engagement in learning through different tools, by implementing a third study based on virtual reality as a technological support for the learning environment and in learning on courses. Structuring the proposed model based on the S-O-R framework, and following the work of Pine and Gilmore (1998), where experiences can originate engagement at different levels (physical, emotional or intellectual), we were able to confirm positive associations between telepresence, and memory and student engagement.

Considering the teaching-learning process as a route to academic success and good learning outcomes, the fact that telepresence appears positively associated with student engagement seems to make sense since telepresence represents how students can sense their participation inside the learning experience and therefore become immersed in the virtual reality context. The sensation of immersion and being present can also encourage them to search for other sources of information and probably heighten the desire to participate in the curricular and learning activities. Memory and memory processes are some of the most relevant cognitive types of engagement (Christenson, Reschly, & Wylie, 2012), and in our study, they appear positively associated with student engagement.

All things considered and analyzing our third research question (RQ 3), on how the exploration of distinct technological tools contributes to greater student interest, participation and engagement, when we observe our studies and each of the outcome discussions presented, we can state that some technological tools may, in fact, contribute to greater student participation and engagement (Loureiro, Guerreiro, Eloy, Langaro, & Panchapakesan, 2019; Pérez-Pérez et al., 2019; Turan et al., 2016). Gamification, transmedia based on learning management systems and immersive environments through virtual reality, are the technological tools and methods we have tried, explored and presented throughout this thesis.

In sum, we can claim that this thesis presents distinct contributions. First, this thesis contributes to theory by presenting the literature on the topic of the thesis - relationship marketing and consumer behaviour in the educational context -, using a systematic approach to select relevant scientific information and suggest new avenues for research. Second, this thesis brings to light the relevance of using different tools - such has gamification, learning management system platforms and virtual reality - to capture university students' interest in learning and becoming engaged in the search for more information about their study topics. Third, in study 1 a contribution to understand the influence on engagement and motivation, by using a simple gamification-based tool such as Kahoot! with a group of undergraduate students, revealed interesting results, despite the small sample used.

Fourth, study 2 makes a contribution to theory by showing the potential relevance of the effect on HEI students' involvement and participation in learning tasks, using various interaction points, tools and activities, supported by an LMS such as Moodle. Finally, study 3 adds to theory by presenting a model that extends the S-O-R framework proposing drivers of student engagement. This model can provide new insights in the field of relationship marketing and particularly in the educational context. VR experiences act as motivational factors to enhance telepresence and this, in turn, influences student engagement, through creating memories.

VR experiences were considered effective for university students in acquiring new skills. The current study suggests that VR experiences contribute to creating favourable memories in students' mind about the topic they visualize and hear through VR equipment. VR experiences seem to be even more effective in the case of low mindful students than in the case of mindful students. Less mindful students are particularly attracted through the vivid sensation of telepresence and the positive emotions felt. Therefore, positive emotional states are especially important for less mindful students to become engaged with the topic of study.

6.2   Managerial implications

The research developed in this thesis allows us to share some ideas and contributions that could be useful for business managers in general, and educators and administrators of higher education institutions. With this goal in mind, we will start by leaving some suggestions for business managers.

Having to deal with workers and collaborators engagement and optimum levels of motivation, so they can apply their skills and perform their daily activities at maximum performance, is something that should be part of the "job description" of every business manager. The constant care and attention to business customers and consumers should also be a matter for constant dedication and attention. In this thesis we have tried to demonstrate how different tools and approaches could contribute to improving people's engagement and motivation, by creating activities and environments where they can be at their best in terms of performance and behaviour.

Managers having to deal with employees' motivation and engagement – perhaps one of the most challenging management tasks – should be aware of some available options and tools that could help them to implement activities for their collaborators, knowing that properly engaged employees are linked to better key organizational outcomes.

As explored in this thesis, a simple gamification-tool such as Kahoot! gives managers the opportunity, for example, to refresh their meetings or events by creating a more participatory environment, where every participant can actively share their view and opinion through this easy-to-use tool. Simple questions asked and answered through this tool can create a supportive and fun atmosphere among participants, able to unlock discussions and promoting creativity. This tool can also be used remotely through a premium feature available in the Kahoot! for business app.

Considering the need for employee training for example, and all the inherent aspects, managers also have a good opportunity to improve this area of their corporations by adopting a Learning Management System, which will allow the implementation of e-learning based courses through a personalized learning approach, to enable employees to learn at their own pace and interact with their co-workers and trainers.

In addition, the use of an LMS, offering a library of knowledge in distinct formats, can be an important support in promoting training on products or services (e.g. product compliance, productivity issues, product/service safety, rules and regulations, etc.), addressed to different groups of people outside the company (e.g. stakeholders in general). Through an LMS a company can inform customers about its products and services, teach its personnel about various subjects and, above all, manage a collaborative and participatory digital environment shared by all its stakeholders. For marketing managers, easy collection and analysis of customers' opinions about company products or services, recording customer suggestions for

improvement through discussion forums or even creating an environment with a real possibility for product or services co-creation are some of the possibilities available through an LMS platform.

Marketing managers should also pay close attention to the potential of virtual reality and to the customer experience and previewing products for example, since these may influence customers' buying decisions. The possibility of trying out a product virtually prior to its acquisition, can positively influence the purchase decision. Regarding the results achieved in this thesis, we can say that an immersive experience allows participants to navigate through different contexts and environments, creating a desire to further explore or physically try out the products or services shown during their VR experience, which may contribute to maximizing consumer experience and spending.

Concerning the pleasure that comes from a virtual reality experience, it is also worth highlighting that this can influence the customer's attitude towards the brand and the products or services provided so, all efforts made by managers to create virtual experiences and environments at their customer contact points deserve more attention.

Regarding educators and higher education institution administrators it seems clear that students are the main reason for their existence, and so most of their time should be dedicated to students' learning outcomes and academic success, through challenging and engaging activities. This is not always an easy task, not because they do not know how to do so, but, mostly because they simply do not know how to handle some of the existing tools that could help them achieve their teaching goals.

On the other hand, we also know that students in higher education institutions – a technologically literate youth generation – are extremely open to trying out using new technology-based tools and to exploring new ways of interaction and learning through these means. Knowing this, it is almost mandatory for HEI's to explore and try out new teaching methods and methodologies, attempting to fill the gap between more traditional teaching methods and more technology-based tools and methods.

Since the implementation of these "educational media" requires educators to know them so they can apply and integrate them correctly in their teaching practices, a good start would be to promote training and awareness actions for the teaching class, demystifying the difficulties inherent to their application as well as showing the advantages and disadvantages of using them.

The positive results achieved in this thesis regarding the gamification-based tool Kahoot!, a free and simple versatile online tool that allows people to interact in a competitive but fun way through their smartphones, show the potential of a more active learning approach, if wanting to engage and motivate students to be more enthusiastic about their learning activities, inside or outside the traditional classroom. Most of the feelings expressed by the students about this tool were positive which, to some extent, reinforces the potential of using this kind of tools in the teaching-learning process, stimulating greater participation and interest among students and, consequently, greater willingness to learn and achieve good results.

In parallel and based on our findings, the implementation of a learning management system (LMS), able to support the tasks required in most teaching activities, should also be given great consideration by HEI administration – LMS's are powerful software platforms, online based, offering a wide range of functionalities at reasonable prices (e.g. Moodle is an open-source software based LMS, widely used worldwide and globally supported). Continuous research and technological advances contribute to the improvement of LMS's, their capabilities and especially their usability and integration with other systems, making it possible to develop and implement many different activities and monitor and analyse data from various sources.

Synchronous and asynchronous ways of interaction are possible through these platforms, which allowing full coverage of the time users have available, to perform various tasks or activities according to their own pace and personal availability. To be able to follow class topics remotely and interact with colleagues or professors are, some of the capacities most appreciated by all those that use these platforms to support their learning activities. For educators and faculty, proper knowledge and use of the full capabilities of an LMS can contribute significantly to more stimulating and engaging pedagogical practices.

Regarding virtual reality, it is also worth highlighting some of the results obtained in this thesis, namely those that revealed the ability to engage and motivate students throughout their studies and academic path. Focusing on the results achieved through an immersive VR experience, student showed greater motivation and desire, to search for more information about specific topics. Students' will to explore new sources of information, working on their own learning experience, is increased. Another interesting result of the virtual reality experience developed in this thesis, seems to suggest that VR technology can positively influence students' involvement and interest, even among those who are not creative or willing to look for new

ways of doing things. Considering VR's potential to promote better learning outcomes among students, it deserves greater attention from HEI administrators and faculty members in general.

6.3 Limitations and future research

6.3.1 Limitations

The three studies conducted and presented in this thesis were designed, conceived and prepared with caution to avoid bias and be accurate. Nevertheless, as in any research, we find limitations, which may open avenues for further research.

Considering study 1, one main limitation was the test of one single gamification-based tool, despite the existence of other possibilities that could be used simultaneously, therefore being able to reveal a mix of tools and methods that could contribute in an aggregated way to improving the teaching-learning process. Also, regarding study 1 and since the experiment developed could only be applied to a restricted group of undergraduate students during a full semester, that small sample can also be considered a limitation by preventing broader conclusions about outcomes in different student profiles.

Considering study 1, the sample of participants is one of convenience, usually employed in experimental studies. The target population was contacted, and the sample represents university students on management and marketing courses. Future studies should use more diverse university courses in different cultural contexts to consolidate the findings.

Considering study 2, one main limitation is the fact of focusing on only a single subject from the course syllabus – Innovation. Another limitation is due to technical and time constraints. In the future it will be important to develop and implement other social network pages as a complement to Facebook, in order to study students' levels of interest and participation in different media platforms.

Study 2 also presents the limitation of the reduced number of starting discussions (5 main topics) in the forum, because this aspect limited the diversity of the subjects covered and may have led to some disinterest of the part of some students. Since this study was applied to senior students in their last semester, when they also had their most demanding course and business simulation activity ("*Simulação empresarial*" with 21 ECTS's), this might also be considered

a limitation since a greater availability and willingness from students to participate more actively, could have led to different results.

Regarding study 3, the sample size (n= 136) is appropriated for an experiment. Experimental studies conducted in a laboratory usually employ a smaller sample size (some employ only 20 participants), as seen, for instance in Mobascher et al., (2009) or Posada-Quintero et al., (2016). Our sample size is also appropriate for the PLS technique employed. Indeed, Joe F. Hair et al., (2011) suggest a sample size at a minimum of ten times the biggest set of arrows heading towards any construct, which in this case would mean a minimum of 30 (10×3 arrows). Even when considering the power analysis (Cohen, 1992; Joseph F Hair et al., 2017), the recommended sample size is 124, by using power analysis for a statistical power of 80% (and also 5% level of significance with minimum R^2 equal to 0.10 in the most conservative case), and maximum number of arrows pointing to a latent variable being equal to 3. However, a larger sample size could be important in the future to consolidate the findings, introduce other interesting variables to enrich the model and create more complexity and even to compare between different cultures.

In study 3 we only consider university students in the field of management and administration. In the future the same model can be employed and analysed in different fields of knowledge, using different VR scenarios and exploring when and whether the model suits better. The VR film should be created and prepared with different material allowing adaptation to different educational courses. It is important to create films in VR taking into consideration the pedagogic material of a certain module of the course. In the creative process of making a VR film it will also be possible to introduce some gamification elements to enhance the positive emotions and to effectively engage less mindful students. We also suggest considering AVATARs that could interact with students during the VR experience. The AVATAR may contribute to developing a sense of connection, possibly increasing positive emotions and the engagement process.

Another suggestion lies in the use of senses other than sight and hearing to increase the sensation of vividness, presence and ultimately immersion. This will be particularly important for students less focused on course topics.

Other constructs may be recommended for incorporation in the model, for instance, the sense of power, meaning a perception of control over a certain situation (e.g., Madzharov, Block, & Morrin, 2015). This perception may alter the sensation of telepresence in using VR experience

because students with a high sense of power could be expected to be more critical of everything, they receive from the VR experience than students with a lower sense of power.

Another example is the construct of "cool". Can the use of VR experience be regarded as a "cool" tool to learn? Or how less "cool" learning material becomes cool using VR equipment or the combination of VR and Augmented Reality (see Warren et al., 2019).

The perception of authenticity - considering authenticity a subjective evaluation of the originality and genuineness of the VR experience and environment - can also be important to analyse (see for instance Newman & Dhar, 2014). Finally, personality traits and other psychological variables may be regarded as moderators in the proposed model.

6.3.2   Future research

This thesis arises from a firm desire to explore different methods and tools which, when applied in a complementary way to the teaching-learning process, could contribute to a better learning, with more engaged students and educators in their common search for knowledge.

Educational methods in general and, especially some of the teaching methods used in higher education, are increasingly subject to the "pressure" of recent technologies, to supply other alternatives to supporting the mission of teaching and motivate students and educators. The forthcoming pathway raises many challenges, leading us into distinct avenues for future research.

In fact, from this thesis several research avenues may be addressed by researchers: (i) How to build a learning community that allows an integrative educational process? An integrated learning process tends to shorten the gap between educators and students, through creating and implementing new approaches to teaching and learning, using a comprehensive set of teaching tools and methods able to improve students' engagement, motivation and learning outcomes; (ii) How to implement an integrated process of learning using gamification, transmedia and virtual reality, bringing onboard the total cooperation of the stakeholders (institutions, educators and students)?

New technologies and gadgets appear almost daily, originating a flood of new possibilities and challenges to cope with their capacities and features. Despite having so many non-educational tasks in their daily agenda, educators and faculty need to be aware of what can help them in their teaching mission, to enhance their teaching results. Today, the ability to create and exploit

online resources that foster collaboration and cooperation among education stakeholders may never have been simpler; (iii) How to develop a collaborative system where lecturers and students can create and discuss their experiences from using multimedia lectures and the knowledge benefits gained? (iv) What are the best methods to disseminate and encourage educators to explore and learn about new technologies applied to teaching?

In this thesis we have developed three independent studies addressing, separately, a technology or teaching method. However, given the current technological provision and the existence of an extensive portfolio of teaching-methods, seeking to better understand the outcome of the simultaneous interaction between various technological tools and some teaching methods is a challenge, leading to another set of questions: (v) What technological tools and teaching-methods could be used simultaneously to promote students' engagement and academic success? (vi) Which teaching methods and technologies could be widely tested in higher education institutions to ensure the best learning outcomes? (vii) How can 5G technology contribute to enhancing the learning process using transmedia and gamification?

Promoting student engagement is a "hot topic" in education but, is far from being the only one supporting their academic success and several others need to be in mind, such as: completion rates; assessment methods; new courses or syllabus updates in accordance with new and more technological jobs and skills; networking and point to point interactions in and out of the school; personalizing education; supporting social learning. Based on these topics, that deserve to be studied, we propose the following question: (viii) What other constructs beside engagement can be employed in studying the long-distance interactions between student-student and lecturer--student?

In study 3 we explore virtual reality, and how VR experience can enhance university students' engagement in learning. In this, we explored some drivers of engagement in the learning environment through virtual reality, such as telepresence, pleasantness of the experience, memory and the virtual reality experience itself. Since student engagement can be influenced in many other ways, other approaches and topics should also be explored, such as cultural influences or artificial intelligence (ix) Could cultural issues change the findings of the model proposed in study 3 (VR)? (x) How can incorporating artificial intelligence systems into virtual reality devices help in the learning process?

These are some of the questions and concerns that arise from this thesis as future research avenues, at a time when higher education students are becoming more and more engaged with

their "online presence". Students are well-acquainted with technology and question some of the current teaching methods used in many institutions.

New generations with different ideas, priorities and ambitions pose a permanent challenge to organizations, such as firms or educational institutions, and in relation to some of the tools that organizations use to engage and motivate distinct stakeholders, such as students, for instance. It is time to explore and implement some changes but, most of all, to search for the answers of "how" and "why" we should change the way organizations interact with their stakeholders.

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Appendices

Appendix A: Study 2 - Moodle experience questionnaire

UC IEE - CPE 1 (Inovação) - apreciação final

Caro(a) Estudante do 3º ano do curso de Contabilidade e Finanças (diurno),

Pretende-se com o presente questionário recolher a sua apreciação relativamente ao exercício prático nº 1 (CPE 1 - Inovação) na UC de IEE.

Não existem respostas certas ou erradas, todos os dados recolhidos são anónimos e serão tratados de forma agregada.

O questionário possui 13 tópicos que tomarão cerca de 3 minutos do seu tempo.

Muito obrigado pela sua compreensão e participação neste breve questionário !

* Required

Algumas questões sobre a plataforma Moodle ...

1. **Durante o seu curso, tem utilizado a plataforma Moodle de forma regular ? (todos os semestres)** *
   Mark only one oval.

   ◯ Sim

   ◯ Não

2. **Onde e com que frequência utiliza a plataforma Moodle ?** *
   Mark only one oval per row.

	Nunca	Raramente	Às vezes	Muitas vezes	Sempre
Na sala de aula	◯	◯	◯	◯	◯
No campus do IPS	◯	◯	◯	◯	◯
Em casa	◯	◯	◯	◯	◯

3. Que tipo de atividades já realizou na plataforma Moodle ? *

Mark only one oval per row.

	Nunca	Raramente	Ás vezes	Muitas vezes	Sempre
Acesso a informação e conteúdos	◯	◯	◯	◯	◯
Realização de testes e quizzes	◯	◯	◯	◯	◯
Partilha de informação e conteúdos	◯	◯	◯	◯	◯
Participação em fóruns de discussão	◯	◯	◯	◯	◯

4. Indique qual a opção que mais se adequa para descrever a sua opinião em relação à utilização da plataforma Moodle: *

Mark only one oval per row.

	Discordo totalmente	Discordo	Sem opinião formada	Concordo	Concordo totalmente
Facilita a minha aprendizagem	◯	◯	◯	◯	◯
Permite ter mais orientação dos conteúdos da UC	◯	◯	◯	◯	◯
Ajuda-me a ter os assuntos de estudo mais organizados	◯	◯	◯	◯	◯
Permite uma participação mais ativa entre os colegas	◯	◯	◯	◯	◯
Ajuda-me no trabalho colaborativo	◯	◯	◯	◯	◯
Melhora o relacionamento em sala de aula	◯	◯	◯	◯	◯
Aumenta o meu interesse pelos conteúdos abordados	◯	◯	◯	◯	◯
Acho muito complicado	◯	◯	◯	◯	◯
É indiferente para mim	◯	◯	◯	◯	◯

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5. Quais as principais dificuldades sentidas na utilização da plataforma Moodle ? *

_____

_____

_____

_____

_____

6. Que funcionalidades gostaria de ver implementadas na plataforma Moodle ? *

_____

_____

_____

_____

_____

7. A plataforma Moodle foi útil ao seu estudo na UC de IEE ? *
Mark only one oval.

◯ Sim

◯ Não

Sobre o CPE 1 - Inovação
Nesta seção pedimos que partilhe a sua opinião relativamente à forma como se desenrolou a atividade prática do CPE 1, sobre Inovação:

8. No CPE 1 (inovação) qual foi o seu nível de interesse, relativamente às diversas atividades? *
Mark only one oval per row.

	Bastante interessante	Muito interessante	Foi-me indiferente	Pouco interessante	Nada interessante
Casos de estudo sobre inovação	◯	◯	◯	◯	◯
Participação no fórum geral	◯	◯	◯	◯	◯
Participação na página Inovação-ESCE no Facebook	◯	◯	◯	◯	◯
Ensaio sobre Inovações portuguesas	◯	◯	◯	◯	◯

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9. **Sobre a(s) atividade(s) que achou menos interessante(s), diga-nos porquê ?** *

_____

_____

_____

_____

_____

10. **Sobre a(s) atividade(s) que achou mais interessante(s), diga-nos porquê ?** *

_____

_____

_____

_____

_____

11. **No CPE 1 (inovação) qual foi o seu grau de dificuldade, relativamente às diversas atividades?** *

Mark only one oval per row.

	Bastante difícil	Muito difícil	Foi-me indiferente	Pouco difícil	Nada difícil
Casos de estudo sobre inovação	◯	◯	◯	◯	◯
Participação no fórum geral	◯	◯	◯	◯	◯
Participação na página Inovação-ESCE no Facebook	◯	◯	◯	◯	◯
Ensaio sobre Inovações portuguesas	◯	◯	◯	◯	◯

12. **Qual a sua opinião sobre a forma como foi abordado/conduzido o CPE 1 (Inovação) na UC de IEE (pontos fortes e fracos) ?** *

_____

_____

_____

_____

_____

13. **Pode agora deixar sugestões para o funcionamento futuro da UC de IEE:**

_____

_____

_____

_____

_____

Caraterização pessoal do respondente:

14. **Género** *
   Mark only one oval.

   ( ) Masculino

   ( ) Feminino

15. **Idade** *
   Mark only one oval.

   ( ) 18 a 21 anos

   ( ) 22 a 25 anos

   ( ) 26 a 30 anos

   ( ) Mais de 30 anos

16. **É trabalhador-estudante ?** *

Mark only one oval.

◯ Sim

◯ Não

17. **Está a repetir a UC de IEE ?** *

Mark only one oval.

◯ Sim

◯ Não

Appendix B: Study 3 – VR experience questionnaire

Experiência de visualização em RV (Realidade Virtual)...

O presente questionário enquadra-se num estudo relacionado com uma experiência sobre RV (Realidade Virtual), onde todas as respostas são anónimas e os dados recolhidos serão tratados em conjunto.

Não existem respostas certas ou erradas !

Pretende-se apenas obter a sua opinião pessoal para cada um dos tópicos apresentados.

O questionário possui 49 tópicos que tomarão cerca de 4 minutos do seu tempo.

Muito obrigado pela sua compreensão e participação neste estudo !

* Required

Por favor classifique numa escala de 1 (nada interessado) a 10 (totalmente interessado), como considera ser o seu nível de interesse pelo ... (vídeo)

1. **A. O meu nível de interesse pelo vídeo visualizado ...** *
   Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Nada interessado	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Totalmente interessado

Por favor responda aos seguintes tópicos, numa escala de 1 (discordo completamente) a 7 (concordo completamente):

2. **Q1. A configuração da experiência de RV foi muito atraente** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

3. **Q2. A experiência de RV foi muito agradável** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

4. **Q3. Eu senti uma verdadeira sensação de harmonia** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

5. **Q4. Eu aprendi algo de novo durante a experiência de RV** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

6. **Q5. A experiência tornou-me mais conhecedor** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

7. **Q6. Estimulou a minha curiosidade em aprender coisas novas** *
   Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

8. **Q7. Foi uma verdadeira experiência de aprendizagem** *
   Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

9. **Q8. A experiência de RV foi engraçada** *
   Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

10. **Q9. A experiência de RV foi interessante** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

11. **Q10. A experiência de RV foi divertida** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

12. **Q11. Eu senti-me como um personagem diferente ao usar a aplicação de RV** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

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Por favor responda aos seguintes tópicos, numa escala de 1 (discordo completamente) a 7 (concordo completamente):

13. **Q12. Eu senti como se estivesse a viver num tempo ou lugar diferente** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

14. **Q13. A experiência de RV permite-me imaginar ser outra pessoa** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

15. **Q14. Eu escapei completamente da realidade** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

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16. **Q15. Eu terei boas lembranças sobre esta experiência de RV** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

17. **Q16. Não vou esquecer a minha vivência com esta experiência de RV** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

18. **Q17. Vou lembrar-me de muitas coisas positivas sobre esta experiência de RV** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

19. **Q18. Esta experiência motivou-me a descobrir mais sobre os oceanos ...** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

20. **Q19. Esta experiência motivou-me a descobrir mais sobre investigação científica sobre os oceanos ...** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

21. **Q20. Esta experiência motivou-me a participar nas actividades relacionadas com os oceanos ...** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

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22. **Q21. Eu senti com se estivesse em ...** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

23. **Q22. Eu senti que visitei ...** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

Relativamente à sua experiência, indique como se posiciona relativamente aos seguintes tópicos:

24. **P1** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Deprimido	◯	◯	◯	◯	◯	◯	◯	Contente

25. **P2** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Infeliz	◯	◯	◯	◯	◯	◯	◯	Feliz

26. **P3** *
    Mark only one oval.

	1	2	3	4	5	6	7	
Insatisfeito	◯	◯	◯	◯	◯	◯	◯	Satisfeito

27. **P4** *

Mark only one oval.

	1	2	3	4	5	6	7	
Irritado	◯	◯	◯	◯	◯	◯	◯	Contente

28. **P5** *

Mark only one oval.

	1	2	3	4	5	6	7	
Aborrecido	◯	◯	◯	◯	◯	◯	◯	Relaxado

29. **P6** *

Mark only one oval.

	1	2	3	4	5	6	7	
Desesperado	◯	◯	◯	◯	◯	◯	◯	Esperançado

Mindfulness:

Por favor responda aos seguintes tópicos, numa escala de 1 (discordo completamente) a 7 (concordo completamente):

30. **MF1. Eu gosto de investigar as coisas** *

Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

31. **MF2. Eu crio poucas ideias novas** *

Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

32. MF3. Eu estou sempre aberto a novas formas de fazer as coisas *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

33. MF4. Eu envolvo-me em quase tudo o que faço *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

34. MF5. Eu não procuro ativamente aprender coisas novas *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

35. **MF6. Eu faço muitas contribuições novas (dou ideias em aulas e com amigos)** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	○	○	○	○	○	○	○	Concordo completamente

36. **MF7. Eu conservo as velhas e comprovadas maneiras de fazer as coisas** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	○	○	○	○	○	○	○	Concordo completamente

37. **MF8. Eu raramente noto o que outras pessoas estão a fazer** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	○	○	○	○	○	○	○	Concordo completamente

38. **MF9. Eu evito conversas provocadoras** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	○	○	○	○	○	○	○	Concordo completamente

39. **MF10. Eu sou muito criativo** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	○	○	○	○	○	○	○	Concordo completamente

40. **MF11. Eu posso comportar-me de muitas maneiras diferentes para uma dada situação** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	○	○	○	○	○	○	○	Concordo completamente

41. **MF12. Eu olho para o todo (não para o particular)** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

42. **MF13. Eu sou muito curioso** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

43. **MF14. Eu tento pensar em novas formas de fazer as coisas** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

44. **MF15. Eu raramente estou ciente de mudanças** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

45. **MF16. Eu tenho uma mente aberta sobre tudo, até mesmo coisas que desafiam as minhas crenças básicas** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

46. **MF17. Eu gosto de ser desafiado intelectualmente** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

47. **MF18. Eu acho fácil criar ideias novas e eficazes** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

48. **MF19. Eu raramente estou alerta para novos desenvolvimentos** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

49. **MF20. Eu gosto de descobrir como as coisas funcionam** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

50. **MF21. Eu não sou um pensador original (alguém que pensa em coisas originais)** *
Mark only one oval.

	1	2	3	4	5	6	7	
Discordo completamente	◯	◯	◯	◯	◯	◯	◯	Concordo completamente

Caraterização pessoal do respondente:

51. **É a primeira vez que participa numa experiência de Realidade Virtual ?** *
Mark only one oval.

◯ Sim

◯ Não

52. **Género** *
Mark only one oval.

◯ Masculino

◯ Feminino

53. **Idade** *
Mark only one oval.

◯ 18 a 21 anos

◯ 22 a 25 anos

◯ 26 a 30 anos

◯ 31 a 40 anos

◯ 41 a 50 anos

◯ 51 a 60 anos

◯ Mais de 60 anos

54. **Nível de escolaridade** *

Mark only one oval.

- ( ) Estudante de Licenciatura
- ( ) Estudante de Mestrado
- ( ) Estudante de CTESP
- ( ) Bacharel
- ( ) Licenciado
- ( ) Pós-graduação
- ( ) Mestrado
- ( ) Doutoramento

55. **É trabalhador-estudante ?** *

Mark only one oval.

- ( ) Sim
- ( ) Não