Cognitive Engagement's Effect on Digital and Distance Learning Outcomes in Higher Education

José Miguel Correia de Araújo Freire

Thesis to obtain the Master of Science Degree in

Information and Enterprise Systems

Supervisor: Prof. Arnaldo Manuel Pinto dos Santos

Examination Committee

Chairperson: Prof. Miguel Leitão Bignolas Mira da Silva

Supervisor: Prof. Arnaldo Manuel Pinto dos Santos

Members of Committee: Prof. Luís Francisco Mendes Gabriel Pedro

October 2021

Abstract

BACKGROUND: The current contexts of collaborative learning and self-learning, inserted in technological environments designed for Digital Learning, allow the achievement of different performances both at the cognitive and operational levels (Ramirez-Arellano et al., 2018).

AIM: To identify cognitive engagement strategies and solutions and to verify the existence of a correlation between these strategies and learning outcomes, in the context of higher education.

METHODOLOGY: This dissertation used the survey methodology. For the experiment, distance learning students were asked to answer a questionnaire and teachers and coordinators were asked to answer a different questionnaire.

RESULTS / FINDINGS: The results from the questionnaires are presented. Correlations between learning strategies and learning outcomes are analyzed. Students' opinion on distance learning and overall engagement in the MISE are also presented. A correlation and association analysis was made between certain questions that were deemed more important to meet the goals of the students' questionnaire.

CONCLUSION: The reasoning behind the research methodology is presented and explained. Conclusions from the state of the art, literature review and results from the questionnaires are taken, in line with the research problem, questions and objectives. Limitations and future work are discussed.

ORIGINALITY / VALUE: Few studies directly analyze the relationship between students' cognitive engagement and learning outcomes, especially in higher education (Gunuc, 2014).

Keywords

Higher Education; Cognitive Engagement; Learning Outcomes; Digital Learning

Resumo

CENÁRIO: Os atuais contextos de aprendizagem colaborativa e autoaprendizagem, inseridos em ambientes tecnológicos voltados para a Aprendizagem Digital, permitem a obtenção de diferentes desempenhos tanto a nível cognitivo como operacional (Ramirez-Arellano et al., 2018).

OBJETIVO: Identificar estratégias e soluções de cativação cognitiva e verificar a existência de uma correlação entre essas estratégias e os resultados de aprendizagem, no contexto do ensino superior.

METODOLOGIA: Esta dissertação utilizou a metodologia de pesquisa e análise estatística (Survey Research). Para a experiência, alunos de ensino à distância foram convidados a responder um questionário e os professores e coordenadores foram convidados a responder um questionário diferente.

RESULTADOS: As respostas dos questionários são apresentadas. Correlações entre as estratégias de aprendizagem e os resultados de aprendizagem são analisados. A opinião dos alunos sobre o ensino à distância e a cativação geral no MISE também são apresentadas. Foi realizada uma análise de correlação e associação entre determinadas questões consideradas mais importantes para atender aos objetivos do questionário.

CONCLUSÃO: É apresentado e explicado o raciocínio que justifica a metodologia de investigação. São retiradas conclusões do estado da arte, revisão da literatura e resultados dos questionários, de acordo com o problema de pesquisa, questões e objetivos. Limitações e trabalho futuro são discutidos.

ORIGINALIDADE / VALOR: Existem poucos estudos que analisam diretamente a relação entre a cativação cognitiva dos alunos e os resultados de aprendizagem dos mesmos, especialmente no ensino superior (Gunuc, 2014).

Palavras-chave

Ensino Superior; Cativação Cognitiva; Resultados de Aprendizagem; Aprendizagem Digital

Index

List of Figures

List of Tables

List of Abbreviations

Abbreviation	Meaning
AOSI	Information Systems Organizational Architecture
ATE	Enterprise Technology Architecture
CG	Management Control
COAO	Conception of Organizational Learning Objects
EE	Economic Engineering
GPW	Web Platforms Management
ICAP	Interactive, Constructive, Active, Passive
ICT	Information and Communication Technologies
IST	Instituto Superior Técnico
LO	Learning Objects
MISE	Master's in Information and Enterprise Systems
ND	Digital Business
PCM	Multimedia Content Production
SISE	Seminar on Information and Enterprise Systems
TICE	Information Technology and Business Communication
UAb	Universidade Aberta
USI	Usability and Information Systems

1 Introduction

1.1 Overview

Digitalization has drastically modified students' daily lives and activities (Anthonysamy et al., 2020). The speed of technological evolution affects the lives of digital students deeply (Anthonysamy et al., 2020). But even though higher education students regularly use these digital devices, contemporary researches reveal that students have trouble with digital learning, due to their lack of self-regulation skills, which results in mediocre performance (Anthonysamy et al., 2020; Anthonysamy et al., 2021). Self-regulated learning strategies can be used to help students learn effectively and efficiently (Anthonysamy et al., 2020).

There is currently an undisputable need for the education sector to adapt to an ever-changing digital environment and to keep up with an aggressively dynamic world (Anthonysamy et al., 2020). With the availability of computers and worldwide communication technologies, teaching no longer has to be centered around teachers (Malecela & Hassan, 2019). Students can become autonomous, taking charge of their learning and opening the window to innovative intervention that cognitively engages students (Malecela & Hassan, 2019).

Student engagement comprises cognitive, emotional and behavioral engagement (Lei et al., 2018). This dissertation will focus mostly on cognitive engagement, even though all three components of student engagement are positively correlated with learning outcomes (Lei et al., 2018). Cognitive engagement of students is one of the more prominent phenomena in current learning strategies that speed up the acquisition of skills necessary in the job market (Robles, 2012, as cited in Malecela & Hassan, 2019; Lee et al., 2018). Most scholars have claimed that student engagement positively forecasts learning outcomes (Gunuc, 2014; Lei et al., 2018; Raza et al., 2019). In education, investigation on instructional practices has centered itself on raising student engagement to obtain its benefits of increased learning, perseverance, and academic success (Barlow & Brown, 2020).

Shukor et al. (2014) state that evaluating students' cognitive engagement is a fruitful way of evaluating the quality of online learning. The quality of online learning reflects a specific standard at which students are cognitively engaged (Shukor et al., 2014). Cognitive engagement is considered, by Solis (2008), a requirement for students' meaningful learning (as cited in Shukor et al., 2014; Galikyan & Admiraal, 2019; Malecela & Hassan, 2019). Learning outcomes are directly affected by cognitive and learning strategies (Chang and Ley, 2006; Mega et al., 2014; Pérez et al., 2012; Pintrich and de Groot, 1990; Weinstein and Mayer, 1983, as cited in Ramirez-Arellano et al., 2018; Galikyan & Admiraal, 2019; Sedaghat et al., 2011). Cognitive engagement has been demonstrated to positively influence student performance, goal orientation and perseverance (Appleton et al., 2006; Meece, Blumenfeld, & Hoyle, 1988, as cited in Barlow & Brown, 2020). Cognitively engaged students are more capable of generating new knowledge and understanding what is being discussed in online forums (Malecela & Hassan, 2019; Shukor et al., 2014). Cognitive engagement is also a good indicator of learning success (Baranova et al., 2019; Lei et al., 2018; Rotgans et al., 2017; Shukor et al., 2014), since students who use cognitive and learning strategies generally have better learning outcomes (Baranova et al., 2019; Bernacki et al., 2012; Ramirez-Arellano et al., 2018; Wu et al., 2020). However, Appleton et al. (2006) found that the correlation between cognitive engagement and academic achievement was weak (as cited in Lei et al., 2018). One recurring result in many studies, though, is that using learning strategies results in better learning outcomes (Green & Miller 1996; Graham & Golan, 1991; Miller, Greene, Montalvo, Ravindran, & Nicholls, 1996, as cited in Sedaghat et al., 2011; Bernacki et al., 2012). This idea highlights the importance of cognitive engagement and self-regulation strategies in learning (Bernacki et al., 2012; Joo et al., 2014), especially in digital learning with less guidance from the teacher (Joo et al., 2014; Rienties et al., 2019).

Higher education is sometimes criticized for its drop-out and graduation rates (Ramirez-Arellano et al., 2018). Several studies associate low students' engagement with high school drop-out (Terrenghi et al., 2019). Blended (partly digital environment, where face-to-face classes are bolstered by offline and/or online activities performed via computers (Anthonysamy et al., 2020)) and online learning have been cited as two potential solutions for these issues, because of their flexibility (Ramirez-Arellano et al., 2018). The easier, simpler and supportive alternatives to complete a course have become the alluring, engaging and vital platform to succeed in the academic and professional world (Rennie and Morrison, 2012, as cited in Chakraborty & Muyia Nafukho, 2014). Instructors and learning facilitators see the relevance of creating and delivering engaging online courses and, therefore, endeavor to get learners' attention and interests in online class settings (Chakraborty & Muyia Nafukho, 2014). Instructors and students must continuously strive to be creative and innovative in their teaching and learning, respectively (Chakraborty & Muyia Nafukho, 2014).

1.2 Research problem, questions and purpose statement

The current contexts of collaborative learning and self-learning, inserted in technological environments designed for Digital Learning, allow the achievement of different performances both at the cognitive and operational levels (Ramirez-Arellano et al., 2018).

This research study has, as its main objectives, **the identification of cognitive engagement strategies and solutions and to verify the existence of a correlation between these strategies and learning outcomes, in higher education.** In this context, the following research questions were identified:

1) *What are the main cognitive engagement strategies for higher education contexts?*
2) *What technological environments are available for applying cognitive engagement solutions?*
3) *What correlation exists between the proposed strategies and learning outcomes, in digital learning environments?*

1.3 Summarized Methodology

This dissertation used the survey methodology, which is used to describe specific aspects of a population quantitatively. Surveys can acquire data from large population samples and are particularly suited to gathering demographic data. Surveys don't need big investments to be created and carried out (Glasow, 2005).

However, surveys are also subject to biases, from lack of response to the nature and accuracy of the answers received (Bell 1996, as cited in Glasow, 2005). Respondents might also find it difficult to evaluate their behavior or recall circumstances wrongly.

Designing a survey involves two steps (Levy and Lemeshow, 1999, as cited in Glasow, 2005):

1) Develop Sampling Plan;

2) Create procedures to get population estimates from the data and to appraise the reliability of said estimates.

The choosing of the sample depends on size of the population, homogeneity, the media and its usage cost, and the necessary precision level (Salant & Dillman, 1994, as cited in Glasow, 2005).

Salant and Dillman (1994) stated that the researcher must guarantee that the amount of distributed surveys is enough to permit non-responses and unusable ones (as cited in Glasow, 2005).

2 State of the Art

2.1 Digital Learning

Digital learning is a broad subject that encompasses many sub-types of learning. However, it can be defined as any learning style that effectively utilizes technology to provide knowledge to its students (Anthonysamy et al., 2020). Digital learning and teaching's foundations are the accessibility and utilization of this content, including online information resources (Shalev-Shwartz, 2011).

Interactions in these environments can be synchronous or asynchronous, between student and teacher, among students and between students and the learning content. High-quality interactions will create a stable learning environment. Students' cognitive engagement in an online environment is measured by the quality and quantity of their participation in asynchronous online discussions (Oh & Kim, 2016). Adequate technology and educational strategies should be chosen considering the students' needs (Choudhury and Pattnaik, 2020). Choudhury and Pattnaik (2020) explain that the biggest drivers of digital learning are:

1) User's Acceptance of Technology;
2) The User's Personal and Environmental Factors;
3) Learner's Intention.

According to Norris and Lefrere (2011), the big advantages of digital learning innovations is the overall cost-reduction to students and HEI (transportation and opportunity costs, facility costs, and so on…) and scalability. Flexibility, ease of learning customization and no socioeconomic barriers are also key benefits of digital learning and faster training, more control over the learning process and no socioeconomic barriers are described as major factors in attracting students to digital platforms (Anthonysamy et al., 2020; Anthonysamy et al., 2021; Choudhury and Pattnaik, 2020; Jensen, 2019). Digital learning provides collaboration and content access beyond the classroom with customized and engaging learning experiences (Anthonysamy et al., 2020).

Some disadvantages are students' skepticism and distaste of distance learning and the blurred barrier between work and home/family life. Initial costs, lack of effective evaluation methods and lack of knowledge of the student's non-verbal language (essential for a teacher to understand how the student's progress is evolving) are also disadvantages for the HEI and the teachers (Choudhury and Pattnaik, 2020).

Additionally, digital learning can simultaneously be highly interactive and isolating, since there are inherent challenges in developing adhesiveness, resulting in low interaction between students (Choudhury and Pattnaik, 2020). Choudhury and Pattnaik (2020) establish the following roles for teachers and HEIs in digital learning:

- Teacher – Proximity with the students. Motivate and guide them. This proximity will lower anxiety and drop-out rates;

- Designer – Dubious, due to immense variability;
- Higher Education Institutions – Guaranteeing the availability of up-to-date and easy to use technology to students, which will result in more effective digital learning.

Anthonysamy et al. (2020) conclude in their study that the acquisition of cognitive skills is needed to succeed in digital learning. Blended learning can support improved cognitive engagement through reflection and critical debate (Garrison & Kanuka, 2004; Nystrand & Gamoran, 1991, as cited in Halverson & Graham, 2019). In blended and online contexts, the use of cognitive strategy and the ability to self-regulate (Pintrich & DeGroot, 1990; Sun & Rueda, 2012, as cited in Halverson & Graham, 2019) are particularly important. Winne and Hadwin (1998) describe self-regulated learning as a sequential phenomenon, where learners start by defining the activity, choose objectives to achieve and plan their studies in accordance, put the plan into action and monitor their learning progress, relating it to their objectives and contrasting it with a set of internal standards (as cited in Bernacki et al., 2012).

Blended learning can branch out the learning pathways available to accomplish tasks. This increased flexibility and customization incites curiosity, absorption, and attention (Esteban-Millat et al., 2014, as cited in Halverson & Graham, 2019). At the same time, customization and flexibility can require students to put forth a greater effort and cognitive strategy use (Halverson & Graham, 2019). Anthonysamy et al. (2020) state that success in a blended learning environment depends on the students' mastery and control of digital learning methods.

As more higher education institutions assimilate new technologies into their learning environments to improve their students' learning, it becomes progressively more important to have a propound grasp of their results on student's learning outcomes (Blasco-Arcas et al., 2013) and to advocate for shared knowledge creation methods and the creation of learning systems that enable meaningful engagement and interactions (Galikyan & Admiraal, 2019). Collaborative knowledge creation drives students to critical thinking and enhanced learning gains (Brindley, Walti, & Blaschke, 2014, as cited in Galikyan & Admiraal, 2019).

2.2 Cognitive Engagement

Rotgans and Schmidt (2011) define cognitive engagement as the length to which learners are willing and capable of tackling the learning assignment at hand, including how long they will persist (Richardson & Newby, 2006; Walker et al., 2006, as cited in Rotgans & Schmidt, 2011; Lee et al., 2018). Cognitive engagement happens when students put an effort into getting involved with the learning material (Shukor et al., 2014). Cognitive engagement is put to use by integrating and using students' motivations and strategies in their learning (Richardson & Newby, 2006).

Cognitive engagement focuses on students' psychological investment in academic tasks, the mental process of gaining knowledge (through thinking, experiencing and using the senses) and self-regulation strategies students use in their learning (Fredricks et al., 2004; Walker, Greene, & Mansell, 2006, as cited in Lei et al., 2018) to understand and master knowledge and skills (Kahu, 2013; Kahu & Nelson, 2018; Lawson & Lawson, 2013; Pintrich, Wolters, & Baxter, 2000, as cited in Xu et al., 2020). Cognitive engagement is affected by interactions and teaching strategies (Blumenfeld, Puro, & Mergendoller, 1992, as cited in Joo et al., 2014).

Okaz (2015) stresses that digital learning develops cognitive engagement in students (as cited in Anthonysamy et al., 2021).

Cognitive engagement consists of four strategies (Anthonysamy et al., 2020):

- Rehearsal – Practicing; Best in simple activities and using memory, instead of the acquisition of new information;
- Elaboration – Capability to link previous knowledge with new information to remember new content;
- Organization – Capability of a student to choose the adequate information and manage their thoughts during the learning process;
- Critical Thinking – Ability to make contents more relevant by summarizing and evaluating them.

Anthonysamy et al. (2020) state that cognitive strategies promote better student engagement online and in different educational environments (Shaw et al., 2019). Anthonysamy et al. (2021) found that students who employed these strategies had improved their learning outcomes.

However, the literature states that out of the four cognitive engagement strategies, a positive relationship was only found between critical thinking strategies and higher education academic outcomes (Broadbent and Poon, 2015; Goradia & Bugarcic, 2017, as cited in Anthonysamy et al., 2021).

The other three cognitive strategies were found to have the lowest empirical evidence and not to be useful to students' learning outcomes in digital learning environments (Broadbent and Poon, 2015; Goradia & Bugarcic, 2017, as cited in Anthonysamy et al., 2021). However, it is important to note that different cognitive strategies will create different learning outcomes in different settings (Greene et al., 2004; Sedaghat et al., 2011).

It's been shown that cognitive strategies can mitigate the effect of boredom (Daniels et al., 2015, as cited in Ramirez-Arellano et al., 2018).

Chen et al. (2010) proposed that if students connect their effort to their success, their self-esteem rises (as cited in Chakraborty & Muyia Nafukho, 2014). Regarding relating external help, for example the teacher's help, and students' self-esteem, Kreps (1997) defended the importance of extrinsic motivation (as cited in Chakraborty & Muyia Nafukho, 2014).

Examples, such as positive feedback, rewards and recognition often produce extrinsic motivation (Chakraborty & Muyia Nafukho, 2014). Motivation plays a critical role in an online class environment (Beffa-Negrini et al., 2002; Palloff and Pratt, 2003, as cited in Chakraborty & Muyia Nafukho, 2014). Motivated students generally have engaging learning experiences viewing and reviewing course content (Chakraborty & Muyia Nafukho, 2014).

Miltiadou and Savenye (2003) claimed that to understand if a student will or will not succeed in an online class environment, keeping score of the students' motivation factors is very important (Chakraborty & Muyia Nafukho, 2014). However, Ramirez-Arellano et al. (2018) claim that motivation has no direct effects on cognitive strategies.

Examples of cognitive strategies that can be used in online classes include: providing information in small blocks, placing relevant information in the center of the screen, explaining why the students receive specific information and having students read (even figures) from left to right (Chakraborty & Muyia Nafukho, 2014). Teachers and creators of online courses need to know how learning strategies, previous experiences and motivation cooperate within online courses.

Cognitive engagement helps them understand how students work and if their past experiences aid their learning (Richardson & Newby, 2006). Cognitive techniques help students with learning problems, but they assist students in creating inner processes (Anthonysamy et al., 2020).

Researchers have also created a sub-category of cognitive engagement called situationally-determined cognitive engagement. This type of cognitive engagement assumes cognitive engagement reacts to the activity at hand (Chlapana 2016; Rotgans and Schmidt 2011; Schmidt et al. 2016, as cited in Rotgans et al., 2017; Barlow & Brown, 2020), meaning it is determined case-by-case and is unique to every situation. Researchers have stated that teachers need to understand the context in which they carry out their strategies. Otherwise, they should expect those strategies to be ineffective (Hutchinson & Huberman, 1994, as cited in Barlow & Brown, 2020).

Lei et al. (2018) found that the correlation between cognitive engagement and learning outcomes was influenced by culture and gender, with Eastern students, and female students having a much higher correlation than their counterparts. Malecela and Hassan (2019) found that academic readiness massively contributed to students' cognitive engagement enhancement, something corroborated by Wu (2021), who stated that a student's past knowledge or cognitive abilities had been a significant forecaster of their performance and help-seeking behaviors.

Students with more self-motivational and self-regulatory abilities, that establish academic goals, appear to be more prone to showing behaviors indicative of cognitive involvement with school-related activities (Chong et al., 2018). Wood and Wood (1999) also found a positive connection between past knowledge and performance in an interactive learning environment (as cited in Wu, 2021).

On the other hand, students with low past knowledge have a performance increase, when they seek help, while students with high past knowledge, who may have better adaptive skills, often looked for help after making errors (Wood & Wood, 1999, as cited in Wu, 2021).

Also, all students had better performances, when they looked for help, except the higher past knowledge students (Wu, 2021). Therefore, past knowledge might also be a critical factor in seeking help and performance in Personalized Learning Environments.

Chi and Wylie (2014) created a framework, with the goals of understanding how cognitive engagement can improve students' learning of complex subject matters and to empower teachers to evaluate their students' cognitive engagement as one of four possible levels, being (in descending order): Interactive, constructive, active, or passive (ICAP).

The ICAP framework hypothesizes that as students become more engaged with the learning content, their learning improves. Students' cognitive engagement is defined as passive, when they are oriented toward the educational content without doing much else to improve their learning (Chi & Wylie, 2014). Chi and Wylie (2014) describe cognitive engagement as active, when some form of motoric action is taken; constructive, when students create extra externalized outputs, beyond what was given in the learning content; and interactive, when dialogues produce mainly constructive outputs from both sides and when there is an acceptable amount of turn-taking. Different learning outcomes can be attained for activities within the same engagement level (Chi & Wylie, 2014).

This might be explained by the fact that some tasks are more cognitively demanding than others (Chi & Wylie, 2014). The ICAP framework implies that better learning outcomes are correlated with more cognitive engagement (Wylie & Chi, 2014, as cited in Wu et al., 2020). The ICAP framework hypothesis has been verified through many classroom and laboratory studies (Chi & Wylie, 2014).

2.3 Cognitive Engagement in Technological Environments

Cognitive engagement is essential in any learning environment (Malecela & Hassan, 2019). It has a massive role in the learning progression of students (Anthonysamy et al., 2020). In traditional classrooms where cognitive strategies are employed, the teacher is vital in connecting students to the learning content or capability to be attained (Anthonysamy et al., 2020).

Researchers have shown that instructional practices (the structure of courses, exams, lectures and student interactions) often play a central role in influencing student engagement (Nicol & Macfarlane-Dick, 2006; Prince, 2004; Wang, Yang, Wen, Koedinger, & Rosé, 2015, as cited in Barlow & Brown, 2020). However, in a digital learning environment, the students take charge of that role and manage their learning progression (Anthonysamy et al., 2020). So, using ineffective cognitive processes will lead to learning difficulties (Anthonysamy et al., 2020).

Chen et al. (2010) claim that using the right technology helps improve students' perceived learning outcomes (as cited in Chakraborty & Muyia Nafukho, 2014). Examples include using digital learning features and opening doors for journaling, including prompts to record study time and reflection exercises (Anthonysamy et al., 2020).

Aslanian and Clinefelter (2012) concede, optimistically, that with adequate technology and communication tools usage, an online class may be more engaging than a traditional class (as cited in Chakraborty & Muyia Nafukho, 2014). However, research suggests that the excitement caused by educational innovations, such as using tablets or computers in school, dims over time (Cumming and Rodriguez 2013, as cited in Rotgans et al., 2017).

Shukor et al. (2014) found in their study that, for students' online cognitive engagement, sharing information and posting high-level messages are two significant variables. However, online discussion in itself doesn't automatically give students meaningful learning experiences (Darabi & Jin, 2013; Dennen & Wieland, 2007; Garrison, Anderson, & Archer, 2001, as cited in Oh & Kim, 2016). Without proper design and facilitation, students might not engage in productive discussions, which will trouble their learning of the course material and their critical thinking skills development (Dennen & Wieland, 2007, as cited in Oh & Kim, 2016).

The myriad of results in online cognitive engagement and problems such as students being at the lower degree of cognitive engagement have brought up the need to assess cognitive engagement, particularly in online learning contexts to a greater extent (Shukor et al., 2014).

Cognitive engagement has traditionally been operationalized by measuring students' homework completion, extra-curricular activities participation, attendance in class, and general interactions with teachers and peers (Appleton et al. 2006, as cited in Rotgans et al., 2017). Assuming that cognitive engagement can change with time, due to the activities a student does, it isn't enough to measure cognitive engagement just one time (Rotgans et al., 2017). In an ideal world, students would be constantly monitored for their engagement levels throughout an entire learning event (Rotgans et al., 2017).

Macfadyen and Dawson (2010) discovered that the online learning variables capable of predicting students' better future performance in tests, using a predictive model, are the number of discussion messages posted, finished assessments and mail messages sent (as cited in Shukor et al., 2014). Hung and Zhang (2008) discovered that students who got final grades of over 80% had high variables, such as frequency of course materials access and several bulletin board messages read (as cited in Shukor et al., 2014).

Hung and Zhang (2008) also discovered that log-in frequency and the number of messages read and posted anticipated students' future performance (as cited in Shukor et al., 2014). Richardson and Newby (2006) found that as students become experienced with online learning, they take more responsibility for their learning.

There are four types of interactions that require student engagement in online courses (Abrami et al., 2011; Angelino et al., 2007; Chen, 2007, as cited in Chakraborty & Muyia Nafukho, 2014), namely:

- Student – Student interactions;
- Student – Faculty interactions;
- Student – Technology interactions;
- Student – Content interactions.

These interactions are vital to determine students' engagement in online courses and to engage them (Chakraborty & Muyia Nafukho, 2014; Joo et al., 2014). Vrasidas and McIsaac (1999) stress the need for online facilitators to observe the occurrences and results of these interactions when creating and delivering online classes (as cited in Chakraborty & Muyia Nafukho, 2014). As argued in prior studies, Oh and Kim (2016) suggest that it is essential to sophisticate the structure and design of online discussion to evolve from the traditional open-ended questions. Cognitive engagement and interactions in online discussions are key to creating new knowledge (Zhu, 2006).

A qualitative case study conducted by Boling et al. (2012) disclosed that text-based learning and disconnections in class are barriers to the creation of engaging online classes (Chakraborty & Muyia Nafukho, 2014). On the opposite side, real-world-related and practical projects and social interaction foster the creation of effective online classes (Chakraborty & Muyia Nafukho, 2014). Creating a learning community, providing customized experiences to students, designing courses using adequate technology and having a supportive community (for both students and faculties) to learn from each other are very important (Chakraborty & Muyia Nafukho, 2014).

An example where high levels of cognitive engagement were found in students was in Team-based Learning. Rotgans et al. (2017) researched in a team-based learning environment to see how cognitive engagement fluctuated during a session and how it predicted learning outcomes.

They found that cognitive engagement was medium to high during the various team-based learning activities, which attributes credibility to the idea that team-based learning does foster cognitive engagement in students.

However, cognitive engagement measurements for 1st-year students were substantially higher than those of 2nd-year students. This implies that team-based learning might be more engaging for students who are new to it (Rotgans et al., 2017).

There was also a statistically significant variation in cognitive engagement throughout the day, suggesting that cognitive engagement is sensitive to different educational activities (Rotgans et al., 2017), as was theorized in situationally-determined cognitive engagement. In addition, Rotgans et al., (2017) found evidences in their data that suggested students are substantially more cognitively engaged when working with peers in small groups, since cognitive engagement levels were consistently higher during these activities.

In-class activities where the teacher had the lead, cognitive engagement levels were consistently lower. This is backed by research suggesting that cognitive engagement is positively affected by being autonomous from the direct influence of the teacher and being in charge of one's learning (Appleton et al. 2006; Assor et al. 2002; Greene et al. 2004; Rotgans and Schmidt 2011, as cited in Rotgans et al., 2017), which eventually leads to a deeper understanding of the subject (Rotgans & Schmidt, 2011).

In their research, Rotgans et al. (2017) concluded that sustained cognitive engagement causes substantial knowledge gains in team-based learning.

Like in team-based learning, in the problem-based learning classroom, being autonomous from the direct intervention of a teacher and being in charge of one's learning is also supposed to result in higher cognitive engagement with the learning subject, which eventually leads to a higher understanding of it (Fatima et al., 2019; Rotgans & Schmidt, 2011).

For example, working in groups and discussing, browsing information online and being in a lecture are all likely to develop different levels of cognitive engagement, due to different levels of autonomy (Rotgans & Schmidt, 2011). Out of these three examples, listening to a lecture is debatably the least cognitively engaging, because the student has little to no autonomy (Rotgans & Schmidt, 2011).

Nevertheless, when students independently search for information online, meaning they engage in self-started information-seeking, they have more autonomy, which creates more cognitive engagement (Rotgans & Schmidt, 2011). Working in groups and discussing has an unclear level of autonomy, because of the dynamic of the group (Rotgans & Schmidt, 2011).

If there are domineering colleagues in the group, submissive students may feel less autonomy and engage less cognitively, than groups with members that work well together (Rotgans & Schmidt, 2011). This suggests that autonomy is innately linked to the activity and has a determinant role in students' cognitive engagement (Rotgans & Schmidt, 2011).

Consequently, if the activity's parameters change during the learning event, as is the case in problem-based learning, it is expectable that students perceive different levels of autonomy and, as a consequence, engage differently (Rotgans & Schmidt, 2011). For example, in problem-based learning, during the beginning phase of problem definition, students work in teams, while the teacher guides them (Rotgans & Schmidt, 2011). During this phase, students' autonomy is low (Rotgans & Schmidt, 2011).

Afterwards, however, students study independently, meaning the autonomy increases, meaning they are more cognitively engaged (Rotgans & Schmidt, 2011). After this, students assemble and share their results, resulting in lower autonomy and cognitive engagement (Rotgans & Schmidt, 2011). It is important to note that evidence suggests that problem-based learning hasn't been able to cognitively engage millennials (Fatima et al., 2019). A massive problem identified in the literature is the lack of authentic, real-life challenges that peak students' interest and help attain a deeper knowledge of the processes surrounding the problem (Fatima et al., 2019).

Rotgans and Schmidt (2011) found that if students are cognitively engaged during the earlier stages, they are likely to be engaged during the next stages. They also found that students' cognitive engagement increases substantially and consistently throughout the day. Autonomy seems to depend on the knowledge students gain during their learning, though (Rotgans & Schmidt, 2011).

Another study where the cognitive engagement of students increased was performed by Utama et al. (2020). In this study, medical students joined an ocular trauma flipped-classroom Facebook group and cognitive engagement changes were measured (Utama et al., 2020). The study found that all students' cognitive engagement variables rose substantially after joining the group. This was especially true for active users, whose knowledge increased more than passive users. Self-efficacy and self-management increased the most.

Therefore, a Facebook group can improve students' cognitive engagement with the flipped-classroom method and user-friendly features and interfaces can improve teacher – student interactions (Utama et al., 2020). Teachers can also use a feature known as Insight, which is a data analyzer in a Facebook group, to monitor the group's activity (Utama et al., 2020).

Lin et al. (2017) found that the flipped-classroom provides opportunities for students to gain basic cognitive abilities before classes are held, so the time in the classroom can be spent developing higher cognitive abilities, for example, applying, analyzing, evaluating and creating (as cited in Utama et al., 2020). This method allows for more freedom and flexibility in the learning process, highly bolsters teamwork skills, material retention and, most crucial, stimulates student curiosity in the content and learning process (as cited in Utama et al., 2020).

In this study, all four research hypotheses were accepted, students' knowledge about ocular trauma emergencies, their motivation to study and their self-directed learning readiness all had a significant increase and significant increase in all students' cognitive engagement variables was attained after joining a closed Facebook group which moderated to support ocular trauma in a flipped-classroom.

In their study, Xu et al. (2020) found that students with teacher facilitation showed significantly higher cognitive engagement than those without it. In their study, when teachers became facilitators in WeChat-based online group learning (WeChat is a multi-purpose messaging, social media and mobile payment app), students raised their cognitive engagement, which is consistent with past findings.

Teacher facilitation was shown to stimulate student interaction, which, in turn, had a solid connection with learning outcomes (Xu et al., 2020). Also, when teachers asked the student to clarify their positions, they had to cognitively process it and give their ideas (Xu et al., 2020), meaning that, students had to think, instead of just copy and pasting information they found online, which massively raised their cognitive engagement (Xu et al., 2020).

Teacher support has been proven to be an extra and independent contributor to cognitive engagement (Chong et al., 2018), which suggests that it is possible for support from one place to compensate for the lack of support from another (family, peers, etc…) (Wang & Eccles, 2012; Wentzel, 2016, as cited in Chong et al., 2018). Teacher support for student learning can interrupt a process where students begin to show disengaged behaviors and is an asset for those experiencing setbacks with their learning (Chong et al., 2018).

3 Literature Review

3.1 Introduction

How one carries out a review is key (Zawacki-Richter et al., 2020). The more this methodology is used to advise policy and decision-making, the more attention is given to methodological and circumstantial restraints of research evidence that studies contribute (Zawacki-Richter et al., 2020).

Literature reviews can aid in addressing these issues when carried out in a meticulous, clear, accountable and systematic way, which once more emphasizes the relevance of how reviews are conducted (Zawacki-Richter et al., 2020). The reasoning for systematic literature reviews is that literature reviews are a way of conducting research and can thus be enhanced by using suitable and unambiguous procedures (Zawacki-Richter et al., 2020). The practice of procedures of systematic literature reviews in and to specific research questions, has created many types of systematic literature review conductions (Zawacki-Richter et al., 2020).

Thus, the concept "systematic literature review" refers to a body of investigation methodologies, that researches secondary data and assembles primary research findings to answer a research question (Zawacki-Richter et al., 2020). Gunuc (2014) points out that, while some research has found positive relationships between student engagement and learning outcomes, few studies directly analyze the relationships between student engagement's dimensions (cognitive, behavioral and emotional) and learning outcomes, especially in higher education.

3.2 Data Collection

As for the literature review, as was previously stated, it followed the principles of the book Systematic Reviews in Educational Research – Methodology, Perspectives and Application by Zawacki-Richter et al. (2020). The following sources were used to do this review: 13 articles from Q1 journals, 2 articles from journals with an unassigned quartile, 3 articles whose journals weren't in the Scimago Journal & Country Rank database and 1 book. Three databases were used, B-On, SCOPUS and GOOGLE Scholar.

When searching on SCOPUS, the following steps were taken:

1) Search Field –> Article Title, Abstract, Keywords – Digital Learning, Cognitive Engagement, Learning Outcomes
2) Date Range – 2000-Present
3) Added to SCOPUS – Anytime

This search yielded 59 results; thus, a fourth step was taken to shorten the list, which was as follows:

4) Refine Results –> Document Type – Article

This extra step lowered the number of results to 34 and produced the final query string, which was the following:

TITLE-ABS-KEY (digital AND learning, AND cognitive AND engagement, AND learning AND outcomes) AND PUBYEAR > 1999 AND (LIMIT-TO (DOCTYPE , "ar"))

The 34 articles were superficially read and the list was shortened based on if they mentioned, at least two of the following keywords:

Keywords – Cognitive Engagement; Cognitive Strategies; Digital Learning; Higher Education; Learning Performance; Learning Outcomes; Learning Strategies; Student Engagement.

In the end, 4 articles from the SCOPUS database were used.

When searching on B-On, the following steps were taken:

1) Search Terms –> Cognitive Engagement Strategies (Field – Abstract); AND Learning Performance (Field – Abstract)
2) Advanced Search –> Search Options –> Choose a discipline to search –> Disciplines – Business & Management; Computer Science; Education; Information Technology; Library & Information Science; Social Sciences & Humanities; Technology
3) Advanced Search –> Search Options –> Search Modes and Expanders –> Track all my keywords – Also search within the full text of the articles; Apply equivalent subjects
4) Advanced Search –> Search Options –> Limit your results – Full Text; Peer Reviewed; Available in Library Collection; Date Published (January, 2000 – December, 2021); Language (English)
5) Search

This search yielded 50 results; thus, a sixth step was taken to shorten the list, which was as follows:

6) Refine Results –> Types of Sources (Academic Journals, which reduced the list to 48); Subject (higher education; academic achievement; learning; learning strategies; educational technology; education; learner engagement; blended learning; teaching methods; college students; outcomes of education; undergraduate students; computer assisted instruction; active learning; learning analytics; learning outcomes; learning processes.)

After selecting the type of sources (Academic Journals), the list was reduced to 48 results. This list was shortened, for the final time, and after selecting the subjects, the results list was down to 26. The 26 articles were superficially read and the list was shortened based on if they mentioned, at least two of the same keywords mentioned in the SCOPUS search. In the end, 9 articles from the B-On database were used.

Finally, when searching on GOOGLE Scholar, the advanced search prompt was clicked and the data depicted in the following image was input:

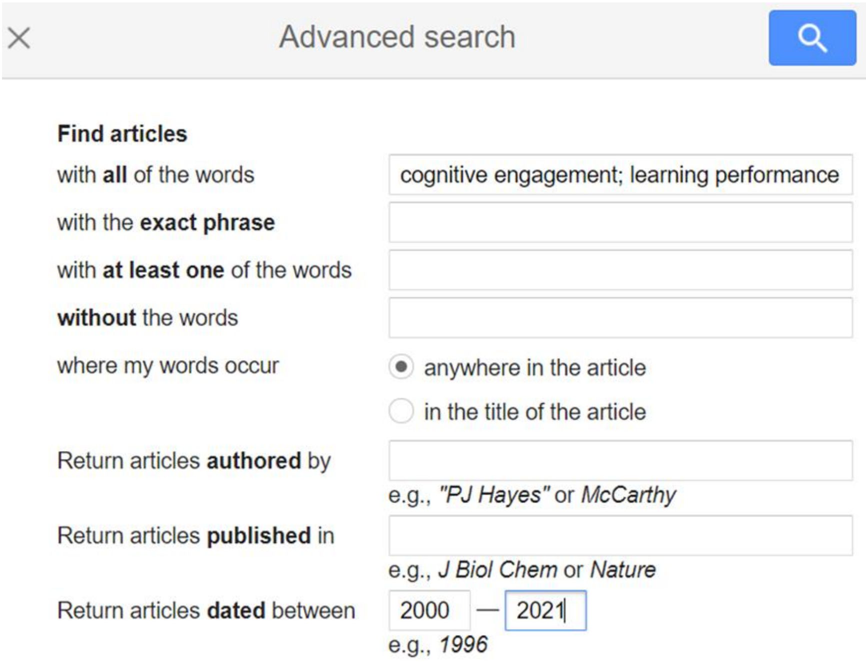

Figure 1: GOOGLE Scholar Advanced Search Menu

This search yielded 1,480,000 results. Because it is impossible to quickly superficially read all these articles, 10 articles were selected, based on if their title seemed in line with what was being researched, those articles were superficially read and the list was shortened based on if they mentioned, at least two of the same keywords mentioned in the SCOPUS search. In the end, 5 articles from the GOOGLE Scholar database were used.

YEAR	PUBLICATIONS (*N*)	PERCENTAGE (%)
2004	1	5.55
2006	1	5.55
2011	2	11.11
2013	1	5.55
2014	2	11.11
2017	1	5.55
2018	1	5.55
2019	5	27.77
2020	3	16.66
2021	1	5.55
TOTAL	18	100

Table 1: Number of publications per year

3.3 Content Analysis

Gunuc (2014) found in his study that there was a powerful, positive connection between cognitive engagement and learning outcomes. Sedaghat et al. (2011)'s research found a positive, direct relationship between cognitive engagement strategies and learning outcomes.

Greene et al. (2004) found that more complex strategies, like trying to connect new information with existing information, result in better learning outcomes, instead of simple strategies, like underlining or re-reading new information. When students' experience high cognitive engagement, they become more inclined to use learning strategies, that they develop through the learning process, in the future (Schunk, 1991, as cited in Joo et al., 2014).

Anthonysamy et al. (2021) found that organization strategies (e.g., concept mapping, creating graphics) allowed students to structure learning content visually, which helped them remember and understand information. Elaboration strategies (e.g., paraphrasing online content, taking notes) were necessary for digital learning, as they required deeper information processing (Anthonysamy et al., 2021). It was referred that when students learned something digitally, they linked the information to what they already knew, which was shown to improve student engagement (Anthonysamy et al., 2021).

Besides, using rehearsal strategies (e.g., repeatedly watching a film to recall and understand the content, repeatedly using software to improve the skill in utilizing said software) can lead students to have better learning outcomes (Anthonysamy et al., 2021). When students attentively study content and reflect on it to make rational judgements, they use critical thinking (Anthonysamy et al., 2021).

Results from the study conducted by Anthonysamy et al. (2021) showed that higher education students used these cognitive engagement strategies and that they positively related to better learning outcomes in their digital learning.

Galikyan and Admiraal's (2019) research into engagement in asynchronous discussions online detected a statistically significant relationships between cognitive engagement and the final mark of the course. In agreement with current literature, the results indicate that online discussion forums help maintain the momentum of a conversation and broadening its focus, which will stimulate reflection outside the classroom (Galikyan & Admiraal, 2019). Promoting student interactions and participation in online discussion forums through thought-provoking student discussions and dialogue may lead to higher-performing learning networks. The interactions create knowledge, which is linked with better learning outcomes (Galikyan & Admiraal, 2019). This validates the essential role of collaborative tasks in knowledge creation, theorized by past researches (Garrison & Cleveland-Innes, 2005; Schrire, 2006) (Galikyan & Admiraal, 2019). Practical implications of their research include (Galikyan & Admiraal, 2019):

1) Student inputs to online forums can depict cognitive engagement and supply teachers with proof related to the level of cognitive engagement with course content. This wisdom is essential for course creators to design courses that use traits of text-based communication that promote critical thinking.
2) The results imply that social presence mediates the relationship between cognitive presence and learning outcomes. This indicates that higher education institutions should endeavor to promote interaction and participation among students and to instruct them.

Galikyan and Admiraal (2019) conclude that online asynchronous discussion boards can be a useful tool to analyze students' cognitive engagement with the learning process. Zhu (2006) found that a lack of guidance and scaffolding decrease cognitive engagement in online asynchronous discussions. Students' past knowledge of the subject at hand may also affect cognitive engagement levels (Zhu, 2006). The teacher's presence in an online discussion was another possible determinant that can influence types of interaction and cognitive engagement levels (Zhu, 2006).

When a teacher is absent from a discussion or marginally participates, the messages tend to be informative and explanatory. However, if the teacher very actively participates, they may repress the dialogue (Zhu, 2006). The teacher has to find a balance that leads their students to higher levels of cognitive engagement (Zhu, 2006). It is important to note that there are many types of interactions in online forums, that can create different levels of cognitive engagement (Zhu, 2006).

Variables that can influence online interactions and cognitive engagement include the teacher's presence, expectations, class size, gender, academic maturity and so on… (Zhu, 2006). Teachers should know this and use these variables, and others, to nurture interaction and cognitive engagement, which may, consequently, improve student learning and outcomes (Zhu, 2006).

Joo et al. (2014) found that continuous course design modifications positively affected students' cognitive engagement and learning outcomes in open and distance higher education environments.

Students tend to be the most engaged during the evaluation periods of the learning process, this introduces an opportunity for teachers and higher education institutions to improve learning outcomes (Shaw et al., 2019). Online cognitive assessment tools usually mix many cognitive strategies within an evaluation to improve learning.

Online cognitive assessment tools have advantages for teachers and students. However, becoming proficient with these online tools and platforms can be hard and time-consuming (Shaw et al., 2019). This disadvantage also applies to students, especially those with no experience using online cognitive assessment tools, which will increase the anxiety of taking exams (Özden, Ertürk, & Sanli, 2004, as cited in Shaw et al., 2019).

Online cognitive assessment tools can be useful, due to their flexibility in timeframes and places the student prefers (Shaw et al., 2019). This flexibility can also reduce stress (Shaw et al., 2019). These tools allow teachers to quickly deliver complete feedback to students, enabling students to self-regulate more effectively (Miller, 2009, as cited in Shaw et al., 2019).

In their study, Shaw et al. (2019) found that students have to engage with the cognitive learning features of the online cognitive assessment tools to perfect their learning processes. However, the cognitive learning features are only a plus when students take the time to master and use them to perfect their learning processes (Shaw et al., 2019). Also, if students use cognitive strategies, they are more likely to become proficient in the learning content (Shaw et al., 2019).

For example, Smith (2007) discovered that students who regularly read feedback on their midterm evaluations outperformed their peers who didn't read them on the summative evaluation (as cited in Shaw et al., 2019). Shaw et al. (2019) advise higher education institutions and teachers to educate their students on cognitive strategies and on online cognitive assessment tools as a studying tool.

As it pertains to the flipped classroom model, it has been shown to have the ability to improve teaching practices and students' learning outcomes and motivation (Kostaris et al., 2017). It can also perfect the use of face-to-face classes and provide more engaging learning experiences (Kostaris et al., 2017). The flipped classroom replaces theoretical classes with learning content, so students can study it outside the class.

On a side note, Rienties et al. (2019) found that the way students chose to interact with the learning material appeared to be the key factor in predicting the learning outcomes in a blended learning environment. In a flipped classroom, face-to-face classes are spent mostly on practical classes (Chen et al., 2014, as cited in Kostaris et al., 2017), so they can have more engaging tasks (Kostaris et al., 2017).

Advantages attributed to flipped classroom learning include enhancing learning outcomes and motivation (Kostaris et al., 2017). Kostaris et al. (2017) found that incorporating the flipped classroom model in the learning process significantly boosted students' cognitive learning outcomes. The worst students were discovered to be the group that had the biggest performance improvement (Kostaris et al., 2017). This was credited to the formative feedback and scaffolding during face-to-face classes (Kostaris et al., 2017).

Moreover, the group's motivation massively increased, indicating that students' satisfaction and interest in the course (Information and Communications Technologies) increased. In addition, students could link their interests with the learning process (Kostaris et al., 2017). Regarding student engagement, the research results conducted by Kostaris et al. (2017) indicated that the flipped classroom model had two main advantages: that the students were much more engaged throughout the course and that the worst students had the most learning improvement.

These benefits are attributed to the better, more efficient exploitation of face-to-face classes provided by the flipped classroom model (Kostaris et al., 2017). The flipped classroom enabled the students to focus on competence-building skills and formative feedback provision. Lee et al. (2018) state that, in a flipped classroom environment, engagement should consider the online pre-class learning (pre-class engagement) and the face-to-face learning (in-class engagement).

Lee et al. (2018) found that academic ability affected pre- and in-class engagement in a flipped classroom. Both types of engagement were key predictors of engagement (Lee et al., 2018). The results found that academic ability hugely benefits student engagement, which, in turn, influenced learning outcomes (Lee et al., 2018). Learning outcomes were largely affected by pre-class and, even more, by in-class engagement (Lee et al., 2018).

Students' academic ability was a key determinant for student engagement and learning outcomes, implying that there is a need to consider academic ability when creating a flipped classroom course (Lee et al., 2018). Lee et al. (2018) stress that students' academic ability is a predominant determinant for engagement and learning outcomes and must be considered when creating a flipped classroom course.

Terrenghi et al. (2019) found that flipped classroom appears productive in improving cognitive engagement. Findings reveal that students put more effort and use cognitive strategies to learn more effectively (Terrenghi et al., 2019). Students monitor themselves, while trying to regulate their attention span, finding links between different information, self-evaluating, all of which are effective strategies (Terrenghi et al., 2019).

Findings reveal that teachers' engagement, does not change meaningfully and perceived anxiety increases and self-efficacy belief decreases (Terrenghi et al., 2019). Wu et al. (2020) found proof suggesting that flipped classroom learning can improve learning outcomes.

Anthonysamy et al. (2021) found that students may still favor face-to-face learning for acquiring knowledge, so Blasco-Arcas et al. (2013), who studied the benefits of using clickers in class, suggested their use and they found that their use increased interactivity with other students and teacher, which, in turn, fostered active and collaborative learning and engagement, which, in turn, fostered learning performance of students.

Blasco-Arcas et al. (2013) also observed that student engagement and collaborative learning mediate the effect of interactivity on student learning outcomes. Interactivity with other students and the teacher was also a determinant factor in the student's active and collaborative learning and engagement (Blasco-Arcas et al., 2013).

Blasco-Arcas et al. (2013) stress the importance of active and collaborative learning in improving students' learning experience. It enables students to critically think about the contents of the course and comprehend different answers. This process requires reflecting and reviewing, which, in turn, demands processing the learning content in some amount of depth (Lantz, 2010, as cited in Blasco-Arcas et al., 2013). This leads to deeper processing of knowledge.

As a result, active and collaborative learning is displayed as a crucial factor of engagement and learning outcomes (Blasco-Arcas et al., 2013). Previous studies (e.g., Kauffman, Ge, Xie, & Chen, 2008) suggest that students can self-regulate, but tend to fail to do it. Literature shows that a main predictor of learning outcomes is the ability to manage their learning progression (as cited in Anthonysamy et al., 2020).

Self-regulated learning can be defined as an active process where students master their learning process (Anthonysamy et al., 2020). Self-regulated learning strategies can help students learn more efficiently (Anthonysamy et al., 2020).

These strategies include time management, effort monitoring, and cognitive (engagement) strategies, such as rehearsal, elaboration and organization (Anthonysamy et al., 2020). Many scholars have stated that, if one is to excel and be more efficient and effective in digital learning, one has to learn self-regulation skills (Greene et al., 2018; Kizilcec, Pérez-Sanagustín, and Maldonado, 2017; Phillips et al., 2015, as cited in Anthonysamy et al., 2020).

In addition, past studies have revealed that, without a doubt, students performed better online when using self-regulated learning strategies (Sedigheh, Rashid, & Reza, 2012; Haron et al., 2015, as cited in Anthonysamy et al., 2020).

Previous studies have also stated that self-regulated learning strategies lead to higher student engagement (Pellas, 2014, as cited in Anthonysamy et al., 2020). Haron, Harun, Ali, Salim, & Hussain (2015) find self-regulated learning to be a major predictor of learning outcomes (as cited in Anthonysamy et al., 2020). Moreover, Anthonysamy et al. (2020) recommend that teachers help students develop these skills and make self-regulation a habit by applying self-regulation skills in class.

Self-regulation is a vital skill in very autonomous learning environments (Anthonysamy et al., 2020). Anthonysamy et al. (2020) argue that digital learning problems can be faced by using self-regulated learning strategies.

Galikyan and Admiraal (2019) suggest instructing students on monitoring their cognitive and learning performance and interactions in discussion forums, by using automatic analysis of learner-generated data. Perceived ability, directly and indirectly, affects learning outcomes, which is in line with the researches that study the same link (Sedaghat et al., 2011).

This highlights the relevance of having a good image of one's ability as a student. Perceived ability's role is not only as a predictor of learning outcomes, but also of other motivational factors (Sedaghat et al., 2011). If students learn to self-regulate, they'll gain perceived ability and, consequently, improve their learning outcomes.

Studies in engagement have shown that when workers are cognitively engaged in their work, they are less likely to be distracted by peripheral matters and less likely to be hindered by problems that appear during work (Sonnentag, 2003, as cited in Ho et al., 2009). Due to their focus, they are more likely to surpass obstacles and, thus, achieve more success and are more effective and efficient at work, meaning they show better performance (Ho et al., 2009).

Ho et al. (2009) found cognitive engagement to be the main mediating factor in the relation between passion and work performance.

Ho et al. (2009) suggest that bosses should attempt to nourish their employees' passion for their jobs, by, for example empowering employees to make decisions and be responsible for them and giving unanticipated positive feedback about their work and their contributions to the company (e.g. Vallerand and Houlfort, 2003, as cited in Ho et al., 2009).

3.4 Generic Conclusions

Cognitive Engagement and its strategies positively correlate with learning outcomes (Galikyan & Admiraal, 2019; Gunuc, 2014, Sedaghat et al., 2011). High levels of cognitive engagement in students, make them more inclined to use meaningful strategies in the future, which generally translates to better learning outcomes in their digital learning (Anthonysamy et al., 2021; Joo et al., 2014).

These cognitive skills are essential for learning (Ignacio & Chen, 2020). Literature shows that a main predictor of learning outcomes is the ability to manage learning progression. Therefore, self-regulated learning strategies can help students learn more efficiently (Anthonysamy et al., 2020).

Past studies decisively state that, without a doubt, online students have increased cognitive engagement and better learning outcomes when using self-regulated learning strategies (Sedigheh, Rashid, & Reza, 2012; Haron et al., 2015, as cited in Anthonysamy et al., 2020).

In this context, teachers should help students develop these skills and make self-regulation a habit by applying self-regulation skills in class (Anthonysamy et al., 2020). Self-regulation is a vital skill in very autonomous learning environments (Anthonysamy et al., 2020).

Perceived academic ability and actual academic ability affect cognitive engagement and learning outcomes. If students learn to self-regulate, they'll gain the ability and perceived ability and, consequently, improve their learning outcomes (Lee et al., 2018; Sedaghat et al., 2011).

Current literature indicates that online discussion forums can help maintain the momentum of conversations and broaden their focus, which will stimulate reflection outside the classroom (Galikyan & Admiraal, 2019). This chain of collaborative tasks can lead to higher-performing learning networks, that generate better learning outcomes (Galikyan & Admiraal, 2019).

Course creators should use student inputs to online forums, as a way to evaluate students' cognitive engagement. With that they can continuously design courses and modify them and use the traits of text-based communication that promote critical thinking and positively affect students' cognitive engagement and learning outcomes in open and distance higher education environments (Galikyan & Admiraal, 2019; Joo et al., 2014).

Regarding teachers' presence in online forums, their role is a tricky one. The teacher has to find a balance, where they intervene to increase students' levels of cognitive engagement, but don't over-participate, lest they risk repressing the dialogue (Zhu, 2006).

Teachers also have to be aware that many variables can influence online interactions and cognitive engagement, and teachers should use them to nurture interaction and cognitive engagement. This will, consequently, improve student learning outcomes (Zhu, 2006).

Taking advantage that students tend to be the most engaged during the evaluation periods, online cognitive assessment tools can enhance learning outcomes (Shaw et al., 2019).

However, becoming proficient with these online tools and platforms can be hard and time-consuming for both students and teachers (Shaw et al., 2019).

Therefore, higher education institutions and teachers should educate their students on cognitive strategies and online cognitive assessment tools as a studying tool (Shaw et al., 2019).

The flipped classroom model is another possible way to improve teaching practices, cognitive engagement, learning outcomes, and motivation (Kostaris et al., 2017; Terrenghi et al., 2019; Wu et al., 2020). This model seems to be especially effective in increasing the learning outcomes of the worst students (Kostaris et al., 2017).

4 Methodology

4.1 Introduction

This dissertation used the survey methodology, which is used to answer questions, solve problems, assess needs and set goals, to determine whether or not specific objectives have been met, to establish baselines against which future comparisons can be made, to analyze trends, and generally, to describe what exists, in what amount, and in what context. (Isaac & Michael, 1997, as cited in Glasow, 2005).

According to Kraemer (1991), survey research is used to describe specific aspects of a population quantitatively, which involves studying the relationships between variables. To analyze the population, a sample is selected from which the findings can later be generalized to said population (as cited in Glasow, 2005).

Surveys can acquire data from large population samples and are particularly suited to gathering demographic data. Surveys don't need big investments to be created and carried out (Glasow, 2005).

However, surveys only supply estimates, not exact measurements (Glasow, 2005). Also, surveys are generally unsuitable when an understanding of the historical context is needed. Surveys are also subject to biases, from lack of response to the nature and accuracy of the answers received (Bell 1996, as cited in Glasow, 2005). Respondents might also find it difficult to evaluate their behavior or recall circumstances wrongly.

Designing a survey involves two steps (Levy and Lemeshow, 1999, as cited in Glasow, 2005):

1) Develop Sampling Plan;
2) Create procedures to get population estimates from the data and to appraise the reliability of said estimates.

The sampling plan explains the method used to select the sample, how the appropriate sample size will be determined, and the reasoning behind the choice of the media used to publish the survey (Glasow, 2005). The second step includes identifying the wanted response rate and level of accuracy for the survey (Salant & Dillman, 1994, as cited in Glasow, 2005).

The choosing of the sample depends on size of the population, homogeneity, the media and its usage cost, and the necessary precision level (Salant & Dillman, 1994, as cited in Glasow, 2005). Salant and Dillman (1994) observed that a prerequisite to sample selection is to define the target population as narrowly as possible (as cited in Glasow, 2005).

Determining the size of the sample depends on five factors (Glasow, 2005):

- Desired degree of precision (significance level or confidence interval);

- Statistical power required;
- Ability to gain access to the study subjects;
- Degree to which the population can be layered (according to sector, technology level, etc…);
- Selection of the relevant units of analysis (whether the respondents to a survey will be 2-3 individuals, offices, entire firms, etc…)

Salant and Dillman (1994) stated that the researcher must guarantee that the amount of distributed surveys is enough to permit non-responses and unusable ones (as cited in Glasow, 2005).

4.2 Implementation Strategy

According to the methodology and process previously presented, the data of this investigation was acquired through the state of the art and the literature review (reading of the articles, reports, papers, books and so on…), for the first two research questions (Zawacki-Richter et al., 2020).

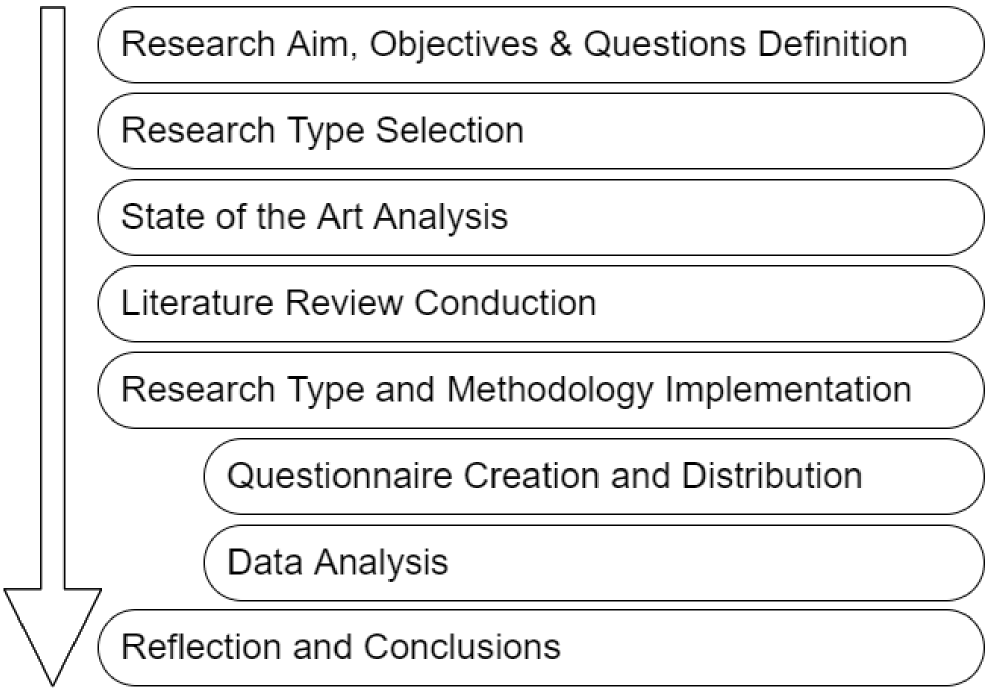

Figure 3: Research Methodology Diagram

To analyze the state of the art, articles were selected taking into account the following list of selection criteria, which was formed, considering the research questions (Zawacki-Richter et al., 2020):

- Article existing in the B-On or SCOPUS database;
- Article written in English;
- Article with peer review;
- Article written in the year 2000 or later;

- Research keywords – Academic Achievement; Cognitive Strategies; Digital Learning; Higher Education; Learning Performance; Learning Strategies; Motivation; Student Engagement; Student-centered Learning.

Articles that explored the aforementioned keywords and their application and the results in learning outcomes were selected. Subsequently, the following questions were asked:

- ✓ Were the first and second research questions answered properly?
- ✓ Does this article help me understand what determines learning outcomes improvement?

The selected articles were then summarized. These summaries were, in turn, read, rewritten and transformed together with the data from the questionnaires and placed in their proper order in the dissertation, omitting any information that was considered unnecessary to add.

In the context of this dissertation, the following sources were used: 1 report, 22 articles from Q1 journals, 5 from Q2 journals, 1 from Q3 journals, 3 articles from journals with an unassigned quartile, 8 articles whose journals weren't in the Scimago Journal & Country Rank database.

This research study used primary data and secondary data. The primary data was collected through the questionnaires. Secondary data was obtained through the state of the art and the literature review. The state of the art and the literature review regarded the first two research questions and helped formulate the structure of the questionnaires.

There is a difference between the keywords used in the state of the art and those used in the literature review. This difference happens because SCOPUS doesn't allow for the same customization of keywords, as B-On does.

4.2.1 Context of the Experiment

For this experiment, **two questionnaires** were conducted. The first one was applied to students of the distance learning online masters MISE (Master's in Information and Enterprise Systems) of Instituto Superior Técnico (IST) and Universidade Aberta (UAb), who attended the courses of TICE (Information Technology and Business Communication) and COAO (Conception of Organizational Learning Objects). These two courses were chosen, so that the questionnaire would tackle a primary course (TICE) and a secondary course (COAO) of the MISE.

As for the second questionnaire, its target group was professors and coordinators of the MISE. Some of these professors were in charge of the TICE and COAO courses.

TICE is a course of the MISE, which, according to its website, aims to "provide students with substantial knowledge about the principles, concepts, models and key technologies of information and communication oriented to business, and those that support and facilitate business activities in companies and organizations in general". By the end of this course, students should be able to:

- Justify the importance of Information and Communication Technologies (ICT) in institutions, in particular those that support business;
- Recognize and categorize the principles, main models and ICT from an architectural global perspective and operation of the institutions;
- Recognize, examine, categorize and assess available enterprise systems and technologies to be explored within institutions;
- Examine technological solutions that are utilized in institutions, recognizing their main functions, characteristics, potential and limitations;
- Develop small enterprises' information and communication systems or applications in real end-user context.

TICE's Program is as follows:

1) Information systems and organizational performance;
2) Concepts of information technologies management;
3) Information systems for business support;
4) Planning of information systems;
5) Development and maintenance of information systems.

As for its assessment methodology, students' assessment is individual and uses both continuous assessment (60%) and final evaluation (40%).

COAO's goal is to research the concept of learning object (LO), as an autonomous learning unit, searchable and reusable in e-learning environments.

The design of LO is developed, considering the educational and technological aspects and object description, storage, indexation and interoperability. Special attention is given to the practical experimentation at organizational knowledge retrieval and their integration as a learning object. By the end of this course, students should be able to:

1) Understand what a LO is;
2) Create a LO in particular knowledge domains in an institutional scope;
3) Create a LO with appropriate authoring tools;
4) Integrate LO in diverse pedagogic and technological settings.

COAO's Program is as follows:

1) Concept of learning object (LO);
2) Pedagogical and technological principles that drive the creation of LO;
3) Reference models: AICC, SCORM;

4) Development of LO using authoring tools;
5) Technology for LO reusability.

As for its assessment methodology, students' assessment is individual and uses both continuous assessment (60%) and final evaluation (40%).

As for the MISE itself, it is distance learning online masters. The MISE covers two curricular years, each one consisting of 60 ECTS. The first year consists of curricular units, with the second year being reserved for some additional curricular units and the preparation of the dissertation work. Training concerning specialized knowledge is supported by optional curricular units that cover the main areas of knowledge considered fundamental for constructing the desired professional profile.

Two introductory curricular units that can be attended in the 1st year. The training of research methodologies skills occurs in a mandatory curricular unit, during the 1st semester of the 2nd year. All curricular units involve a learning effort of 7.5 ECTS each, equivalent to 210 hours of work, of which 40 are for contact with the teacher and the remainder for student work, adopting a student-centered model, typical of distance learning. In both semesters of the 1st year, the student has three compulsory curricular units and chooses one optional curricular unit of 7.5 ECTS, making a total of four curricular units/30 ECTS per semester.

During the 2nd year, the student will prepare, present and defend their dissertation under the guidance of a PhD, who is also a professor of the MISE. By the end of the 1st year of the course, the list of proposals for the dissertation is made available and by the beginning of the 2nd year, each student must have made their choice, either by choosing one of the proposals, or by presenting their own. The student must deliver the dissertation/project work/report plan to the master's secretariat of internship, indicating the supervisor.

The course is equivalent to 120 ECTS corresponding to 75 ECTS to the curricular part and 45 ECTS to the dissertation's preparation, realization, and presentation. IST and UAb award the Postgraduate Specialization Diploma in Information and Business Systems to students who have only passed the curricular part of the Master's Degree.

The Master's degree is held by a Course Letter issued by the legal and statutorily competent body. It is conferred in the field of Business Information and Systems, assuming attendance and approval in the curricular units that make up the Course, or equivalent, the preparation of a dissertation, specially written for the purpose, its defence and approval in public evidence.

MISE is aimed at undergraduates or holders of a 1st cycle degree in any area of knowledge, who wish to develop skills in the area, or update their training. Its main goal is to prepare students with solid basic training and skills in technologies and business systems and in the functioning of organizations to meet the needs of constant technological innovation in companies and organizations in the context of the rapid development of the information and knowledge society.

MISE has the following objectives:

1) Provide a grounded and problematizing knowledge of models, theories and conceptual frameworks that frame the use of information and information and communication technologies and business systems in organizations;
2) Training for autonomous professional performance, developing scientific models and devices, conceptually and methodologically suitable for projects of technological intervention in organizations exploring with rigor and effectiveness innovative solutions for information, knowledge and learning management as well as the application of business systems;
3) Develop methodologies for the exploration, application and evaluation of technologies adjusted to the study of/intervention in scenarios of digital use, exploration and experimentation in an organizational context;
4) Enable the exercise of scientific supervision functions in experimentation/research projects.

MISE's pedagogical model is provided by UAb, (a public distance learning university) and is a model, in which teaching and learning activities take place entirely in an online context, based on communication devices that can integrate several communicational resources, such as current eLearning platforms, but also being able to use other Web 2.0 technologies such as Blogs, Wikis, ePortfolios, among others.

Because of this, the first semester is anticipated by an initial virtual module, which lasts two weeks, designed to accustom students to the virtual context and e-learning tools, allowing them to acquire online and social communication skills necessary to build a virtual learning community. MISE's pedagogical model mainly consists of asynchronous communication, which aims to maximize the degree of flexibility of student participation in the course.

The general educational process consists of weekly/biweekly tasks, where students are given the reading material necessary to attain the knowledge said tasks requires; during that weekly/biweekly period, students read the educational content and post their questions and start educational discussions on an eLearning forum (sometimes teachers start discussions, as well).

These forums are typically where teachers answer students' questions and where students share ideas with each other and the teacher(s). There are also mandatory intensive face-to-face moments, in the form of workshops and seminars for presentation and demonstration of results and complement of learning. When students finish the task at hand, they submit it to the eLearning platform and the teacher evaluates it, giving it a 0-20 grade (where 0 is the minimum grade 20, the maximum one) and sometimes providing feedback. The final grade is defined by the weighted average of the grades the student got in their tasks.

This master's curricular plan is available in Appendix 1.

4.2.2 Questionnaires

The questionnaire surveys were carried out following the principles of the book "Manuel de recherche en science sociales (Portuguese Edition)" by Raymond Quivy and Luc Van Campenhoudt (2008). A questionnaire survey in social sciences aims to verify theoretical hypotheses and analyze suggested correlations (Quivy & Campenhoudt, 2008).

Quivy and Campenhoudt (2008) state that this type of survey is particularly appropriate when analyzing a social phenomenon that can be better understood by acquiring information relating to the individuals of the population in question. Questionnaire surveys allow for the quantification of massive amounts of data and, consequently, numerous correlation analyses (Quivy & Campenhoudt, 2008).

The students' questionnaire aims to identify a correlation between the learning strategies distance learning students use and their learning results, learn their opinion on distance/online learning and compare their perceived effort with their performance and knowledge gained in two courses (TICE and COAO). The teachers' questionnaire aims to understand teachers' views on MISE's students' engagement.

To achieve this goal, the students' target group was established, as students of the MISE, who attended the courses of TICE (Information Technology and Business Communication) and COAO (Conception of Organizational Learning Objects). The teachers' target group consisted of teachers and coordinators of the MISE.

To create the questionnaires, the following methodological steps were taken:

1) Reading the Research Problem, Questions and Objectives;
2) Reading the State of the Art and the Literature Review;
3) Coding of Information into Topics, so as to facilitate analysis;
4) Creation of Questions based on the Topics;
5) Review and Discussion of Questions with Supervisor;
6) Addition of Questions;
7) Review;
8) Placement of Questions in their appropriate Section and Order;
9) Description of Sections to inform the participants on them;
10) Final Review and Discussion of overall Questionnaire with Supervisor;
11) Delivery of Questionnaire to the Participants.

The questionnaire was delivered to respondents, using messaging technologies (Email). The population size consisted of 118 students, of which 43 of them answered the questionnaire, meaning 36% of the students participated in this questionnaire. The population size for the teachers' questionnaire consisted of 13 students, of which 7 of them answered the questionnaire, meaning 54% participated in this questionnaire.

Both questionnaires contributed to answering the third research question.

For the questionnaire sent to students, please see Appendix 2. For the actual questionnaire sent to students, please see Appendix 3.

4.3 Questionnaires' Data Analysis

With the participants' informed consent, the data obtained by the questionnaires was anonymous and kept confidential. This data was analyzed using the IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp, Armonk, NY, USA). The data was coded into categories taking the state of the art and literature review into account (Elo & Kyngäs, 2008).

The information was later read to obtain a general idea of the adapted information, information that was then coded to develop, classify, summarize and describe aspects that were addressed in the dissertation (Creswell, J., & Clark, V., 2020). The findings were subsequently interpreted and validated.

Data was gathered following GDPR's Chapter 2, Article 5. According to GDPR's Chapter 2, Article 6, 1.a), all participants in the questionnaires acquired informed consent (ch.2, art. 7 & 11). When participation was asked, the information pertained to GDPR's Article 13 was given to the potential participants. The data subject's rights (mentioned in ch.3, art. 13 & 15) were maintained throughout the process.

According to the GDPR's Chapter 4, Section 1, Article 30, data processing records were kept as stated in that article. Security of processing and personal data was kept at an appropriate level to the risk (ch.4, section 2, art. 32).

Descriptive statistics were used to examine response variability and missing data. To identify and eliminate items with missing data, an individual descriptive item analysis was performed. A missing-value analysis was performed to verify if it was necessary to remove questionnaires from the data set.

Traditional descriptive methods used demographic characteristics, namely mean and standard deviation for continuous variables and percentages for categorical variables.

Spearman's correlation coefficients (rS) were computed to analyze the relationship between two ordinal items.

Contingency coefficient association was obtained to quantify the association between two nominal items (values between 0.5 and 0.7 reveals a moderate association and higher than 0.7 means a strong association).

A global score was obtained adding the results to the questions 7, 9, 16, 18, 20, 22, 24, 27 and 29 of the student questionnaire, which are in a Likert scale (1=very hard to 5=very easy). This score ranges between 9 to 45, with higher scores meaning higher engagement. Shapiro-Wilk test was used to test for normality adjustment of the global score and one-way ANOVA analyses were conducted to compare more than two independent groups. Multiple testing adjustments were made using the Bonferroni approach.

To compare two independent groups, a t-Test for independent samples was used. Boxplots were used to compare distributions between groups.

The significance level considered was 5%.

5 Results and Discussion

5.1 Students' Questionnaire

5.1.1 Demographic Data

Of the sample size of 43 respondents, 65% are male, 33% of the participants are between 42 and 49 years old (Figure 4), 79% have a full-time job (Figure 5) and 56% have no dependents (Figure 6).

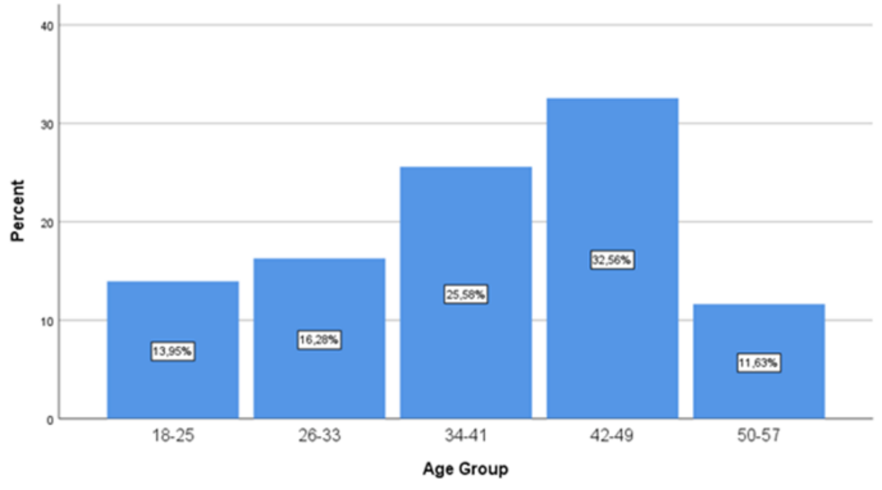

Figure 4: Age Group

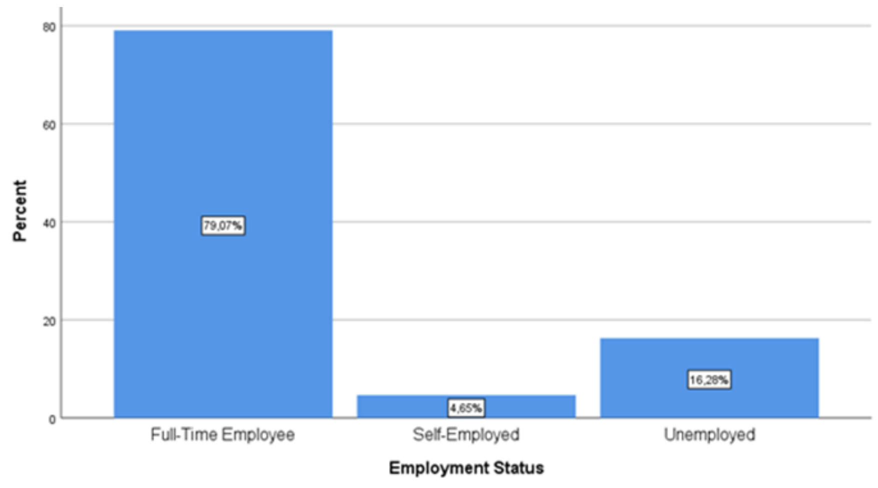

Figure 5: Employment status

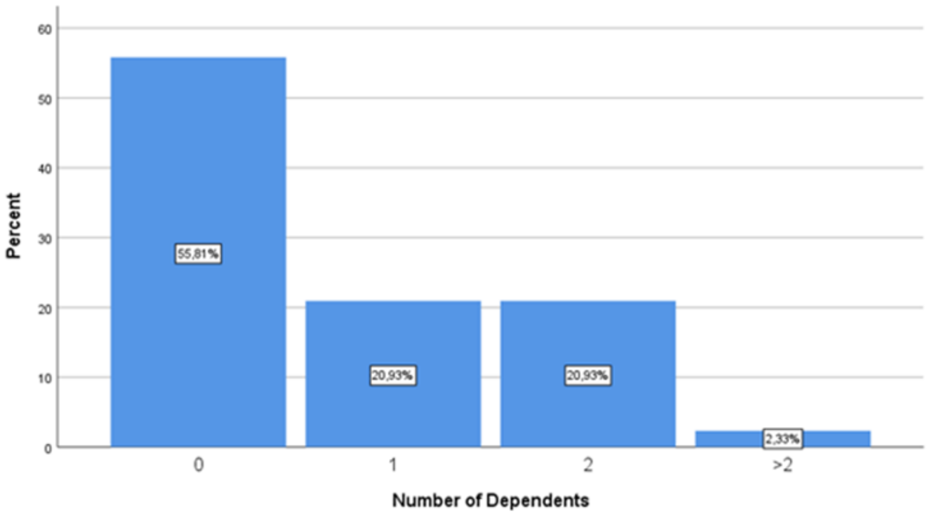

Figure 6: Number of dependents distribution.

The goals of this questionnaire were to:

1) Identify a correlation between the distance learning students' strategies and their learning results;
2) Learn students' opinions on distance/online learning;
3) Compare students' perceived effort with their performance and knowledge gained in two MISE courses (TICE and COAO).

The following section presents the results related to these goals.

5.1.2 Goals

5.1.2.1 Learning Strategies VS Learning Results in the MISE

The learning strategies that students use the most are "Practice via exercises" (81%), "Searching and browsing online" (74%) and "Watching educational videos/lecture videos" (74%). The least used strategies were "Taking notes during classes" (19%) (which makes sense, since there are virtually no classes in the MISE's pedagogical model) and "Organize information for more efficient recall and use" (23%).

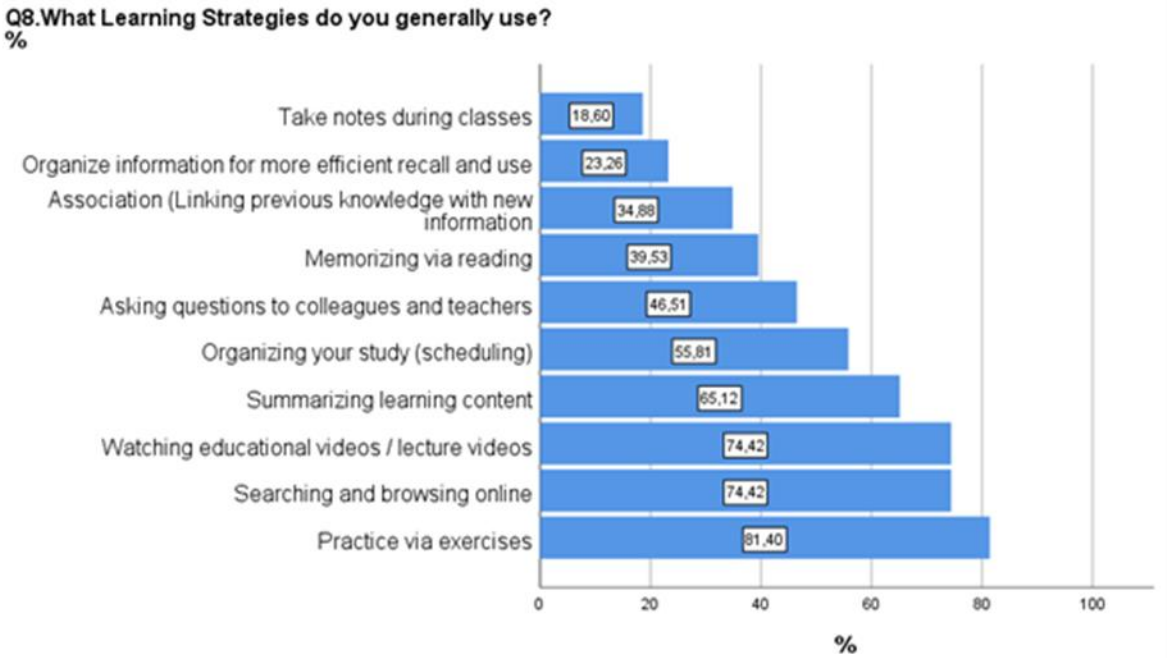

Figure 7: Learning Strategies

Most students attribute their learning results to “Goal orientation” (65%) and “Motivation” (63%), while “Help from the teacher” (9%) appears at the bottom of the list.

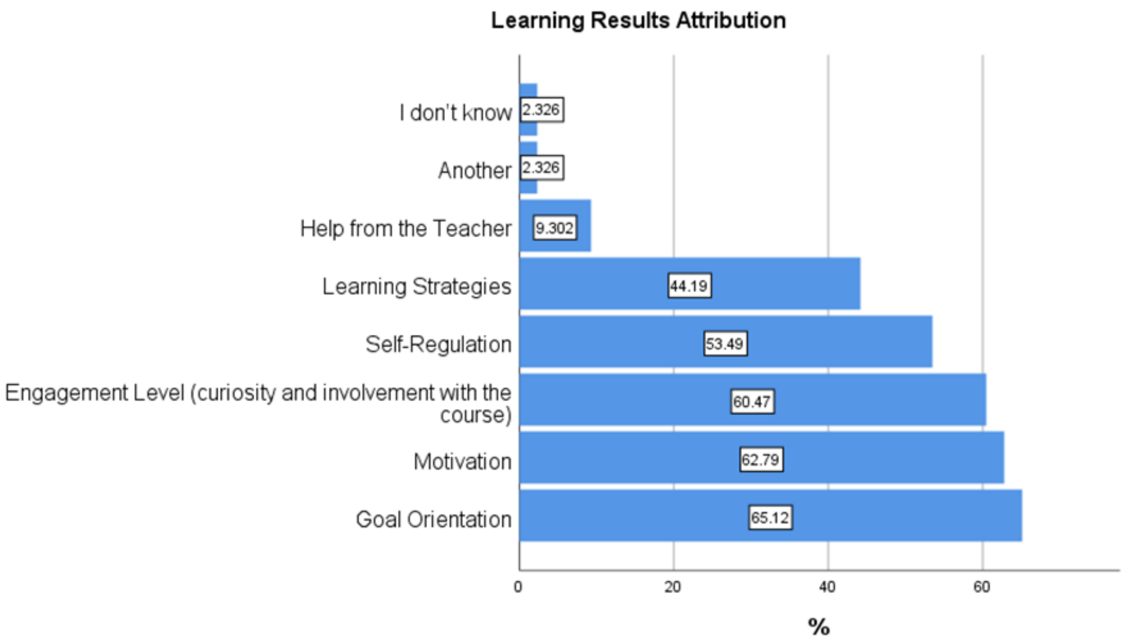

Figure 8: Learning Results Attribution

To identify the association between learning strategies and learning results, a cross-tabulation is shown in table 2, which presents the number and percentage of respondents that chose both a particular learning strategy and a particular learning results attribution. The learning strategies that achieved the highest number of selections were “Practice via exercises”, “Summarizing learning content", "Searching and browsing online". As for the learning results, respondents mostly selected "Self-regulation", "Learning Strategies", "Engagement level", "Goal orientation" and "Motivation".

			Learning Strategies										
			Organizing your study (scheduling)	Practice via exercises	Memorizing via reading	Summarizing learning content	Asking questions to colleagues and teachers	Searching and browsing online	Take notes during classes	Watching educational videos / lecture videos	Association (Linking previous knowledge with new information	Organize information for more efficient recall and use	Total
Learning results attribution	Self-Regulation	Count	16	18	12	17	14	18	3	19	11	8	23
		% of Total	37.2%	41.9%	27.9%	39.5%	32.6%	41.9%	7.0%	44.2%	25.6%	18.6%	53.5%
	Learning Strategies	Count	11	17	9	14	10	18	4	16	8	8	19
		% of Total	25.6%	39.5%	20.9%	32.6%	23.3%	41.9%	9.3%	37.2%	18.6%	18.6%	44.2%
	Engagement Level (curiosity and involvement with the course)	Count	16	21	10	20	13	21	5	22	12	7	26
		% of Total	37.2%	48.8%	23.3%	46.5%	30.2%	48.8%	11.6%	51.2%	27.9%	16.3%	60.5%
	Goal Orientation	Count	18	22	11	20	13	19	6	21	10	6	28
		% of Total	41.9%	51.2%	25.6%	46.5%	30.2%	44.2%	14.0%	48.8%	23.3%	14.0%	65.1%
	Help from the Teacher	Count	2	4	1	2	4	3	1	2	1	1	4
		% of Total	4.7%	9.3%	2.3%	4.7%	9.3%	7.0%	2.3%	4.7%	2.3%	2.3%	9.3%
	Motivation	Count	15	24	12	23	15	20	7	21	15	8	27
		% of Total	34.9%	55.8%	27.9%	53.5%	34.9%	46.5%	16.3%	48.8%	34.9%	18.6%	62.8%
	I don't know	Count	0	1	1	0	0	1	0	1	0	0	1
		% of Total	0.0%	2.3%	2.3%	0.0%	0.0%	2.3%	0.0%	2.3%	0.0%	0.0%	2.3%
	Another	Count	0	1	0	0	1	1	0	0	0	0	1
		% of Total	0.0%	2.3%	0.0%	0.0%	2.3%	2.3%	0.0%	0.0%	0.0%	0.0%	2.3%
Total		Count	24	35	17	28	20	32	8	32	15	10	43
		% of Total	55.8%	81.4%	39.5%	65.1%	46.5%	74.4%	18.6%	74.4%	34.9%	23.3%	100.0%

Percentages and totals are based on respondents.

Table 2: Learning Strategies VS Learning Results

5.1.2.2 Students' Opinions on Distance/Online Learning

Students were asked their opinions on distance learning. The advantage students found most relevant was "accessibility" (study anytime, anywhere), which was selected by 93% of the students, followed by "affordability" (42%). The less-selected advantages were "teacher availability" (16%) and "interactivity" (17%).

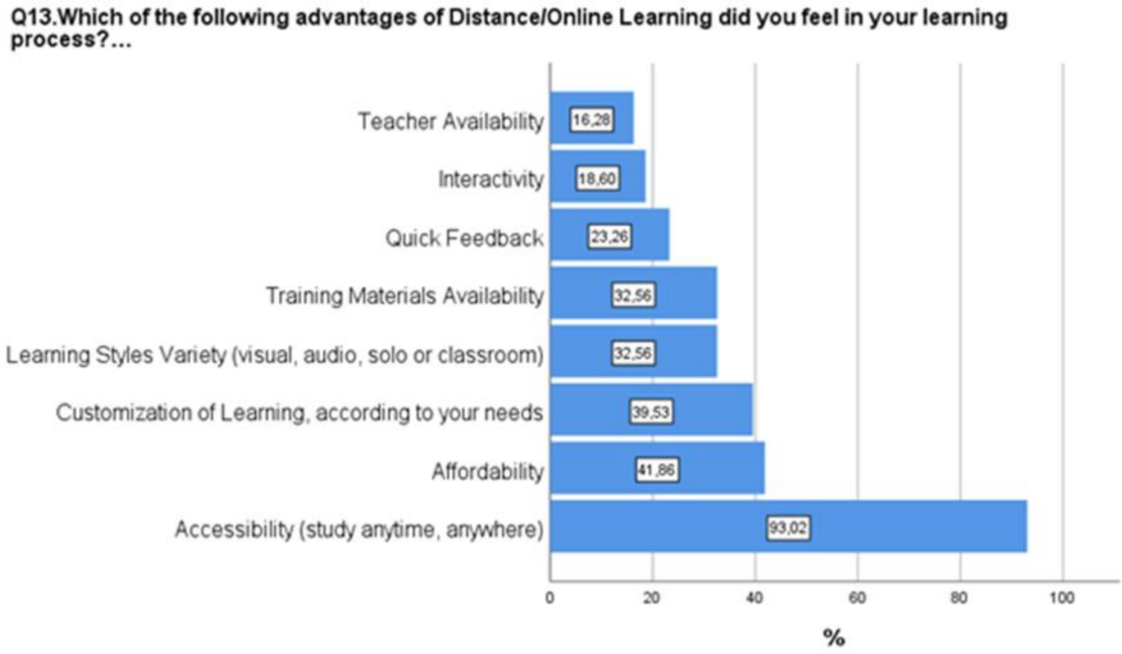

Figure 9: Distance Learning Advantages selected by the students

The disadvantages most referred were "blurred barrier between work and home life" (43%), "isolation" (38%) and "poorer quality feedback" (38%). The least referred was "questionable credibility of the degree" (14%).

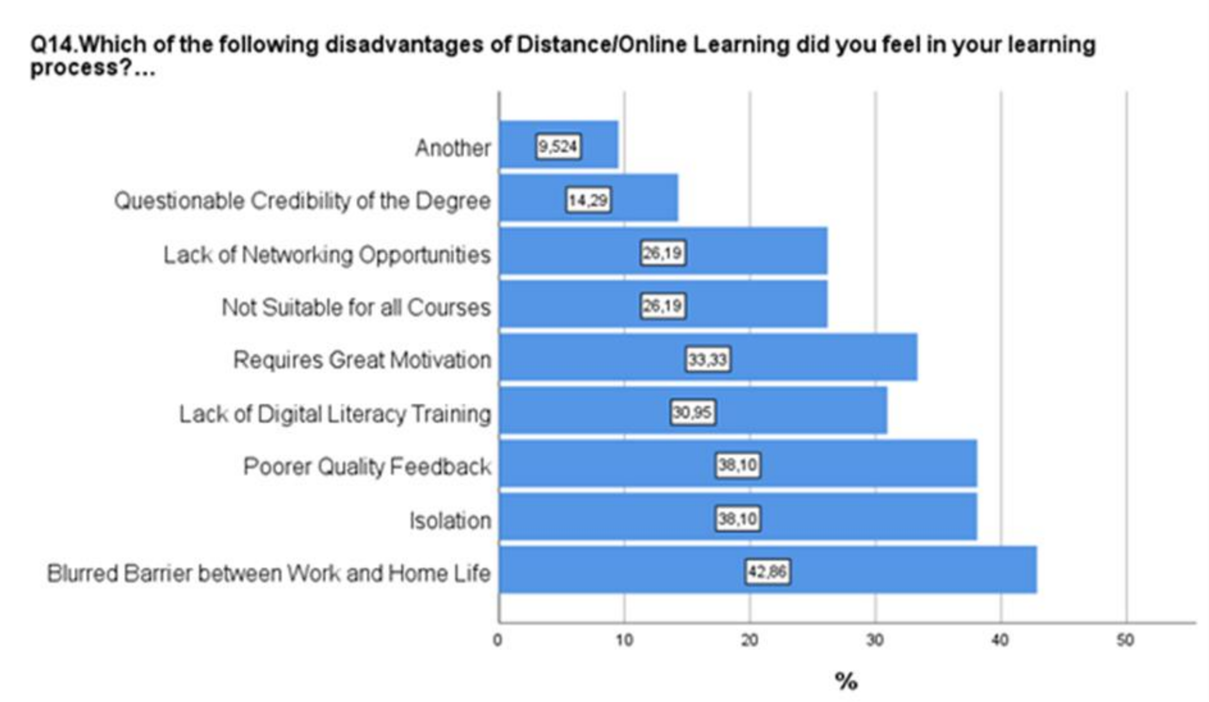

Figure 10: Distance Learning Disadvantages selected by the students

60% of students found synchronous interactions more helpful than asynchronous. When asked to rate the amount of interaction with the teacher and with colleagues in the distance/online learning, as opposed to classroom learning (using a five points Likert scale, where 1 = much less interaction and 5 = much more interaction), students rated more positively the interaction amount with colleagues than with teachers, where 60% of the students rated up to 2 the interaction with teachers opposed to 30% the interaction with colleagues on the same scale classification.

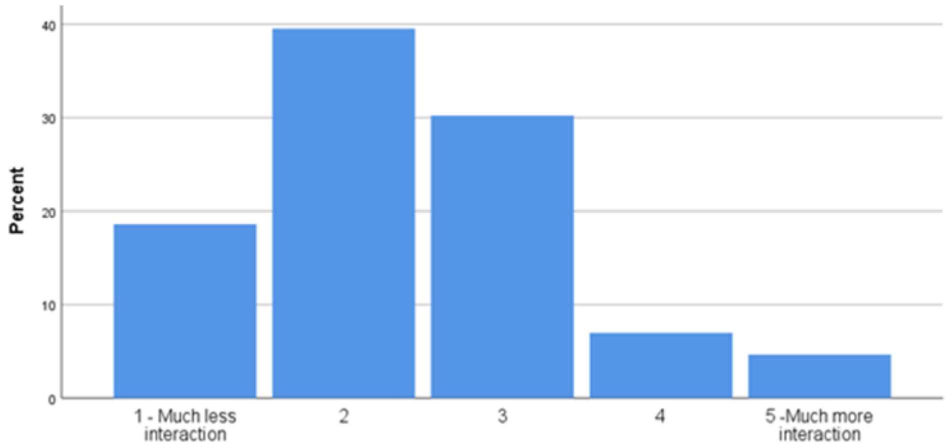

Figure 11: Amount of Interaction with Teachers in Distance Learning, as opposed to classroom learning

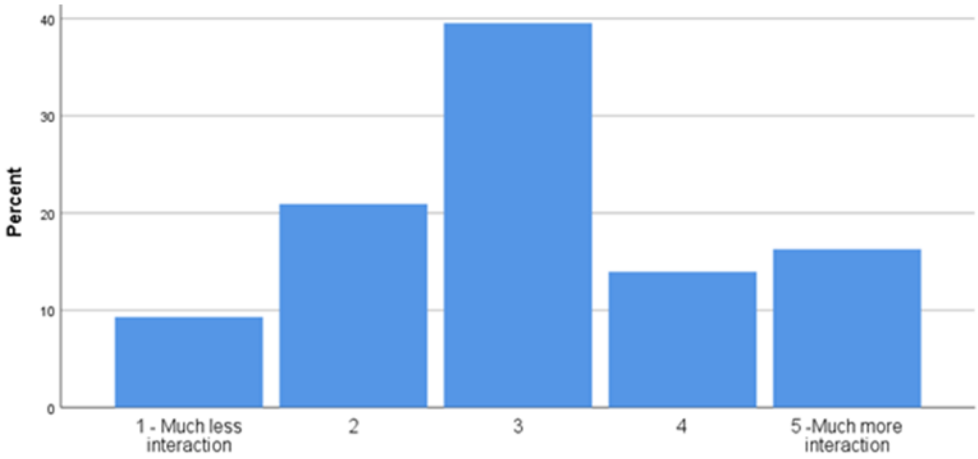

Figure 12: Amount of Interaction with Colleagues in Distance Learning, as opposed to classroom learning

Students were also asked to relate the importance of interaction with teachers and students in the learning process and 37% considered the interaction with teachers hindered the learning process and 28% did not think the interaction with teachers was important in the learning process.

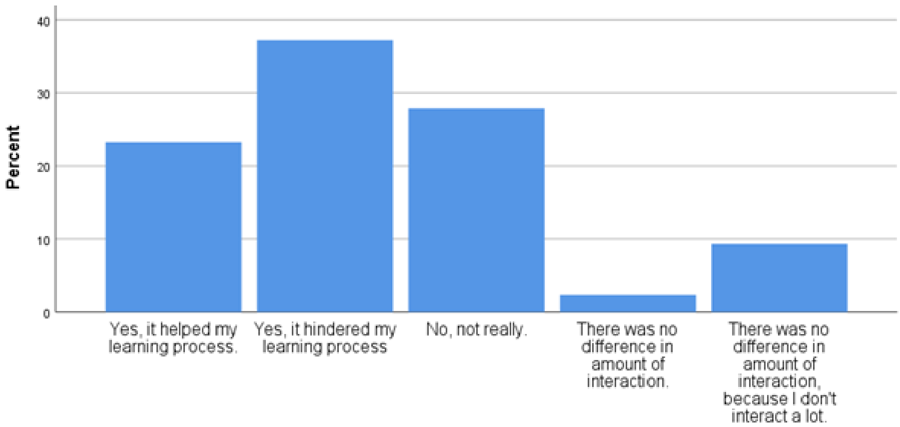

Figure 13: Importance given to interaction with teachers to the learning process and final grade

42% of students considered the interaction with colleagues important in the learning process, 26% don't think the interaction with colleagues is important in the learning process and 21% considered that interaction was negative to their performance.

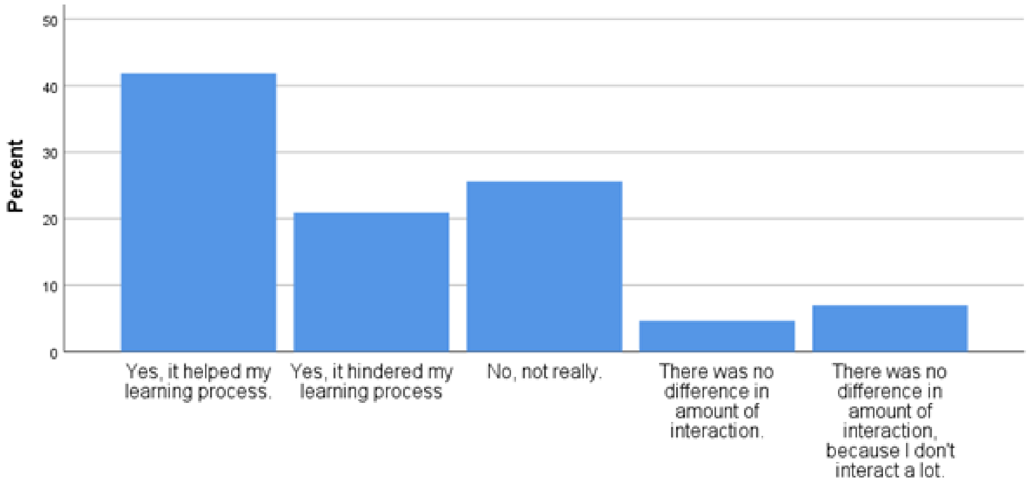

Figure 14: Importance given to interaction with students to the learning process and final grade

Students rated their engagement level in this master's using a five-point Likert scale (1 = Much lower to 5 = Much higher). Nearly 100% rated this master's as engaging or more than a traditional degree.

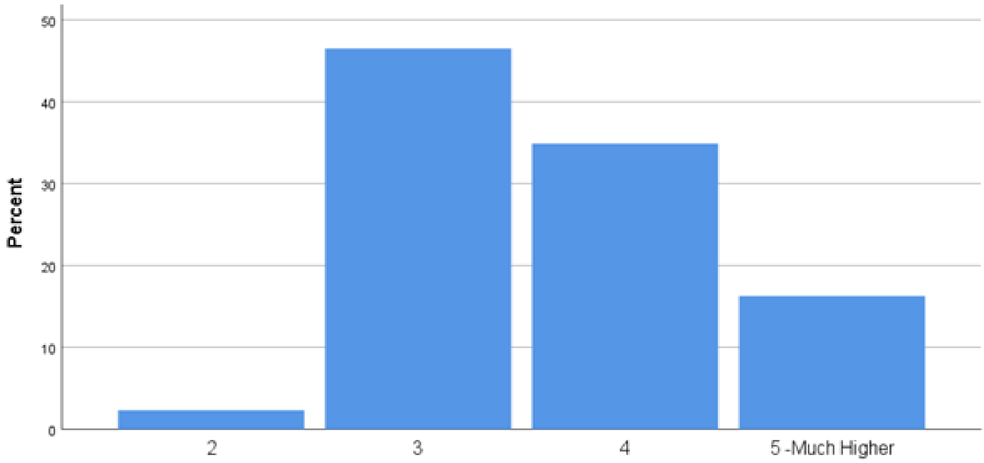

Figure 15: Engagement level in the MISE compared to a traditional degree

40% of the students stated they didn't participate much in asynchronous online discussions, however they felt that they got solid results and 35% of the students felt that the participation effort in asynchronous online discussions matches the final grade.

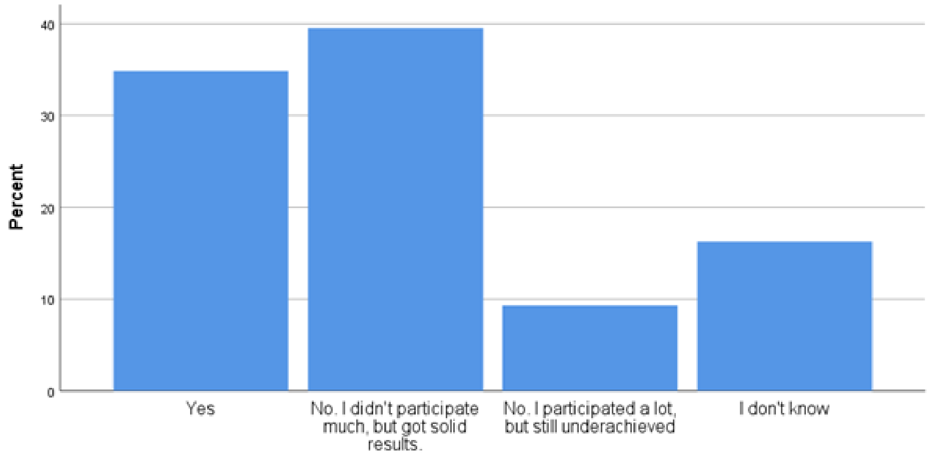

Figure 16: Participation Effort in Asynchronous Online Discussions VS Final Grade

Around 50% of the students considered that distance learning positively affected their engagement levels in TICE and COAO courses and around 14% considered that negatively.

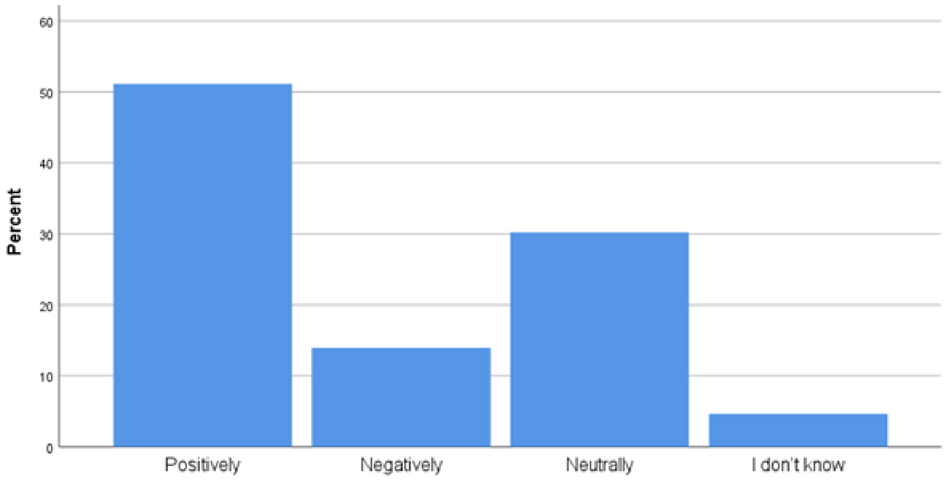

Figure 17: Distance Learning's effect on TICE's Students' Engagement Level

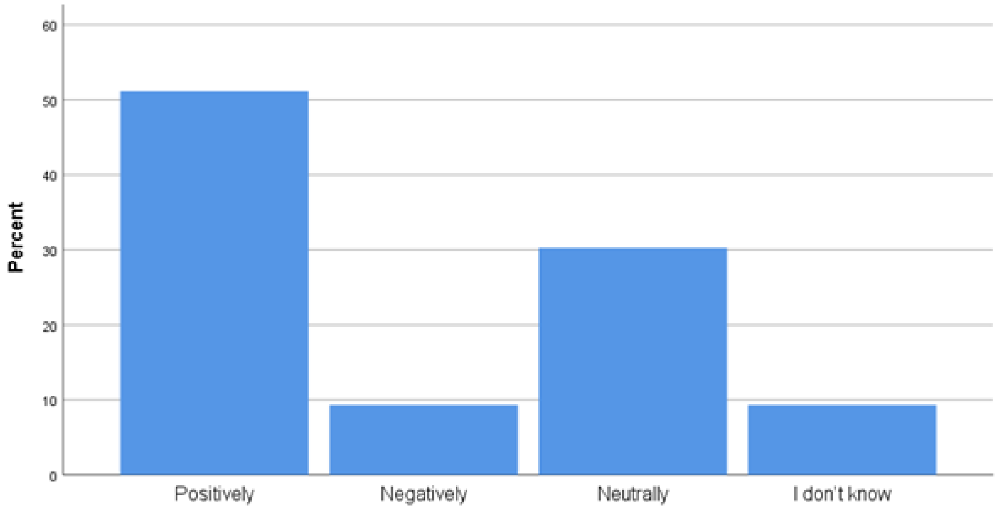

Figure 18: Distance Learning's effect on COAO's Students' Engagement Level

5.1.2.3 Correlation and Association Analysis between Questionnaire Items

A correlation analysis was conducted between items from the questionnaire (Table 3) to find potential correlations between questions' answers. A moderate correlation was found between Question (Q) 16 and Q18; Q22 and Q24; Q24 and Q29; Q11 and Q12. A strong association was verified on the pair of items: Q17 and Q19; Q25 and Q26; Q30 and Q31.

Item	Item	Coefficient
Q7 How would you rate your ease to self-regulate your learning?	Q9. Do you tend to use different Learning Strategies, when tackling different courses?	0.157*
Q16. Please rate the amount of interaction with the teacher in distance/online learning, as opposed to traditional classroom learning.	Q18. Please rate the amount of interaction with colleagues in distance/online learning, as opposed to traditional classroom learning.	**0.525***
Q16. Please rate the amount of interaction with the teacher in distance/online learning, as opposed to traditional classroom learning.	Q20. How would you rate your Engagement Level in this master's, as opposed to a traditional degree (a non-distance learning degree)?	0.287*
Q18. Please rate the amount of interaction with colleagues in distance/online learning, as opposed to traditional classroom learning.	Q20. How would you rate your Engagement Level in this master's, as opposed to a traditional degree (a non-distance learning degree)?	0.327*
Q22. How engaging do/did you find this course (TICE)?	Q24. How would you rate your ease to self-regulate your learning for this course (TICE)?	**0.627***
Q27. How engaging do/did you find this course (COAO)?	Q29. How would you rate your ease to self-regulate your learning for this course (COAO)?	0.334*

Q22. How engaging do/did you find this course (TICE)?	Q27. How engaging do/did you find this course (COAO)?	0.426*
Q24. How would you rate your ease to self-regulate your learning for this course (TICE)?	Q29. How would you rate your ease to self-regulate your learning for this course (COAO)?	**0.627***
Q11. Do you feel that your effort in this master's generally matched your final grade?	Q12. Do you feel that the final grades of the courses you took generally match the knowledge you gained?	**0.633¥**
Q17. Do you think that difference in amount of interaction with the teacher was important to your learning process and final grade?	Q19. Do you think that difference in amount of interaction with colleagues was important to your learning process and final grade?	**0.705¥**
Q25. Do you feel that your effort matched your final grade (TICE)?	Q26. Do you feel that your final grade matches the knowledge you gained (TICE)?	**0.755¥**
Q30. Do you feel that your effort matched your final grade (COAO)?	Q31. Do you feel that your final grade matches the knowledge you gained (COAO)?	**0.755¥**

*Spearman's Coefficient; ¥Contingency Coefficient

Table 3: Spearman's Correlations and Contingency Association Coefficients between Questionnaire Items

The correlations between Q11 and Q12; Q25 and Q26; Q30 and Q31 contribute to answering the 3rd goal of the questionnaire (Compare students' perceived effort with their performance and knowledge gained in two courses (TICE and COAO) of the MISE).

5.1.3 Overall Engagement in the MISE

A global score was obtained by adding the items 7, 9, 16, 18, 20, 22, 24, 27 and 29 of the questionnaire, which are in a Likert scale (1=very hard to 5=very easy). This score ranges between 9 to 45, with higher scores being synonymous with higher engagement. The mean (± standard deviation) is 31.7 (± 0.7) and a minimum of 24 and a maximum of 42 (Figure 19).

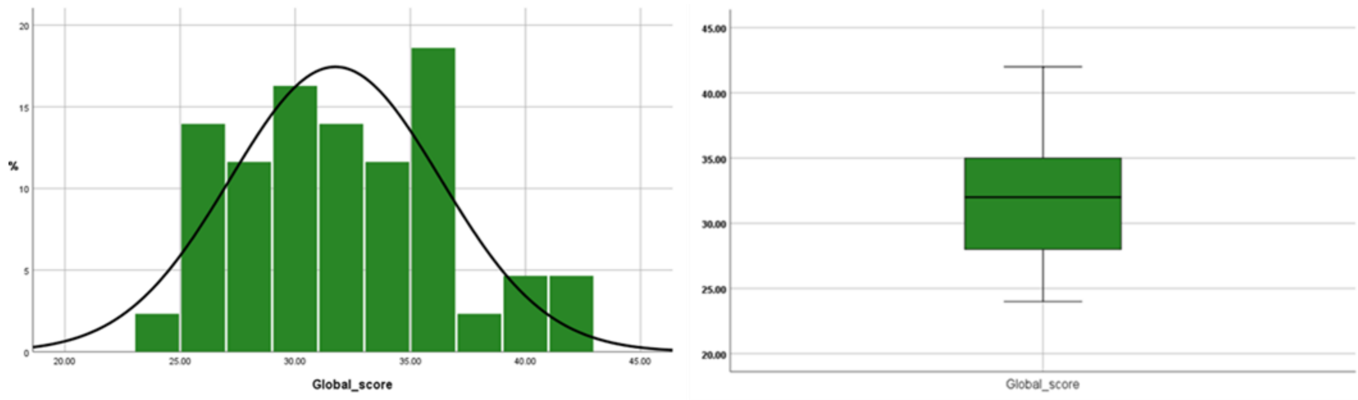

Figure 19: Global Score Distribution. A) Global Score Histogram B) Global Score Boxplot

Comparing the global score between genders, no statistical differences were found using a t-test for independent samples (t = -0.058, p = 0.954), since the normality distribution was verified for global scores for both gender samples.

A one-way ANOVA was performed to compare the mean scores between group ages. Since normality and variances homogeneity was verified, significant differences between group ages (F = 4.69, p = 0.004) were found. The group age that achieved the best score results was 34 and 41 years old (Figure 20).

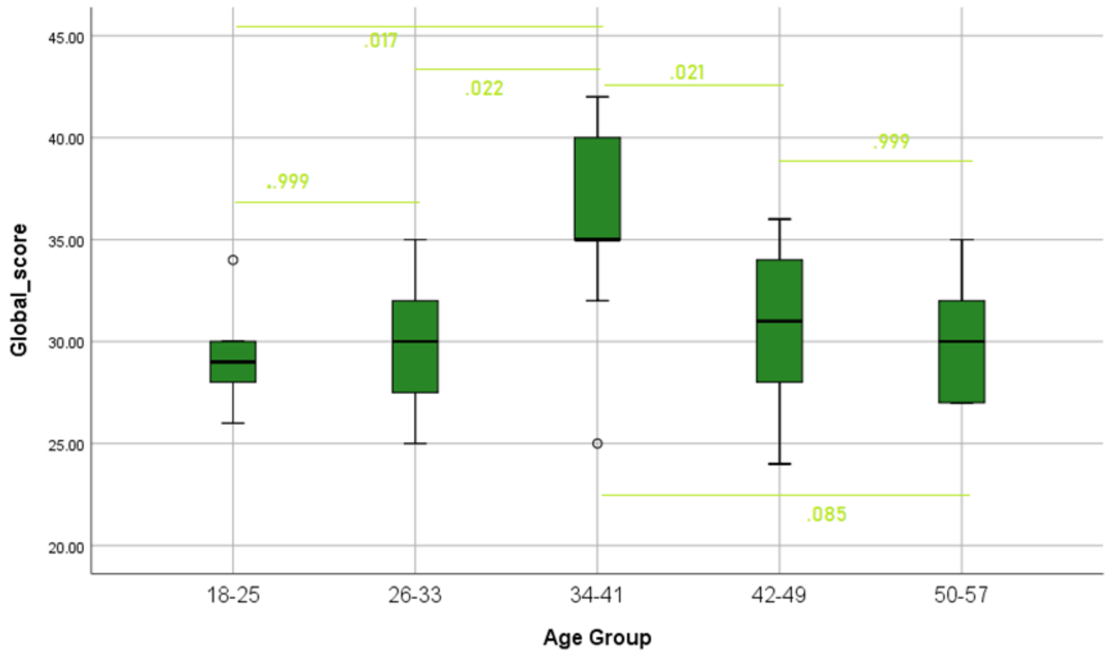

Figure 20: Global score by age group (p-values were obtained using Bonferroni Multiple Comparisons)

5.2 Teachers' and Coordinators' Questionnaire

5.2.1 Demographic Data

Of the sample size of 7 respondents, 71% have been teaching in the MISE for 6-to-8 years. All 7 teachers teach in the MISE, with over 50% interested in the scientific areas of "Computer and Information Sciences" and "Digital Transformation".

		Frequency	Percentage
Valid	3-5	2	28.6
	6-8	5	71.4
	Total	7	100.0

Table 4: Years as a Teacher on the MISE

		Frequency	Percentage
Valid	Dissertation Supervision	5	71.4%
	Teaching	7	100.0%
	Coordination	4	57.1%
	Scientific Comitee	1	14.3%

Table 5: Activities performed in the MISE

		Frequency	Percentage
Valid	Computer and Information Sciences	4	57.1%
	Digital Transformation	4	57.1%
	Management	3	42.9%
	Higher Education	3	42.9%
	Media and Communications	2	28.6%
	Cybersecurity	2	28.6%
	Innovation	2	28.6%

Table 6: Scientific Areas of Interest from the Teachers

		Frequency	Percentage
Valid	COAO (Conceção de Objetos de Aprendizagem Organizacional)	2	28.6%
	CG (Controlo de Gestão)	1	14.3%
	PCM (Produção de Conteúdos Multimédia)	1	14.3%
	EE (Engenharia Económica)	1	14.3%
	GPW (Gestão de Plataformas Web)	1	14.3%
	ND (Negócio Digital)	1	14.3%
	TICE (Tecnologias da Informação e Comunicação Empresariais)	1	14.3%
	ATE (Arquiteturas Tecnológicas Empresariais)	1	14.3%
	SISE (Seminário de Informação e Sistemas Empresariais)	1	14.3%
	USI (Usabilidade e Sistemas de Informação)	1	14.3%
	AOSI (Arquitetura Organizacional de Sistemas de Informação)	1	14.3%

Table 7: Curricular Units taught by Teachers of the MISE

The goal of this questionnaire was to get teachers' views on how MISE's distance learning model affects student engagement and their results.

The following section presents the results related to these goals.

5.2.2 Goal

When asked how they would rate their students' ease to self-regulate on a scale of 1-5, 43% of teachers rate it a 3 (average) and 57% rated it a 4 (easy). When it comes to their students' engagement in the curricular units they teach, 14% of teachers gave them a 3 (average), 57% gave them a 4 (high) and 29% gave them a 5 (very high). As to how their students' engagement affected their final grade, 14% of teachers rated it a 4 (quite a bit) and 86% rated it a 5 (a lot).

When rating students' interactions, teachers generally believe students interact an average amount with them.

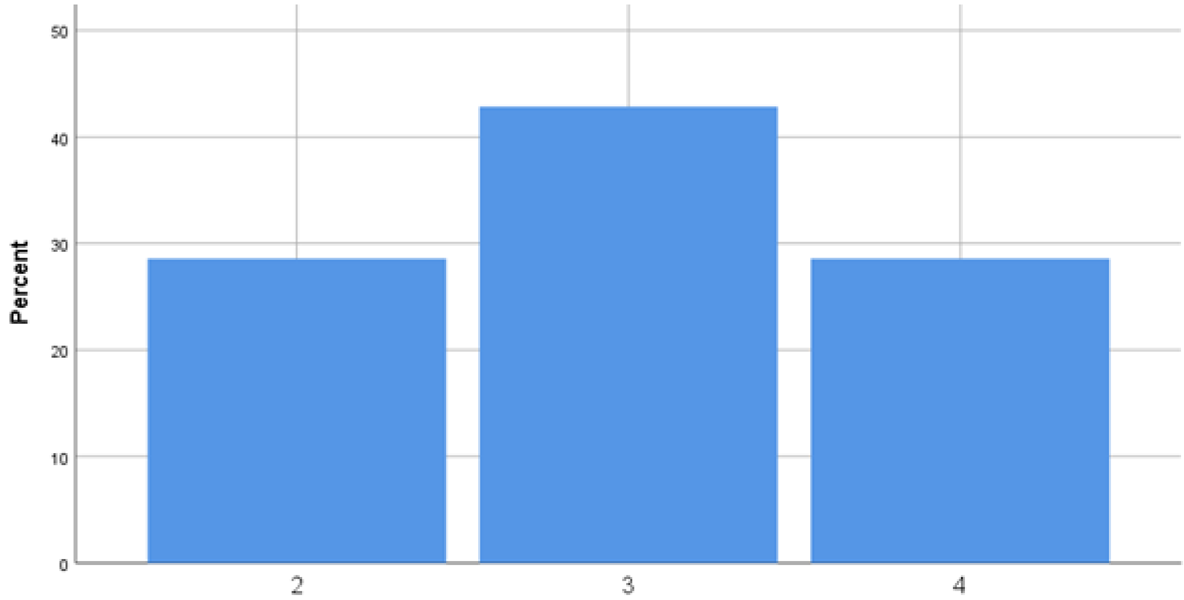

Figure 21: Amount of interactions students have with teachers (1-5 scale)

As for the quality of interactions with the students, 86% of teachers rate it from high to very high. 86% of teachers also believe students have high to very high-quality interactions with technology. Since most of the interactions in the MISE are asynchronous, teachers were asked to rate students' engagement in asynchronous interactions from 1-5 (very low to very high). The results show very scattered opinions, as can be seen below:

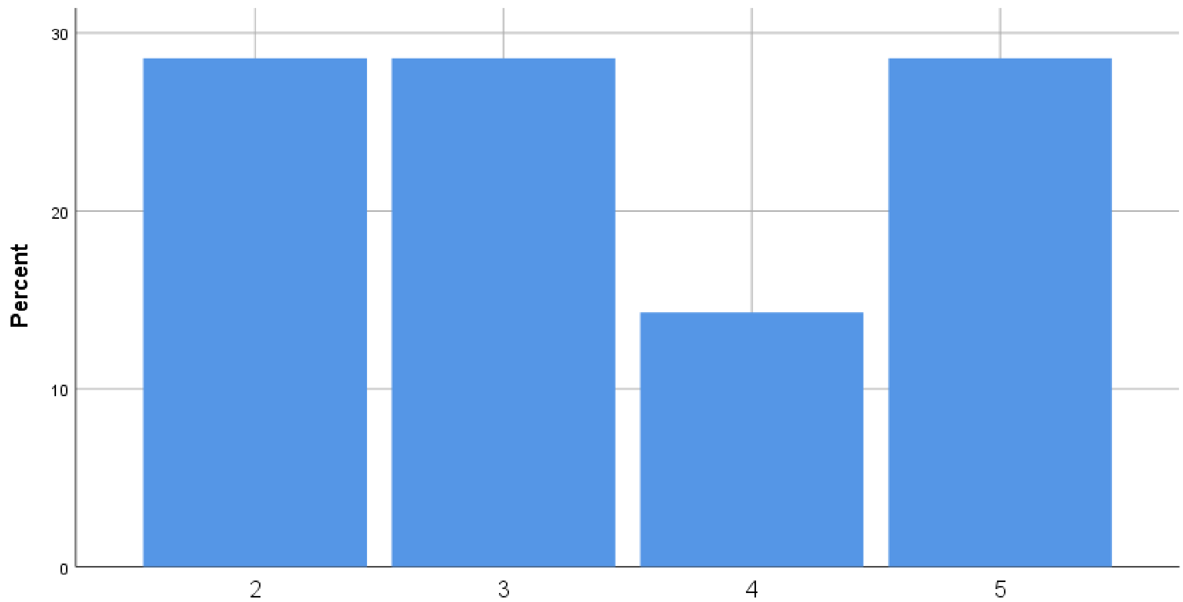

Figure 22: Students' engagement in asynchronous interactions (1-5 scale)

Teachers were also asked to rate how engaging some types of learning content are to students and the results were as follows:

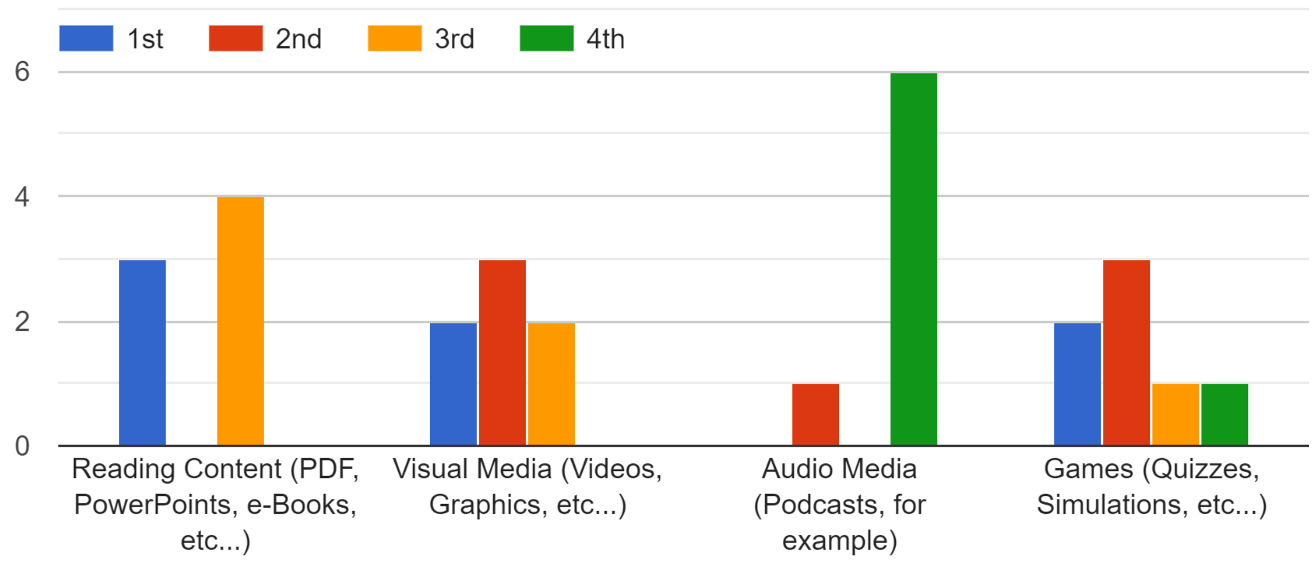

Figure 23: Types of Learning Content ordinally rated for Engagement (y-axis refers to the frequency of answers) (picture taken from GOOGLE Forms)

As to how students answered to the pedagogical strategies teachers used, 86% of teachers rated their students' reaction to their pedagogical strategies 4-5 (well to very well).

From what has been shown in the students' and teachers' questionnaires, one can conclude that teachers judge the engagement of their students as high, which aligns with students' opinions about the engagement of the MISE. Teachers (agreeing with students) also believe that engagement is an important factor in achieving better learning outcomes.

However, regarding the interactions between students and teachers, the opinions of both parties differ.

Teachers believe that the amount of interactions is more or less the same, as in traditional teaching models, and the quality of interactions is high to very high.

On the other hand, most students believe that they interact less with teachers and 65% of the students considered that the interaction with teachers made the learning process difficult or was not important for the learning process.

Besides, there is a low association between the amount of interaction with the teacher and the level of engagement of the students (Q16 and Q20) and only 9% of students attributed their learning outcomes to "help from the teacher", which is consistent with their views on teacher interaction.

Most students considered synchronous interactions more useful than asynchronous interactions, which may explain students' unhappiness with their teacher interactions, since the pedagogical model of the MISE focuses mainly on asynchronous interactions.

6 Conclusions

6.1 Research Problem, Questions and Methodology

This research found that the current contexts of collaborative learning and self-learning, inserted in technological environments designed for Digital Learning, allow the achievement of different performances both at the cognitive and operational levels (Ramirez-Arellano et al., 2018).

In this context, three research questions were posed:

1) *What are the main cognitive engagement strategies for higher education contexts?*
2) *What technological environments are available for applying cognitive engagement solutions?*
3) *What correlation exists between the proposed strategies and learning outcomes, in digital learning environments?*

A research plan was conducted to answer the research questions where the state of the art's analysis and the literature review would contribute to answer the first two research questions. The questionnaires would contribute to answering the third research question.

To conduct this research, the survey methodology was selected. This methodology's selection stems from the desire to use the MISE as the setting to study the students' engagement level and their views on the positives and negatives of distance learning. However, because of this focus, the results only partially answer the research questions, because they don't go as deep into the cognitive engagement strategies, as they should.

6.2 State of the Art and Literature Review

The acquisition of cognitive skills and self-regulation was necessary to succeed in digital learning (Anthonysamy et al., 2020; Halverson & Graham, 2019). Okaz (2015) stressed that digital learning, in turn, develops cognitive engagement in students (as cited in Anthonysamy et al., 2021).

Anthonysamy et al. (2020) state that cognitive strategies promoted better student engagement and improved learning outcomes.

These strategies comprise: Rehearsal, Elaboration, Organization and Critical Thinking. However, according to Barlow & Brown (2020) cognitive engagement is determined case-by-case and is unique to every situation. Therefore, teachers need to understand the context in which they carry out their strategies. Otherwise, those strategies may prove ineffective.

In online and distance learning, Shukor et al. (2014) found that, for cognitive engagement, sharing information and posting high-level messages are two significant variables. This means that amount and quality of interactions are vital, in achieving higher students' engagement in online courses (Chakraborty & Muyia Nafukho, 2014; Joo et al., 2014).

And while real-world-related and practical projects and social interaction foster effective online classes, text-based learning and disconnections in class are barriers to the creation of engaging online classes (Chakraborty & Muyia Nafukho, 2014).

The flipped-classroom model seems to provide opportunities for students to gain basic cognitive abilities before classes are held, so the time in the classroom can be spent developing higher cognitive abilities (Utama et al., 2020).

This method also allows for more freedom and flexibility in the learning process, highly bolsters teamwork skills, material retention and, most crucial, stimulates student curiosity in the content and learning process (Utama et al., 2020).

As more higher education institutions assimilate new technologies into their learning environments to improve their students' learning, it becomes progressively more important to have a profound grasp of their results on students' learning outcomes (Blasco-Arcas et al., 2013).

As for the Literature Review, it was found that high levels of cognitive engagement lead students to use meaningful self-regulated learning strategies, which in turn lead students to better learning outcomes in whatever type of learning environment they are in (Anthonysamy et al., 2021; Joo et al., 2014).

Teachers should help students develop these skills and make self-regulation a habit by applying self-regulation skills in class, especially in more autonomous learning scenarios (Anthonysamy et al., 2020).

For example, online discussion forums can help maintain the momentum of conversations and broaden their focus, which facilitates reflection outside the classroom. Chaining these activities with other collaborative tasks can lead to higher-performing learning networks, which will generate better learning outcomes (Galikyan & Admiraal, 2019).

Course creators should strive to use multiple students' cognitive engagement assessment tools, so they can better understand what engages students. If they do that, they will be able to continuously design and redesign courses that promote the use of cognitive engagement strategies to positively affect students' learning outcomes (Galikyan & Admiraal, 2019; Joo et al., 2014).

6.3 Questionnaires and Data Analysis

The questionnaires were carried out following the book “Manuel de recherche en science sociales (Portuguese Edition)” by Raymond Quivy and Luc Van Campenhoudt (2008). To create the questionnaires, these methodological steps were taken:

1) Reading the Research Problem, Questions and Objectives;
2) Reading the State of the Art and the Literature Review;
3) Coding of Information into Topics to facilitate analysis;
4) Creation of Questions based on the Topics;
5) Review and Discussion of Questions with Supervisor;
6) Addition of Questions;
7) Review;
8) Placement of Questions in their appropriate Section and Order;
9) Description of Sections to inform the participants on them;
10) Final Review and Discussion of overall Questionnaire with Supervisor;
11) Delivery of Questionnaire to the Participants.

The data that the questionnaires provided was analyzed using the IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp, Armonk, NY, USA).

When analyzing the data, both questionnaires’ results were compared and comparing how engagement affects learning outcomes, 60% of students attributed their learning results to their engagement level and all teachers attributed 4-5 (quite a bit – a lot), in a likert scale.

There is almost a consensus from both students and teachers on the importance of engagement to learning outcomes, with teachers giving it more importance than students. 86% of teachers rated their students’ engagement in the curricular units they teach as either high or very high.

With also 86% of teachers stating their students’ engagement very highly affected their final grade and 86% of teachers rated their students’ reaction to their pedagogical strategies from well to very well. One can then assume that either teachers’ pedagogical strategies can generate engagement in their students, or students are intrinsically engaged from the start (meaning they don’t need much external help to be engaged), or both.

Also, nearly 100% of the students rated the MISE as engaging or more than a traditional degree. This might be attributed to the autonomous learning that distance learning requires. Students become more emotionally connected and invested in their learning by being more responsible for their learning and outcomes.

Also, the students’ sample consisted mostly of people who are full-time employees (79%) and over 34 years old (70%), meaning they are not dependents (as in, they don’t have someone to fund them and their endeavors), so they have a greater sense of the value of the money and time they spend. By investing in their education, these students have a generally higher bond with what they are investing in, opposed to patroned students. Another narrative that favors the idea of the importance of intrinsic motivation.

When it comes to student-teacher interaction amount, the opinion of both parties involved is different. While teachers seem to believe it to be about the same as traditional classroom learning, 59% of students believe that they interact less with teachers, with only 12% considering they interact more with teachers. However, 86% of teachers rate the quality of interactions with the students from high to very high.

This means that, unlike in traditional classroom learning, where students pose their questions when they think of them, maybe due to the lesser degree of interaction with teachers in distance learning (according to the students), students first perform research and if they still don't find an answer to their question, only then do they ask their teacher.

This narrative would explain the low amount of interaction with teachers, but the interaction is of high-quality. However, when relating the importance of interaction with teachers in the learning process (figure 13), 28% didn't think interaction with teachers was important in the learning process.

Worse, 37% of students considered that the interaction with teachers hindered their learning process. Most students (60%) found synchronous interactions more helpful than asynchronous, which might explain students' displeasure with their interaction with teachers, as MISE's pedagogical model mostly focuses on asynchronous interactions.

Not only is there a negative opinion of a majority of students on the teachers' effect on the learning process, but table 3 also displays a low association between the amount of interaction with the teacher and the student's engagement level in the course, meaning that the amount of interactions with the teacher has little effect on the engagement level of students (Q16 and Q20).

The same is the case for interactions between students, with only a slightly higher correlation coefficient (Q18 and Q20), even though students state that the amount of interaction with colleagues in distance learning (figure 12) is, on average, virtually the same as in traditional classroom learning experiences.

Additionally, table 3 also shows a strong association between how the difference (from traditional classroom learning to distance learning) in the amount of interaction with the teacher affects the learning process and final grade and how the difference (from traditional classroom learning to distance learning) in the amount of interaction with colleagues affects learning process and final grade (Q17 and Q19).

As figure 16 shows, the results of the correlation between students' participation effort in asynchronous online discussions and their final grade were very mixed, with 35% of the students having good learning outcomes and good participation and 40% of students having good learning outcomes, despite low participation. This leads to the conclusion that asynchronous interactions may not significantly contribute to a student's final grade in distance learning.

When analyzing what students attribute their learning results to, only 9% attribute it to "help from the teacher" which is consistent with their views on interaction with the teacher in a distance learning environment.

However, the two options that showed in first and second place in the learning results attribution chart (figure 8) were "Goal Orientation" and "Motivation" two things that are mostly intrinsic motivation, which might mean that even if the teacher does a perfect job, if the student is not intrinsically motivated to learn, the student won't have very good learning outcomes. Making (intrinsical) motivation vital to perform any learning activity in any learning environment.

When rating students' engagement, as per their questionnaire's results, their global engagement score (figure 19) shows that most students found themselves with a score between average and high. So, while rating their engagement as positive, students don't rate their engagement as positively as teachers (since 86% of teachers rated their students' engagement in the curricular units they teach as either high or very high).

A potential explanation could be that teachers rated their students' engagement based on the amount and quality of the students' interactions with them in the forums and how much effort it took for teachers to address the issues posed in the forums.

In contrast, students might have rated engagement more as a measure of their interest in and during those interactions and forums. According to the students, the biggest advantage they found in distance learning (figure 9) is, by far, "Accessibility", the ability to study anytime, anywhere. 93% of students selected it, with the second being "Affordability" at 42%.

This shows that students want to be able to study what they want, when they want. This means there is an opportunity for higher education institutions to embrace lifelong learning by offering more customized, smaller curriculums, developed together with industry.

Regarding the two subjects picked for the questionnaire (TICE and COAO), while for TICE there was a moderate correlation between how engaging students found the course and how they rate their ease to self-regulate their learning for the course (table 3, Q22 and Q24), for COAO, this correlation was weak (Table 3, Q27 and Q29).

Making the correlation between engagement and self-regulation unclear. However, a moderate correlation was found between self-regulation for TICE and self-regulation for COAO. This might mean that either:

- Students' who self-regulate well for one curricular unit, are statistically more likely to self-regulate well for other curricular units;

- On TICE and COAO, similar learning strategies can be used to achieve good learning outcomes.
- Or both.

As was stated before, the correlations between Q11 and Q12; Q25 and Q26; Q30 and Q31 from table 3 contribute to answering the 3rd goal of the questionnaire (compare students' perceived effort with their performance and knowledge gained in two courses (TICE and COAO) of the MISE).

Two of these sets of items (Q25 and Q26; Q30 and Q31) have a strong association and Q11 and Q12 have a moderate correlation. This leads to the conclusion that students' effort generally matches their knowledge acquisition (Q11 and Q12).

The main contribution this dissertation offers to this investigation area is both questionnaires, their data analysis and the conclusions taken from it.

6.4 Limitations and Future Work

The clearest limitations found in this research were three:

- Sample Size;
- The Experiment's Setting's Range;
- Engagement Analysis Tools;
- Chosen Methodology.

The sample size is small, with the students' questionnaire obtaining 43 answers out of 118 and the teachers' questionnaire obtaining 7 out of 13. The experiment's setting comprised only one course from one university, instead of many courses from many universities, which would have increased the scope and range of the research. And to analyze student engagement, the data gathered and analyzed originated from questionnaires, whereas it could have also originated from:

- Interviews and Focus Groups;
- Online Cognitive Assessment Tools;
- eLearning Platform Data (for example interactions in the forums, hours spent on the platform, and so on…);
- etc…

Regarding the chosen methodology, while it is serviceable to study the issue at hand, it does not feature information systems, as much as would be expected from a Master's degree in the area of Information Systems.

Future work could complement this research study by diving into analyses of the LMS's role in students' cognitive engagement, since LMS are the key learning tool in distance learning and were left mostly out of this study. Future researchers can also do this research for the other two engagement types (emotional and behavioral engagement), professional training, or both.

Bibliography

Anthonysamy, L., Ah Choo, K., & Soon Hin, H. (2021). Investigating Self-Regulated Learning Strategies For Digital Learning Relevancy. *Malaysian Journal Of Learning And Instruction*, *18*(1), 29-64. https://doi.org/10.32890/mjli2021.18.1.2

Anthonysamy, L., Choo, K., & Hin, H. (2020). Impact of cognitive and metacognitive strategies on learning performance in digital learning: What's working and what's not in the age of brilliant technology. *Journal Of Physics: Conference Series*, *1529*, 052019. https://doi.org/10.1088/1742-6596/1529/5/052019

Anthonysamy, L., Koo, A., & Hew, S. (2020). Self-regulated learning strategies and non-academic outcomes in higher education blended learning environments: A one decade review. *Education And Information Technologies*, *25*(5), 3677-3704. https://doi.org/10.1007/s10639-020-10134-2

Baranova, T., Khalyapina, L., Kobicheva, A., & Tokareva, E. (2019). Evaluation of Students' Engagement in Integrated Learning Model in A Blended Environment. *Education Sciences*, *9*(2), 138. https://doi.org/10.3390/educsci9020138

Barlow, A., & Brown, S. (2020). Correlations between modes of student cognitive engagement and instructional practices in undergraduate STEM courses. *International Journal Of STEM Education*, *7*(1). https://doi.org/10.1186/s40594-020-00214-7

Bernacki, M., Byrnes, J., & Cromley, J. (2012). The effects of achievement goals and self-regulated learning behaviors on reading comprehension in technology-enhanced learning environments. *Contemporary Educational Psychology*, *37*(2), 148-161. https://doi.org/10.1016/j.cedpsych.2011.12.001

Blasco-Arcas, L., Buil, I., Hernández-Ortega, B., & Sese, F. (2013). Using clickers in class. The role of interactivity, active collaborative learning and engagement in learning performance. *Computers & Education*, *62*(2013), 102-110. https://doi.org/10.1016/j.compedu.2012.10.019

Chakraborty, M., & Muyia Nafukho, F. (2014). Strengthening student engagement: what do students want in online courses?. *European Journal Of Training And Development*, *38*(9), 782-802. https://doi.org/10.1108/ejtd-11-2013-0123

Chi, M., & Wylie, R. (2014). The ICAP Framework: Linking Cognitive Engagement to Active Learning Outcomes. *Educational Psychologist*, *49*(4), 219-243. https://doi.org/10.1080/00461520.2014.965823

Chong, W., Liem, G., Huan, V., Kit, P., & Ang, R. (2018). Student perceptions of self-efficacy and teacher support for learning in fostering youth competencies: Roles of affective and cognitive engagement. *Journal Of Adolescence*, *68*, 1-11. https://doi.org/10.1016/j.adolescence.2018.07.002

Choudhury, S., & Pattnaik, S. (2020). Emerging themes in e-learning: A review from the stakeholders' perspective. *Computers & Education*, *144*(January 2020), 1-9. https://doi.org/10.1016/j.compedu.2019.103657

Conceção de Objetos de Aprendizagem Organizacional. Técnico Lisboa. (2021). Retrieved from https://fenix.tecnico.ulisboa.pt/cursos/mise/disciplina-curricular/1127428915200180.

Creswell, J., & Clark, V. (2020). *Principles of Qualitative Research: Designing a Qualitative Study*. Retrieved from https://www.researchgate.net/profile/Nakpangi_Thomas/post/What_are_the_tenets_principles_of_sound_fundamental_analysis/attachment/59d64456c49f478072eace42/AS%3A273763373912064%401442281682317/download/Qualitative+Principles.pdf.

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis. *Journal Of Advanced Nursing*, *62*(1), 107-115. https://doi.org/10.1111/j.1365-2648.2007.04569.x

Fatima, S., Ghias, K., Jabeen, K., & Sabzwari, S. (2019). Enhancing Cognitive Engagement of Pre-clinical Undergraduate Medical Students via Video Cases and Interactive Quizzes in Problem-based Learning. *Cureus*, *11*(1). https://doi.org/10.7759/cureus.3832

Galikyan, I., & Admiraal, W. (2019). Students' engagement in asynchronous online discussion: The relationship between cognitive presence, learner prominence, and academic performance. *The Internet And Higher Education*, *43*(2019), 100692. https://doi.org/10.1016/j.iheduc.2019.100692

Glasow, P. (2005). *Fundamentals of Survey Research Methodology*. Manuscript, McLean, Virginia.

Greene, B., Miller, R., Crowson, H., Duke, B., & Akey, K. (2004). Predicting high school students' cognitive engagement and achievement: Contributions of classroom perceptions and motivation. *Contemporary Educational Psychology*, *29*(4), 462-482. https://doi.org/10.1016/j.cedpsych.2004.01.006

Gunuc, S. (2014). The Relationships between Student Engagement and Academic Achievement. *International Journal On New Trends In Education And Their Implications*, *5*(4), 216-231.

Halverson, L., & Graham, C. (2019). Learner Engagement in Blended Learning Environments: A Conceptual Framework. *Online Learning*, *23*(2). https://doi.org/10.24059/olj.v23i2.1481

Ho, V., Wong, S., & Lee, C. (2009). A Tale of Passion: Linking Job Passion and Cognitive Engagement to Employee Work Performance. *Journal Of Management Studies*, *48*(1), 26-47. https://doi.org/10.1111/j.1467-6486.2009.00878.x

Ignacio, J., & Chen, H. (2020). The use of web-based classroom gaming to facilitate cognitive integration in undergraduate nursing students: A mixed methods study. *Nurse Education In Practice*, *46*, 102820. https://doi.org/10.1016/j.nepr.2020.102820

Jensen, T. (2019). *HIGHER EDUCATION IN THE DIGITAL ERA The current state of transformation around the world* (pp. 20-53). International Association of Universities. Retrieved from https://iau-aiu.net/IMG/pdf/technology_report_2019.pdf

Joo, K., Andrés, C., & Shearer, R. (2014). Promoting distance learners' cognitive engagement and learning outcomes: Design-based research in the Costa Rican National University of Distance Education. *The International Review Of Research In Open And Distributed Learning*, *15*(6), 188-210. https://doi.org/10.19173/irrodl.v15i6.1908

Kostaris, C., Sergis, S., Sampson, D., Giannakos, M., & Pelliccione, L. (2017). Investigating the Potential of the Flipped Classroom Model in K-12 ICT Teaching and Learning: An Action Research Study. *Educational Technology & Society*, *20*(1), 261–273.

Lee, J., Park, T., & Davis, R. (2018). What affects learner engagement in flipped learning and what predicts its outcomes?. *British Journal Of Educational Technology*, *0*(0), 1-18. https://doi.org/10.1111/bjet.12717

Lei, H., Cui, Y., & Zhou, W. (2018). Relationships between student engagement and academic achievement: A meta-analysis. *Social Behavior And Personality: An International Journal*, *46*(3), 517-528. https://doi.org/10.2224/sbp.7054

Malecela, I., & Hassan, S. (2019). Investigating Web 2.0 Tools Use and Students Cognitive Engagement in Selected Tanzanian Higher Institutions: Preparing Towards 21st Learning. *International Journal Of Advanced Engineering Research And Science*, *6*(1), 173-183. https://doi.org/10.22161/ijaers.6.1.24

Mestrado Bolonha em Informação e Sistemas Empresariais. Técnico Lisboa. (2021). Retrieved from https://fenix.tecnico.ulisboa.pt/cursos/mise.

Mestrado Bolonha em Informação e Sistemas Empresariais Curriculo. Técnico Lisboa. (2021). Retrieved from https://fenix.tecnico.ulisboa.pt/cursos/mise/curriculo.

Norris, D., & Lefrere, P. (2011). Transformation through expeditionary change using online learning and competence-building technologies. *Research In Learning Technology*, *19*(1), 3-19. https://doi.org/10.1080/09687769.2010.549205

Oh, E., & Kim, H. (2016). Understanding Cognitive Engagement in Online Discussion: Use of a Scaffolded, Audio-based Argumentation Activity. *The International Review Of Research In Open And Distributed Learning*, *17*(5), 28-48. https://doi.org/10.19173/irrodl.v17i5.2456

Quivy, R., & Campenhoudt, L. (2008). *Manual de investigação em ciências sociais* (2nd ed., pp. 188-191). Gradiva.

Ramirez-Arellano, A., Acosta-Gonzaga, E., Bory-Reyes, J., & Hernández-Simón, L. (2018). Factors affecting student learning performance: A causal model in higher blended education. *Journal Of Computer Assisted Learning*, *34*(6), 807-815. https://doi.org/10.1111/jcal.12289

Raza, S., Qazi, W., & Umer, B. (2019). Examining the impact of case-based learning on student engagement, learning motivation and learning performance among university students. *Journal Of Applied Research In Higher Education*, *12*(3), 517-533. https://doi.org/10.1108/jarhe-05-2019-0105

REGULATION (EU) 2016/679 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) (2016). EUR-Lex.

Rienties, B., Tempelaar, D., Nguyen, Q., & Littlejohn, A. (2019). Unpacking the intertemporal impact of self-regulation in a blended mathematics environment. *Computers In Human Behavior*, *100*(2019), 345-357. https://doi.org/10.1016/j.chb.2019.07.007

Richardson, J., & Newby, T. (2006). The Role of Students' Cognitive Engagement in Online Learning. *American Journal Of Distance Education*, *20*(1), 23-37. https://doi.org/10.1207/s15389286ajde2001_3

Rotgans, J., & Schmidt, H. (2011). Cognitive engagement in the problem-based learning classroom. *Advances In Health Sciences Education*, *16*(4), 465-479. https://doi.org/10.1007/s10459-011-9272-9

Rotgans, J., Schmidt, H., Rajalingam, P., Hao, J., Canning, C., Ferenczi, M., & Low-Beer, N. (2017). How cognitive engagement fluctuates during a team-based learning session and how it predicts academic achievement. *Advances In Health Sciences Education*, *23*(2), 339-351. https://doi.org/10.1007/s10459-017-9801-2

Sedaghat, M., Abedin, A., Hejazi, E., & Hassanabadi, H. (2011). Motivation, cognitive engagement, and academic achievement. *Procedia - Social And Behavioral Sciences*, *15*(2011), 2406-2410. https://doi.org/10.1016/j.sbspro.2011.04.117

Shalev-Shwartz, S. (2011). Online Learning and Online Convex Optimization. *Foundations And Trends® In Machine Learning*, *4*(2), 107-194. https://doi.org/10.1561/2200000018

Shaw, L., MacIsaac, J., & Singleton-Jackson, J. (2019). The Efficacy of an Online Cognitive Assessment Tool for Enhancing and Improving Student Academic Outcomes. *Online Learning*, *23*(2), 124-144. https://doi.org/10.24059/olj.v23i2.1490

Shukor, N., Tasir, Z., Van der Meijden, H., & Harun, J. (2014). A Predictive Model to Evaluate Students' Cognitive Engagement in Online Learning. *Procedia - Social And Behavioral Sciences*, *116*, 4844-4853. https://doi.org/10.1016/j.sbspro.2014.01.1036

Tecnologias da Informação e Comunicação Empresariais. Técnico Lisboa. (2021). Retrieved from https://fenix.tecnico.ulisboa.pt/cursos/mise/disciplina-curricular/1127428915200179.

Terrenghi, I., Diana, B., Zurloni, V., Rivoltella, P., Elia, M., & Castañer, M. et al. (2019). Episode of Situated Learning to Enhance Student Engagement and Promote Deep Learning: Preliminary Results in a High School Classroom. *Frontiers In Psychology*, *10*, 1-13. https://doi.org/10.3389/fpsyg.2019.01415

Utama, M., Yuliawan, D., Suhoyo, Y., & Doni, W. (2020). FACEBOOK® GROUP USAGE TO SUPPORT FLIPPED-CLASSROOM LEARNING ON OCULAR TRAUMA. *Jurnal Pendidikan Kedokteran Indonesia: The Indonesian Journal Of Medical Education*, *9*(1), 32-43. https://doi.org/10.22146/jpki.46845

Wu, J. (2021). Learning analytics on structured and unstructured heterogeneous data sources: Perspectives from procrastination, help-seeking, and machine-learning defined cognitive engagement. *Computers & Education*, *163*, 104066. https://doi.org/10.1016/j.compedu.2020.104066

Wu, S., Van Veen, B., & Rau, M. (2020). How drawing prompts can increase cognitive engagement in an active learning engineering course. *Journal Of Engineering Education*, *109*(4), 723-742.

Xu, B., Chen, N., & Chen, G. (2020). Effects of teacher role on student engagement in WeChat-Based online discussion learning. *Computers & Education*, *157*, 103956. https://doi.org/10.1016/j.compedu.2020.103956

Zawacki-Richter, O., Kerres, M., Bedenlier, S., Bond, M., & Buntins, K. (2020). *Systematic Reviews in Educational Research*. Springer VS.

Zhu, E. (2006). Interaction and cognitive engagement: An analysis of four asynchronous online discussions. *Instructional Science*, *34*(6), 451-480. https://doi.org/10.1007/s11251-006-0004-0

Appendices

Appendix 1: MISE's Curricular Plan

MISE2013 — 2020/2021 ▾ | Hide Rules

Second Cycle

Credits for Approval: 120.0

Organizational Architecture of Information Systems (Ead) Year 1, Sem. 1	Semestral (S)	7.5 Cred.	C - 40.00 - AW - 170.0 - T - 210.0
Usability and Information Systems (Ead) Year 1, Sem. 1	Semestral (S)	7.5 Cred.	C - 40.00 - AW - 170.0 - T - 210.0
Enterprise Technological Architectures (Ead) Year 1, Sem. 2	Semestral (S)	7.5 Cred.	C - 40.00 - AW - 170.0 - T - 210.0
Information Systems Modeling (Ead) Year 1, Sem. 2	Semestral (S)	7.5 Cred.	C - 40.00 - AW - 170.0 - T - 210.0
Seminars on Information and Enterprise Systems (Ead) Year 2, Sem. 1	Semestral (S)	7.5 Cred.	C - 3680.00 - AW - 0.0 - T - 3680.0

Dissertation

Credits for Approval: 45.0

Dissertation (Ead) Year 2, Sem. 1	Semestral (S)	30.0 Cred.	C - 210.00 - AW - 630.0 - T - 840.0
Project (Ead) Year 2, Sem. 1	Semestral (S)	15.0 Cred.	C - 105.00 - AW - 315.0 - T - 420.0
Dissertation (Ead) Year 2, Sem. 2	Semestral (S)	30.0 Cred.	C - 210.00 - AW - 630.0 - T - 840.0

Optional

Credits for Approval: 7.5 to 22.5

Corporate Control and Corporate Governance (Ead) Year 1, Sem. 1	Semestral (S)	7.5 Cred.	C - 48.90 - AW - 208.0 - T - 256.9
Introduction to Programming (Ead) Year 1, Sem. 1	Semestral (S)	7.5 Cred.	C - 40.00 - AW - 170.0 - T - 210.0
User Centred Design (Ead) Year 1, Sem. 2	Semestral (S)	7.5 Cred.	C - 40.00 - AW - 170.0 - T - 210.0
Engineering Economics (Ead) Year 1, Sem. 2	Semestral (S)	7.5 Cred.	C - 48.90 - AW - 208.0 - T - 256.9
Engineering Management Projects (Ead) Year 1, Sem. 2	Semestral (S)	7.5 Cred.	C - 49.40 - AW - 210.0 - T - 259.4
Introduction to Data Bases (Ead) Year 1, Sem. 2	Semestral (S)	7.5 Cred.	C - 40.00 - AW - 170.0 - T - 210.0
Multimedia Content Production (Ead) Year 1, Sem. 2	Semestral (S)	7.5 Cred.	C - 40.00 - AW - 170.0 - T - 210.0

Curricular Units - Uab

Credits for Approval: 15.0 to 30.0

Information Technology and Business Communication Year 1, Sem. 1	Semestral (S)	7.5 Cred.	C - 40.00 - AW - 170.0 - T - 210.0
Conception of Organizational Learning Objects Year 1, Sem. 2	Semestral (S)	7.5 Cred.	C - 40.00 - AW - 170.0 - T - 210.0
Research Methods-Ead Year 2, Sem. 1	Semestral (S)	7.5 Cred.	C - 40.00 - AW - 170.0 - T - 210.0

Optional

Credits for Approval: 0.0 to 15.0

Formal Analysis of Social Networks Year 1, Sem. 1	Semestral (S)	7.5 Cred.	C - 40.00 - AW - 170.0 - T - 210.0
Digital Business Year 1, Sem. 1	Semestral (S)	7.5 Cred.	C - 40.00 - AW - 170.0 - T - 210.0
Web Platform Management Year 1, Sem. 2	Semestral (S)	7.5 Cred.	C - 40.00 - AW - 170.0 - T - 210.0

Legend:

S - By Semester
A - Anual
C - Contact Lesson Hours
AW - Autonomous Work
T - Total Load (C + AW)

Appendix 2: Students' Questionnaire Plan

BLOCKS	GOALS	QUESTIONS / OBSERVATIONS
Questionnaire Legitimacy and Respondent Motivation	Identify a correlation between the learning strategies distance learning students use and their learning results, learn their opinion on distance/online learning and compare their perceived effort with their performance.	Goal Target Demographic Length of the Survey Anonymity and Confidentiality Data Usage Voluntary Survey Thanking Respondents
Respondent's Profile (Demographic Data)	Characterization of the respondent's profile.	Q1: Gender Q2: Age Group Q3: Academic Qualifications Q4: Employment Status Q5: Number of Dependents
Self-Regulation, Learning Strategies and Results	Understand ease of self-regulation. Understand which learning strategies are used. Understand the perceived influencers of learning results. Effort VS Results VS Actual Knowledge Retention	Q6: Where does your motivation to study come from? Q7: How would you rate your ease to self-regulate your learning? Q8: What Learning Strategies do you generally use? Q9: Do you tend to use different Learning Strategies, when tackling different courses? Q10: What do you attribute your Learning Results to? Q11: Do you feel that your effort in this master's generally matched your final grade? Q12: Do you feel that the final grades of the courses you took generally match the knowledge you gained?
Distance & Online Learning	Understand the perceived advantages and disadvantages of distance learning in the learning process. Understand the effects of interaction on performance. Engagement Level in Distance VS Traditional Classroom Learning	Q13: Which of the following advantages of Distance/Online Learning did you feel in your learning process? Q14: Which of the following disadvantages of Distance/Online Learning did you feel in your learning process? Q15: Which type of interaction did you find more helpful in your studies? Q16: Rate the amount of interaction with the teacher in distance/online learning, as

		opposed to traditional classroom learning. Q17: Do you think that difference in amount of interaction with the teacher was important to your learning process and final grade? Q18: Rate the amount of interaction with colleagues in distance/online learning, as opposed to traditional classroom learning. Q19: Do you think that difference in amount of interaction with colleagues was important to your learning process and final grade? Q20: How would you rate your Engagement Level in this master's, as compared with a traditional classroom degree? Q21: Do you feel that your participation effort, in asynchronous online discussions, matches your final grade?
TICE - Information Technology and Business Communication	Understand engagement level with this course. Effort VS Results VS Actual Knowledge Retention	Q22: How engaging do/did you find this course? Q23: How does/did Distance Learning affect your Engagement Level with this course? Q24: How would you rate your ease to self-regulate your learning for this course? Q25: Do you feel that your effort matched your final grade? Q26: Do you feel that your final grade matches the knowledge you gained?
COAO - Conception of Organizational Learning Objects	Understand engagement level with this course. Effort VS Results VS Actual Knowledge Retention	Q27: How engaging do/did you find this course? Q28: How does/did Distance Learning affect your Engagement Level with this course? Q29: How would you rate your ease to self-regulate your learning for this course? Q30: Do you feel that your effort matched your final grade? Q31: Do you feel that your final

		grade matches the knowledge you gained?

Appendix 3: Teachers' Questionnaire Plan

BLOCKS	GOALS	QUESTIONS / OBSERVATIONS
Questionnaire's Legitimacy and Participant Motivation and Role	Explain the questionnaire's purpose, its structure, their role in the questionnaire and obtain their informed consent.	Goal Target Group Length of the Survey Questionnaire's Structure Anonymity and Confidentiality Data Usage Voluntary Survey Thanking Participants
Teacher	Characterization of the teacher's profile.	Years Teaching in MISE Involvement (Nature of Activities) with the MISE Scientific Areas of Interest Curricular Units Taught in the MISE
Student Engagement in the MISE	Understand Teachers' Views on MISE's students' engagement	Students' Ease to Self-regulate Student Engagement in Curricular Units you teach Engagement's effect on final grade Students' Interactions with Teachers (amount and quality) Students' Interactions with Students (amount and quality) Students' Interactions with Technology (amount and quality) Engagement in asynchronous interactions Engagement in synchronous interactions Students' Interactions with Content (amount and quality) Rank types of learning content for engagement Pedagogical strategies used Response to the pedagogical strategies