NOVA IMS Information Management School

MGI

Mestrado em Gestão de Informação
Master Program in Information Management

CAN E-LEARNING ENHANCE STUDENTS' ACADEMIC ACHIEVEMENT IN A COUNTRY WITH LOW ICT DEVELOPMENT? ANALYSING STUDENTS' PERCEPTIONS ON THE USE OF E-LEARNING DURING THE COVID-19 PANDEMIC

Bruna Rafaela Correia Vinhas

Dissertation presented as partial requirement for obtaining the Master's degree in Information Management with a specialization in Knowledge Management and Business Intelligence

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

BOOK SPINE

2022 | Title: Can e-learning enhance students' academic achievement in a country with low ICT development? | Bruna Rafaela Correia Vinhas | MGI

2022 | Title: Can e-learning enhance students' academic achievement in a country with low ICT development? | Bruna Rafaela Correia Vinhas | MGI

NOVA Information Management School

Instituto Superior de Estatística e Gestão de Informação

Universidade Nova de Lisboa

CAN E-LEARNING ENHANCE STUDENTS' ACADEMIC ACHIEVEMENT IN A COUNTRY WITH LOW ICT DEVELOPMENT? ANALYSING STUDENTS' PERCEPTIONS ON THE USE OF E-LEARNING DURING THE COVID-19 PANDEMIC

by

Bruna Vinhas

Dissertation presented as partial requirement for obtaining the Master's degree in Information Management, with a specialization in Knowledge Management and Business Intelligence

Advisor: Pedro Maia Malta

November 2022

ACKNOWLEDGMENTS

Firstly, I would like to thank God for guiding me through all my academic journey and for giving me the necessary strength to finish one more chapter.

To my advisor, Professor Pedro Malta, thank you for the constant encouragement, guidance and valuable advice.

To my parents, Elsa and Vítor, words would never be enough to thank you for everything you have done for me. Thank you for believing in myself even when I did not and for the countless opportunities you gave me to follow my dreams and be happy.

To my little brother, Hugo, thank you for being the best brother I could ever ask for. You motivate me to be better every day.

To the rest of my family, especially my auntie Goretti, thank you for being present even from far away and for the unconditional love and support.

To my best friends, Ricardo, Titi, Soraia, Ana, Luma and Kyara thank you for the constant motivation and for always being here for me. Life is much happier because of you guys.

ABSTRACT

E-learning is an approach that has been increasingly used by higher education institutions (HEI) in developed countries to improve teaching and learning efficiency. A particularly different reality from the experienced in most developing countries, where the take-up and the implementation of e-learning initiatives are at a very preliminary stage due to the existence of numerous barriers.

This study aims to describe and understand if and how the e-learning implementation affected students' academic achievement in a country with low development in Information and Communication Technologies (ICT) and in a pandemic context in which the educational system of the country has undergone major changes. In addition, it aims to identify the main barriers faced by students during the e-learning implementation, the profile of students who were more affected by the e-learning implementation and possible solutions to successfully add and maintain e-learning initiatives to the programs of HEI.

The study is based on the perceptions of 102 Angolan students obtained through a paper-based questionnaire. Results indicate that the full benefits of e-learning are not perceived by students when there are institutional barriers and ICT barriers preventing its adequate implementation and maintenance. Results also fortify the evidence that the e-learning implementation in a country with low ICT development is unlikely to successfully occur and can in fact have a negative impact on students' academic achievement.

Keywords—E-learning, ICT, developing countries, higher education, academic achievement.

INDEX

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

As seen in recent years, the development of ICT and the use of the internet are changing the way many educational activities are conducted. Academics have realized the vast potential of the internet as a learning tool and several universities have become increasingly enthusiastic about the possibility of online learning to provide accessible and up-to-date education regardless of time and place (Ayu, 2020).

As the popularity of e-learning increases, it also becomes difficult to identify a commonly accepted definition for the term. In this study, e-learning is defined as an approach to teaching and learning that is based on the use of electronic media and devices as tools for improving access to training, communication and interaction (Sangrà et al., 2012).

Before the outbreak of the covid-19 pandemic, the implementation of e-learning initiatives at HEI of developing countries were at a very embryonic stage. Some of the few initiatives existing in Angola to develop ICT policies and consequently forward the implementation of e-learning in higher education include the creation of the *Plano Nacional da Sociedade de Informação* (PNSI), aiming to bolster the use of ICT in education (Barbante, 2021) and the development of e-learning centres in the more established public and private higher education institutions, as is the case of Universidade Agostinho Neto (UAN), a public university, that developed a distance learning centre in partnership with Global Development Learning Network (GDLN).

In the wake of the pandemic and as a measure to prevent the virus from spreading, Angola, as most countries, was forced to fully adopt the e-learning strategy, which suddenly and abruptly changed the way teaching was undertaken in the country.

In order for a university to be able to adopt and use e-learning in educational activities, it is highly preferable that sufficient resources and conditions within the organization already exist (Mamattah, 2016). The shortage of resources and conditions within higher education institutions, as well as the lack of country-wide initiatives in place to promote e-learning, made the transition from face-to-face classes to online learning in Angola a challenging process for students, teachers, and policymakers.

Although there are a great number of studies addressing students perceptions on e-learning implementation in higher education institutions in a general context (Zhang et al., 2006; Al-Fadhli, 2008; Chee Meng Tham & Werner, 2005; Algahtani, 2011; Abou El-Seoud et al., 2014), there are few compatible studies addressing the reality of the e-learning implementation in countries with low ICT development and in a pandemic context where e-learning had to be implemented without prior preparation. Also, few studies address the direct impact of the e-learning implementation on students' academic achievement in countries with low ICT development. It is a subject that remains open to debate and has not been thoroughly explored (Trucano, 2005).

The current research is motivated by this gap found in literature and aims to answer the research question (RQ): can e-learning enhance students' academic achievement in a country with low ICT development?

The main objective of this research is to assess the impact of the e-learning implementation on the academic achievement of higher education students in a country with low ICT development and in a pandemic context. Besides the main objective, it also aims to achieve the following specific objectives:

- Identify the e-learning barriers according to the students' perceptions.
- Identify the impact of e-learning on students' academic performance according to their gender and income group in order to understand the profile of students who were more affected.
- Identify possible solutions to successfully integrate and maintain e-learning initiatives in the higher education institutions of a country with low ICT development, ensuring that the students' needs are taken into consideration.

The document is organized as follows. Section 2 explains the background of the e-learning concept and types, provides some context on the use of e-learning in higher education, addresses the relationship between the e-learning implementation and the development of ICT, and examines published studies on the impact of e-learning on students' academic achievement. Section 3 describes the methodology used, including the research context and the data collection method. Section 4 presents the results. Section 5 presents the discussion of the results. Section 6 presents the conclusions and implications of the study. Section 7 presents the limitations and perspectives for future studies.

2. LITERATURE REVIEW

2.1 E-LEARNING CONCEPT

Higher education is recognized today as a capital investment and plays an extremely important role in the social and economic development of a country, especially in developing countries, where growth through education is considered one of the main keys to eradicate poverty and achieve development.

In recent decades, a technological revolution has taken place, and the use of e-learning in higher education as a primary teaching method has grown considerably. Agendas of educational institutions all around the world have recognized the benefits of e-learning as a teaching method and described it as having the prospect to transform people, knowledge, skills, and performance (Henry, 2001).

E-learning as a concept covers a broad category of applications and processes (Luminita, 2011) and it is therefore difficult to identify a single definition for the term that would be accepted by the majority of the scientific community. Dublin (2003) states that the existing definitions of e-learning tend to reveal the specialization and interest of the researchers. Sangrà et al. (2012) claim that the different understandings of the e-learning concept are conditioned by the authors' professional and academic profiles. Authors with a more technological profile gear their definitions toward technology or access systems, while authors with an educational profile focus on the new educational paradigm and communication.

The definition considered in this research is based on a study conducted by Sangrà et al. (2012) that focused on the creation of a single and inclusive definition of e-learning based on an extensive literature review in which several e-learning definitions were analysed and on a survey responded by recognised experts in the field of both education and ICT. In that respect, e-learning is an approach to teaching and learning, representing all or part of the educational model applied, that is based on the use of electronic media and devices as tools for improving access to training, communication, and interaction and that facilitates the adoption of new ways of understanding and developing learning.

2.2 E-LEARNING TYPES

As with the e-learning concept, the literature presents many different classifications regarding the e-learning types.

Tîrziu & Vrabie (2015) identified three types of e-learning courses based on the delivery mode: traditional courses supplemented with technology, online distance-learning courses and, hybrid courses. In traditional courses supplemented with technology the professor teaches all sessions in the classroom, but incorporates technology in some or all classes, in online distance-learning courses, the professor conducts class sessions online, and in hybrid courses

the professor combines elements of traditional courses and online distance-learning courses to replace some classroom sessions with virtual sessions.

In accordance with that classification but using different terms, Algahtani (2011) identified three types of e-learning: adjunct, totally online and blended e-learning. The adjunct e-learning is the situation in which e-learning is employed at most as an assistant in the traditional classroom, the totally online e-learning is fully employed online and completely devoid of the traditional learning classroom and the blended e-learning combines adjunct and totally online e-learning.

This last classification leads to another that considers only online distance-learning courses and that is based on the timing of interaction: synchronous and asynchronous e-learning, one of the most frequent classifications of e-learning in the literature. The synchronous e-learning allows learners to converse with the instructors and also among themselves via the internet at the same time with the use of tools such as the videoconference and chat rooms (Arkorful & Abaidoo, 2015). The main features of the synchronous learning are: it is instructor-led, it is collaborative (students can interact with each other), and it is scheduled (synchronous); i.e., everyone is there at the same time (Henderson, 2003).

On the other hand, the asynchronous mode allows learners to converse with the instructors or teachers as well as among themselves over the internet at different times with the use of tools such as e-mails (Arkorful & Abaidoo, 2015). The main features of the asynchronous learning are: it is student-led, it is collaborative (students can interact with each other by leaving messages), and it is semi-scheduled (asynchronous); i.e., everyone is there but not necessarily at the same time (Henderson, 2003).

2.3 USE OF E-LEARNING IN HIGHER EDUCATION

The massive development of ICT and the emergence of e-learning have revolutionized the way teaching is conducted all over the world, offering a wide range of benefits for students, teachers, and institutions.

E-learning is a flexible teaching approach regarding time and place of delivery, therefore, it allows learners and teachers to access and organize classes, respectively, anywhere and when it is convenient for them (Holmes & Gardner, 2006; Nneka Eke, 2010; Algahtani, 2011). It is also a self-paced teaching approach, in the sense that it allows learners to study at their own pace and speed, considering their individual differences (Holmes & Gardner, 2006; Nneka Eke, 2010; Algahtani, 2011).

E-learning motivates learners to interact and exchange viewpoints with each other and with teachers, as they feel that they are in a safe environment where they can make mistakes without exposing themselves to a great degree (Holmes & Gardner, 2006; Nneka Eke, 2010; Algahtani, 2011). It also enhances learners' autonomy and independence, as they are not

exclusively dependent on the content provided by teachers during classes, and have several resources and materials to aid their studies (Nneka Eke, 2010; Algahtani, 2011).

Ultimately, e-learning enhances the efficacy of knowledge and qualifications of learners, as they can easily and instantly access a vast amount of information updated by teachers across the entire network (Holmes & Gardner, 2006; Algahtani, 2011) and is a cost-effective teaching approach, as it reduces several operational expenses including those for facilities and staff (Holmes & Gardner, 2006).

Several studies and authors have mentioned the benefits derived from the adoption of e-learning technologies. Nevertheless, current theories and practices in e-learning are neither simple nor coherent and its application in higher education occurs irregularly, randomly, and with varying degrees of success (Ayu, 2020).

Abou El-Seoud et al. (2014) conducted a study on the effect of e-learning on higher education. Their findings point out that e-learning success in higher education depends on the effectiveness of the delivery and adequate training of instructors. The findings of this study coincide with those obtained by Al-Fadhli (2008), which identify educators as the key to a successful e-learning experience and emphasize the importance of the intellectual and social competencies of the e-learning educator.

In identifying critical issues concerning the implementation of e-learning in higher education, Chee Meng Tham & Werner (2005) state that it is imperative that institutional, technological, and student issues are addressed simultaneously and that if any of these factors receive inadequate attention, successful e-learning is unlikely to occur. A similar study investigating the factors that affect e-learning effectiveness was conducted by Alakklouk (2012), who also reports that instructor characteristics, student characteristics, technology, and impediments have a strong relationship with e-learning effectiveness.

Trakru & Jha (2019) analysed the effectiveness of e-learning according to the experience of higher education students. The results obtained indicate that e-learning benefits can only be gained if it is properly implemented. In accordance, research findings by Adarkwah (2021) indicate that according to students' perceptions, e-learning is not an effective approach in developing contexts due to the existence of several barriers preventing its adequate implementation.

In short, the overall literature that addresses the implementation of e-learning in higher education suggests that its full benefits as perceived by teachers, policymakers and students are obtained only if it is properly delivered and used. Therefore, instructor characteristics, students' characteristics, institutional or organizational characteristics, and technological characteristics are critical factors to guarantee the success of e-learning implementation in higher education.

2.4 Addressing the relationship between the e-learning implementation and the development of Information and Communication Technologies (ICT)

In many developed countries the implementation of e-learning initiatives has reached advanced stages. This is, however, a very distant reality in developing countries, where the implementation and maintenance of e-learning initiatives are at a preliminary stage due to the existence of numerous barriers.

One of the most frequent barriers identified in the literature concerns the lack of an adequate ICT and e-learning infrastructure, including the lack of computers or other ICT tools, the lack of network, the lack of access to the internet, and the non-availability of special laboratories or classrooms at the universities to support students and teachers (Al-Azawei et al., 2016; Tarus et al., 2015; Adarkwah, 2021).

The insufficient financial investment from the government and from the universities is pointed to as the root cause of this barrier. The effective implementation of ICT into education involves substantial funding (Khan et al., 2012) and in most developing countries, the budget allocated to this matter is insufficient to fully support the proper implementation of e-learning, which includes the provision of a suitable ICT infrastructure, staff training, e-content development, and maintenance of e-learning systems (Tarus et al., 2015).

Another barrier hindering the implementation of e-learning in developing countries is the lack of technological skills and literacy on e-learning on the part of both students and teachers (Al-Azawei et al., 2016; Tarus et al., 2015; Adarkwah, 2021). In the majority of developing countries, students are trained during most of their academic path without recourse to any ICT tool or mechanism and as result end up not developing the required skills to support e-learning. Teachers are also unfamiliar with the use of e-learning technologies in teaching and although they have some technological skills, it may not be enough to adequately implement e-learning in teaching nor to develop e-content.

Research identifies the lack of interest and commitment among the teaching staff to use e-learning as an additional barrier faced by developing countries when implementing e-learning. The fear of losing jobs and the work of converting the tangible class materials to e-content are pointed to as the main factors behind teachers' lack of interest (Tarus et al., 2015).

The lack of accessibility to a quality internet connection both at home and at the university is also a barrier faced in developing countries seeking to implementing e-learning. The successful implementation of e-learning requires more than the simple access to the internet (which, in general, is already difficult in developing countries). It requires a quality internet connection, suitable to support important e-learning activities such as the upload and download of learning materials and the continuous access to online classes (Al-Azawei et al., 2016; Tarus et al., 2015; Adarkwah, 2021). The trigger of this barrier resides in the fact that the cost of a quality internet connection in most developing countries is very high and disproportionate to the average income of most households. In the literature, it is noteworthy that students

identify this barrier more than teachers do, as they are the group that has greater difficulty in affording an internet service that allows them to have a suitable connectivity (Al-Azawei et al., 2016).

Lastly, shortage of electricity is also a barrier that hinders the e-learning implementation in developing countries. Despite the progress made over the years in this regard, the lack of access to electricity 24/7 continues to plague several developing countries, especially in rural areas. The energy disruptions that occur during the course of online classes and assessments, as well as the limitation these disruptions cause in terms of accessing materials, impair the successful implementation of e-learning (Khan et al., 2012).

Table 1: Summary of the main barriers of the e-learning implementation in developing countries

Study/Author	Country	IDI 2017	Rank 2017	Barriers
(Adarkwah, 2021)	Ghana	4.05	116	Lack of skills, cost of the technologies used to support e-learning, lack of an adequate ICT infrastructure, lack of accessibility to quality internet connection, and lack of electricity access.
(Barbante, 2020)	Angola	1.94	160	Internet access restrictions, and lack of infrastructure conditions.
(Al-Azawei et al., 2016)	Iraq	Not Available	Not Available	Low internet bandwidth, insufficient financial support, inadequate training programs, lack of ICT infrastructure, and lack of ICT and e-learning literacy.
(Tarus et al., 2015)	Kenya	2.91	138	Inadequate ICT and e-learning infrastructure, lack of affordable and adequate internet bandwidth, lack of technical skills by the teaching staff, and lack of interest and commitment among the teaching staff to use e-learning.
(Khan et al., 2012)	Bangladesh	2.53	147	Inadequate ICT supported infrastructure, lack of electricity access, insufficient funds, political, social, and cultural factors, teachers' attitudes and beliefs about e-learning, and lack of knowledge and skills.

Source: Adapted from (Adarkwah, 2021; Barbante, 2020; Al-Azawei et al., 2016; Tarus et al., 2015; Khan et al., 2012; International Telecommunication Union, 2017)

From the overall literature on the barriers to the e-learning implementation, it is possible to conclude that e-learning thrives on the availability of ICT facilities, and for that reason an adequate ICT infrastructure plays an important role in the successful integration of e-learning in higher education institutions and the consequent improvement in students' academic achievement.

Several studies investigating the e-learning adoption in higher education institutions support this conclusion. The results of the study conducted by Ayu (2020) indicate that in order to benefit significantly from the opportunities offered by e-learning, students need to increase the level of their ICT skills and the available ICT infrastructure needs to be adequate.

Also, according to the results obtained in a study conducted by Mothibi (2015), ICT has a statistically significant positive impact on students' academic achievements when using e-learning, meaning that an adequate ICT infrastructure towards facilitating the use of e-learning can substantially improve students' e-learning-based academic achievements, and that the impact of e-learning on students' academic achievement cannot be isolated from the nature of the ICT infrastructure.

2.5 THE IMPACT OF E-LEARNING ON STUDENTS' ACADEMIC ACHIEVEMENT

Although many academic institutions are today making significant strides toward the use of more interactive e-learning strategies to effectively enhance the overall performance of students (Mothibi, 2015), the impact of e-learning on students' academic performance remain difficult to measure specially in developing countries. There are a number of studies reported in literature suggesting that e-learning can improve students' academic achievement, however some authors argue that the positive impact of e-learning on students' academic achievement has not been proven and despite thousands of impact studies it remains open to debate (Trucano, 2005).

Studying the effectiveness of e-learning, Boumedyen et al. (2011) found that it plays a major role in enhancing the performance of students. The overall results of this research demonstrate that the integration of software and computers in teaching has a significant effect on students' marks, and teaching without the use of books enhances the performance of students.

In a study conducted by Mothibi (2015), a meta-analysis methodology which focuses on combining the results of different studies was implemented in order to provide new insights on the impact of e-learning on students' academic achievement. The results indicate that the provision of adequate ICT infrastructure toward facilitating use of e-learning can lead to substantial improvements in students' academic achievement.

Neema-Abooki & Kitawi (2014) examined the impact of e-learning strategies on students' academic performance by comparing students' average results on courses deploying ICT in their delivery with those that do not. Their results indicate that the e-learning strategies

adopted had a positive impact on students' academic performance, but also that a digital divide in disfavour of poor students affects the effectiveness of e-learning at the university.

Similarly, Abdel Jawad & Shalash (2020) observed an increase in students' GPA while using e-learning, indicating that the implementation of the e-learning strategy had a positive impact in students' academic achievements.

With the aim of analysing the impact of e-learning on students' academic performance, Elfaki et al. (2019) developed a study in a higher education institution of Saudi Arabia involving 80 students, 40 of whom were an experimental group (e-learning group) and the other 40 were a control group (traditional group). In accordance with the results obtained in the studies mentioned above it was verified that the mean scores obtained by students from the e-learning group are statistically significantly higher than those from the traditional group, and therefore that e-learning can enhance students' academic achievement.

Following the previous methodology, Tegegne (2014) conducted a study in a higher education institution of Ethiopia, finding, however, that there is no statistically significant difference between the conventional approach and e-learning on students' academic achievement. Brotherton & Abowd (2004) also found no statistically significant differences in the grades obtained by the online versus face-to-face groups of students and concluded that the use of e-learning does not have a measurable impact on students' academic achievement.

From another point of view, research findings by Adarkwah (2021) in a higher education institution of Ghana indicate that the transition from the traditional approach to e-learning resulted in a negative effect on students' outcomes due to the existence of several barriers such as lack of ICT tools, internet, electricity, and technological skills.

Although the overall literature suggests that the e-learning strategy has a positive and statistically significant impact on the students' academic achievement (Boumedyen et al., 2011; Mothibi, 2015; Abdel Jawad & Shalash, 2020; Neema-Abooki & Kitawi, 2014; Elfaki et al., 2019), conflicting findings suggest that e-learning does not provide significant differences in students' performance (Tegegne, 2014; Brotherton & Abowd, 2004) and when there is a lack of ICT tools, internet, electricity, and technological skills from students and teachers, it can even negatively affect students' academic achievement (Adarkwah, 2021).

3. METHODOLOGY

3.1 RESEARCH CONTEXT

The data used to conduct this research were collected in Angola. Angola is a low development country located in Southern Africa with a total population of approximately 33.6 million and with more than 11 spoken languages, with Portuguese as the official language (Central Intelligence Agency, 2020).

32% of the Angolan population lives in a situation of poverty (World Bank, 2020) and only 11% is enrolled in higher education (UNESCO, 2019). Among the primary causes of poverty in the country are listed the devastation of a prolonged civil war, the lack of quality education, and the income inequality (The Cross-Border Road Transport Agency, 2021).

Access to higher education in Angola is a privilege reserved for only a few individuals. The economic classes with greater economic capital are those that also have a high degree of cultural capital and have a greater possibility of entering higher education. On the other hand, less favoured classes often do not even manage to complete high school.

Regarding ICT access, the country's current situation is very similar to that experienced in most developing countries. According to the International Telecommunication Union (2017) the value of the ICT development index (IDI) of Angola, which is an index "used to monitor and compare developments in ICT between countries and over time", was 1.94 points, occupying the 160th position in a rank with 175 other countries.

Also, as can be seen in Table 2, the number of citizens with access to core ICT tools is very limited, and the access to these technologies, such as the access to higher education, is reserved to a very specific group of individuals.

Table 2: Percentage of citizens with access to core ICT tools

Internet users (2016)	**Computer users (2014)**	**Mobile phone users (2014)**
13%	9.9%	37.5%

SOURCE: Adapted from (UNDP, 2016; UNDP, 2018; UNDP, 2020; INE, 2014)

3.2 DATA COLLECTION METHOD AND ETHICAL PROCEDURES

With the purpose of obtaining useful statistics and information on key indicators of the phenomena under study, the data collection was undertaken using a quantitative approach carried out through the use of a paper-based questionnaire.

As it is a "Those Being Researched" study, aiming to obtain a randomly selected sample capable of guaranteeing that the characteristics of the subjects in the study appear in the same proportion as they exist in the total population (Castellan, 2010), the decision of implementing a paper-based questionnaire, despite being more laborious and time-consuming, was crucial to obtain a diversified sample, including students' with limited access to the internet and to ICT tools. Furthermore, it was verified during the questionnaire implementation, that the majority of students had a disruptive lack of literacy on the subject in question, and it was thus important to have someone present to clarify doubts about the questions and their meaning.

Before distributing the questionnaires, a formal letter asking for permission to carry out the study was sent to the dean of the university and after approximately two weeks, the authorization to carry out the study was received, and the data collection was initiated. The questionnaires were distributed over a five-day period in a higher education institution of Angola to the maximum number of students possible. An exact number of questionnaires to be delivered was not defined *a priori* because the size of the target population; higher education students who used e-learning during the pandemic, is difficult to ascertain since the implementation of e-learning in higher education institutions in Angola occurred very irregularly depending on the province, on the type of institution (public or private), and sometimes even on the degree program (programs with greater use of technology such as computer engineering, had greater adherence to e-learning than "more theoretical" courses such as law, due mainly to the fact that both students and teachers of technology-related programs already used ICT tools and the internet in their daily basis before the pandemic).

3.3 QUESTIONNAIRE DESIGN

The questionnaire is organized in seven blocks. The first block aims to identify some of the sociodemographic characteristics of the respondents, including their gender, age group, academic year, occupation, area of residence, and income group. This block is especially important because one of the objectives of this research is to determine the profile of students who were more affected by the implementation of e-learning during the pandemic, i.e., to determine if some sociodemographic characteristics might have influenced students' adaptation to e-learning and consequently their academic achievement.

The digital divide, defined as the gap between those who have access to vital Information and Communication Technology (ICT) resources and those who do not (DiMaggio et al., 2004), comprises disparities in access between individuals with high and low income and between men and women.

Angola, like most developing countries, has extensive social and economic inequality. The World Bank (2020) verified that the Gini-coefficient, a measure that represents the income distribution of a country's population, in Angola is 0.51. This coefficient varies from 0 to 1, where 0 represents perfect equality and 1 represents maximum inequality. Thus, Angola is considered a country with a high level of inequality, and that could have directly influenced the students' adaptation to e-learning, making the access to teaching materials and to online classes easier for students with a higher income level.

Regarding gender disparities, several studies prove that although barriers to accessing ICT tools and the internet in developing countries are prevalent in both genders, women have other social and cultural obstacles that put them in a less favourable situation. Antonio & Tuffley (2014) stated that women in developing countries are trapped in traditional family roles and lack the basic digital literacy skills which prevents them from reaching their full potential. In Angola, this is the situation experienced in most households, not only for women but also for children and teenagers. The female gender is seen as a source of support for the family, and even in educated families, women assume a disproportionately heavy burden of household duties. Therefore, even when the internet or ICT tools are available at their residence, they may not be able to use them since they are busy with other responsibilities. This traditional role of women in the household can influence their academic achievement when using e-learning.

The second block of the questionnaire aims to analyse students' access to core ICT tools and to the internet both at home and at the university, as well as their degree of satisfaction using them.

The third and the fourth block of the questionnaire are very similar. While the third block focuses on analysing students' experience with e-learning before the pandemic, in order to identify if the phenomenon of taking online classes was in fact completely new for students, the fourth block analyses students' experience with e-learning during the pandemic, including the way students participated in online classes, the platforms and tools they used, and their degree of satisfaction with them.

The fifth block intends to analyse the impact that the e-learning implementation had on students' academic achievement, i.e., if it positively or negatively affected their academic performance and if it affected some important academic achievement determinants.

The sixth block aims to identify the main barriers faced by students during the implementation of e-learning.

In addition, the questionnaire has a seventh block that includes an open-response question, with the aim of investigating viable solutions, according to the students' perceptions, to successfully implement and maintain e-learning initiatives at higher education institutions, both at country and institutional level.

4. PRESENTATION OF THE RESULTS

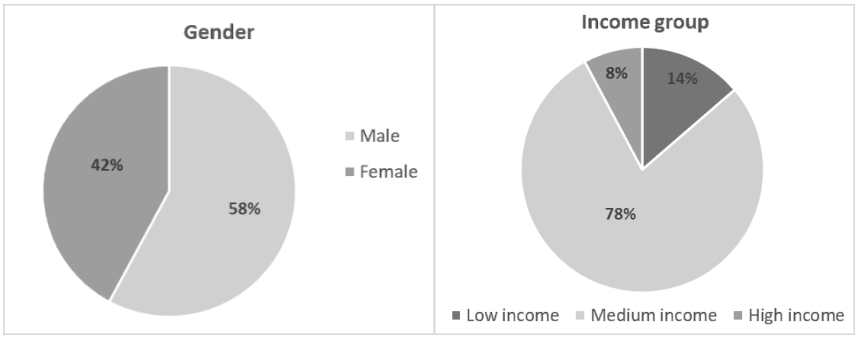
The analysis of the data collected was proceeded using the Microsoft Excel tool. Results are reported below following the order of the questionnaire blocks.

4.1 SOCIO-DEMOGRAPHIC CHARACTERISTICS

As can be seen in the figures below, 58% of the sample is composed by males and 42% by females. With regard to the income group, most students belong to the middle class, while only 8% and 14% belong to the upper and lower class, respectively.

These two variables are particularly important since one of the specific objectives of the research is to identify if the impact of e-learning on students' academic achievement varies according to the students' gender and/or income group. It can already be anticipated that we have a more balanced number of individuals per class in the variable gender and that this variable therefore allows us to obtain results that are more representative of each class of individuals.

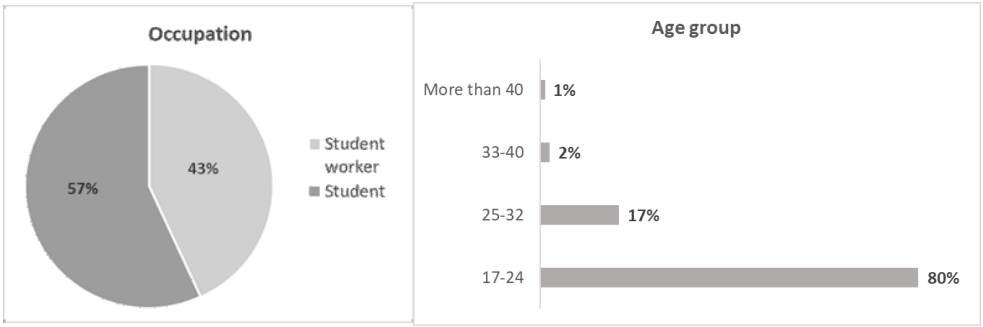
Figure 1: Distribution of students according to their gender and income group



Additionally, other socio-demographic characteristics such as the occupation, age group, academic year and household size were analysed.

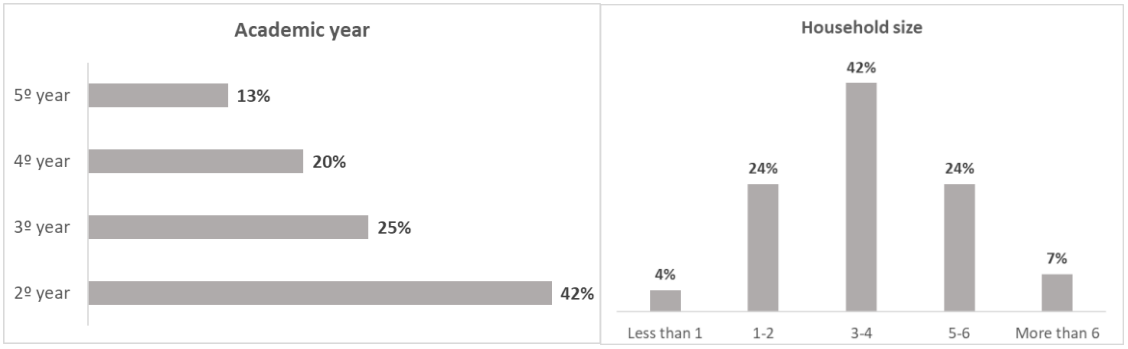
Figure 2 shows that the majority of students (57%) are full time students, while 43% study and work. In terms of age group, as expected, 80% of the sample belong to the age group of 17-24 and only 1% belong to the group that is over 40 years old.

Figure 2: Distribution of students according to their occupation and age group



Regarding the academic year and household size, most students are in the second year of the bachelor's degree, which means they took online classes during their first year and live in a small household (70% of them live with a maximum of 4 people).

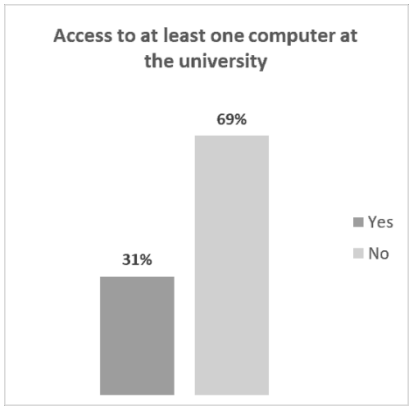
Figure 3: Distribution of students according to their academic year and household size



4.2 ICT ACCESS

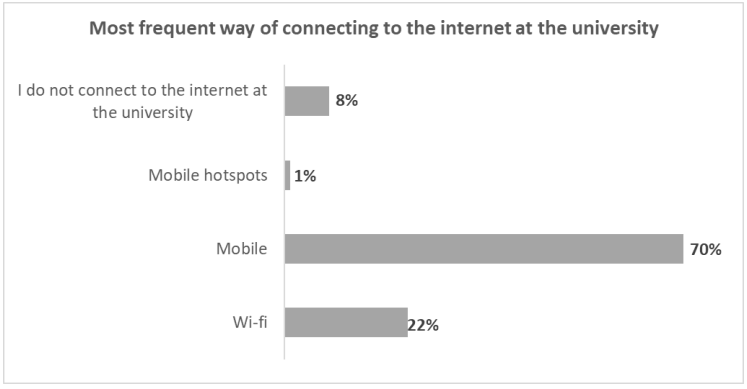
Regarding the access to core ICT tools and to the internet at the university, 69% of the students stated that they do not have access to a single computer at their university.

Figure 4: Students' access to at least one computer at the university



Also, 70% reported that they usually connect to the internet through a paid mobile plan and 8% stated that they do not connect to the internet at the university at all.

Figure 5: Most frequent way of connecting to the internet at the university



These numbers are alarming in the sense that the university should be an asset for students to acquire new knowledge, and unquestionably, free access to both computers and the internet would allow students to access information more quickly and therefore to perform everyday academic tasks more efficiently.

On the other hand, regarding ICT access at home, 66% and 92% of students claim to have access to at least one computer and to a smartphone or tablet, respectively. Also, their most frequent way of connecting to the internet at home is via Wi-fi, which is a more reliable form of connection and capable of supporting e-learning.

Figure 6: Students' access to at least one computer and to a smartphone/tablet at home

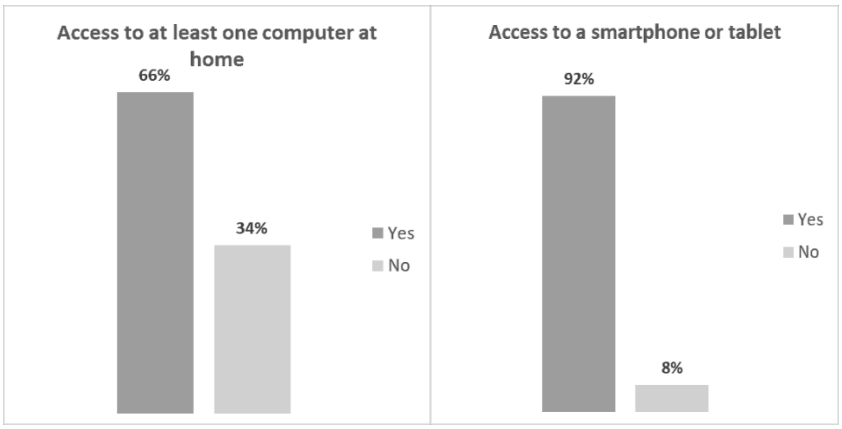
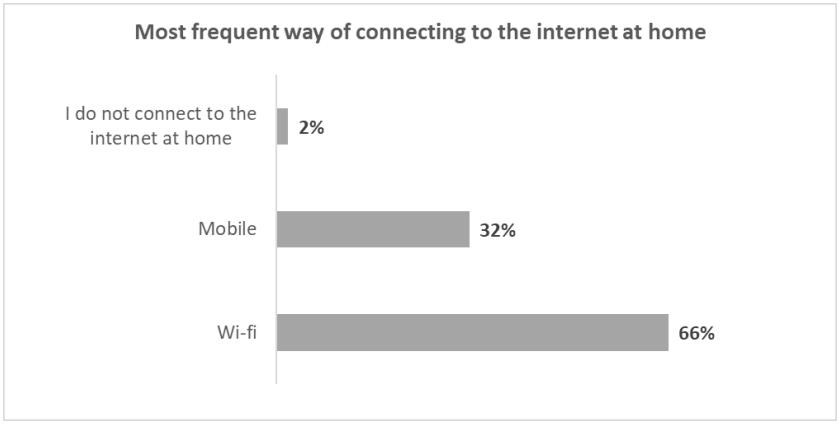


Figure 7: Most frequent way of connecting to the internet at home



As for the level of satisfaction with the quality of the internet connection, the results are also more worrisome at the university than at home. As seen in Table 3, most students (62 of the 102 students interviewed) claim to be *very unsatisfied* with the quality of the internet connection at the university, only 4 of the 102 students interviewed said that they were between *satisfied* and *very satisfied*, and on a scale of 1 to 5 (1 being the lowest level of satisfaction) the average level of satisfaction per student with the quality of the internet at the university is 1.63.

In terms of the quality of the internet connection at home, the number of satisfied and unsatisfied students is quite balanced. 38 students are between *unsatisfied and very unsatisfied*, while 44 are between *satisfied* and *very satisfied*. Accordingly, the average level of satisfaction is 3.04, which corresponds to the label *neutral* or *neither satisfied nor unsatisfied.*

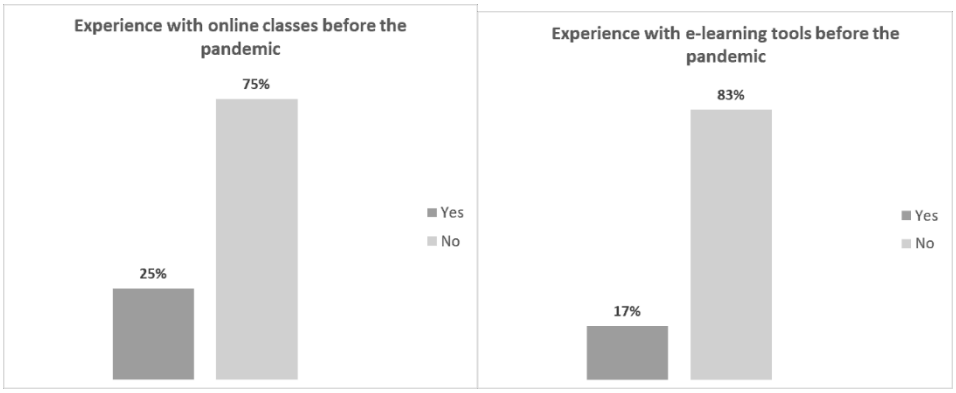
Table 3: Level of satisfaction with the quality of the internet

	1	2	3	4	5	Average
Level of satisfaction with the quality of the internet connection at the university	62	12	16	1	3	1.63
Level of satisfaction with the quality of the internet connection at home	24	14	18	22	22	3.04

4.3 E-LEARNING EXPERIENCE BEFORE THE PANDEMIC

As expected, most students (75% and 83%, respectively) never had an online class or used any e-learning tools before the pandemic.

Figure 8: Percentage of students who had experience with e-learning platforms and tools before the pandemic



The few students who had taken online classes and used e-learning tools before the pandemic (25% and 17%, respectively) used mostly Zoom to access classes and Webmail to access the class materials.

It is important to mention that these two questions were open-response questions in order to understand the level of literacy of students on existing e-learning platforms and tools. The result incorporates some errors regarding the e-learning tools. Some of the students considered WhatsApp and Skype as e-learning tools, when, in fact, Skype can be considered an e-learning platform and WhatsApp is nothing more than a social network.

Figure 9: Platforms where students attended online classes before the pandemic

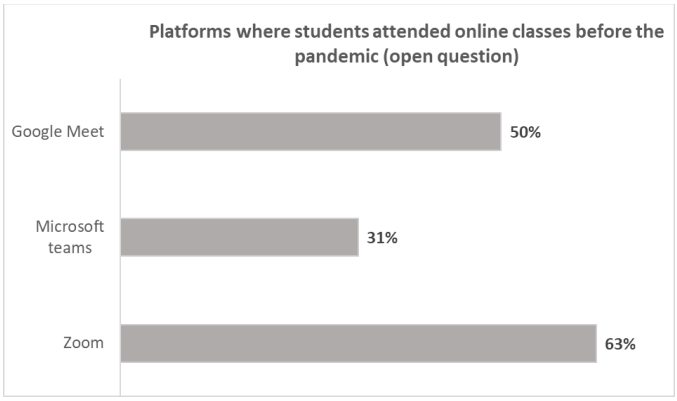
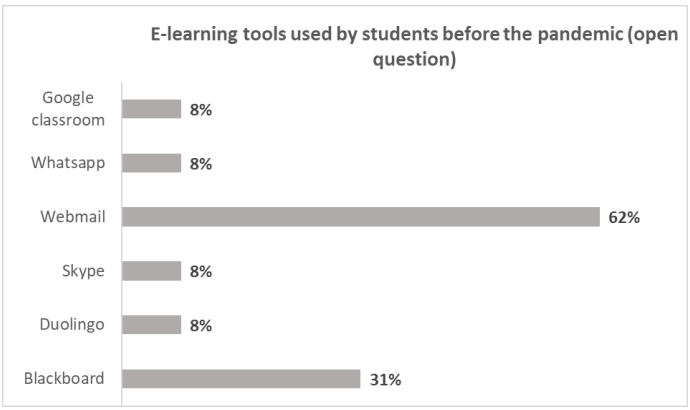


Figure 10: E-learning tools used by students before the pandemic



When it comes to the level of satisfaction with the e-learning tools, 5 of the 17 students who had used e-learning tools before the pandemic reported to be between *very unsatisfied* and *unsatisfied*, 6 reported to be *satisfied* and 5 reported to be *neutral*. The average of this variable is 2.94, which is closer to the label *neutral.*

The level of satisfaction with the e-learning platforms provide us with more information; 14 of the 25 students who had used e-learning platforms before the pandemic were between *very unsatisfied* and *unsatisfied*, 8 were between *very satisfied* and *satisfied,* and 2 were *neutral* on the topic. The average level of satisfaction is 2.46, allowing us to conclude that on average students were unsatisfied with the e-learning platforms they used before the pandemic.

Table 4: Level of satisfaction with the e-learning platforms and tools used before the pandemic

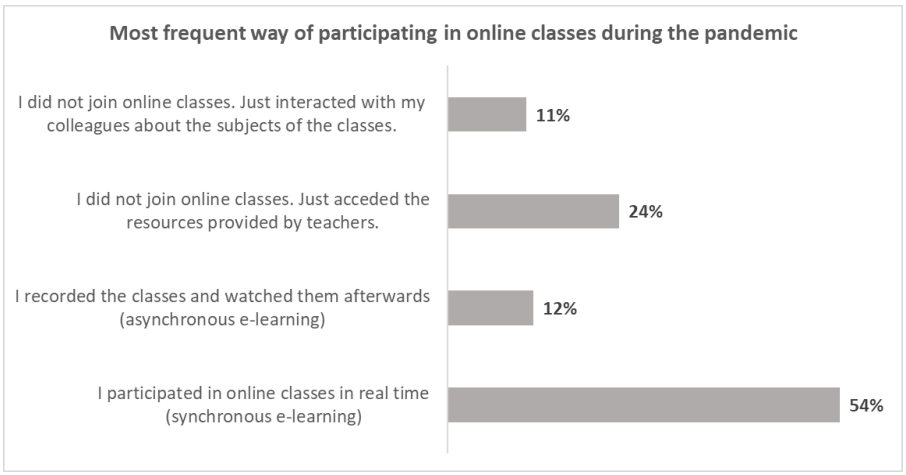
	1	**2**	**3**	**4**	**5**	**Average**
Level of satisfaction with the e-learning tools used before the pandemic	2	3	5	6	0	2.94
Level of satisfaction with the e-learning platforms used before the pandemic	8	6	2	7	1	2.46

4.4 E-LEARNING EXPERIENCE DURING THE PANDEMIC

54% of students stated that they participated in online classes in real time and 12% stated that although they did not participate in classes in real time (because they were busy doing other things), they were present in classes to record them and watch the video afterwards. These numbers are very important since they reveal that most students had the possibility of accessing online classes in real time.

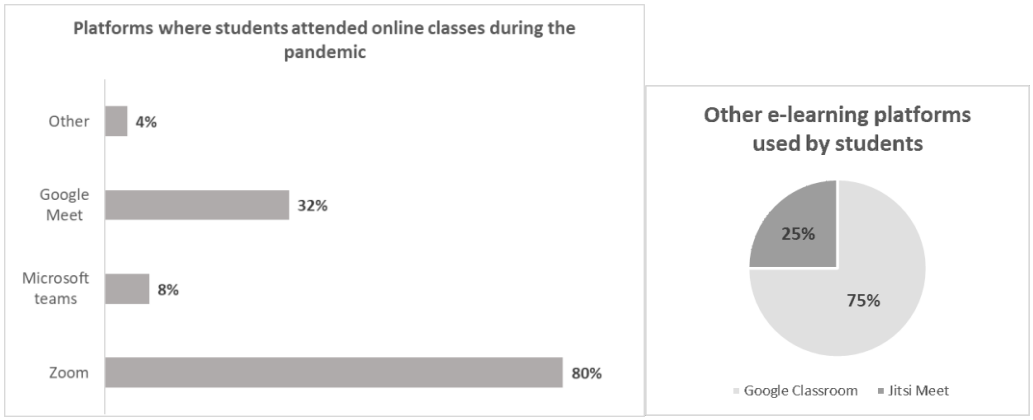
Nonetheless, 35% of students still report having not participated in online classes at all, following the topics of the classes through the resources provided by teachers, or only through interactions with other colleagues who had the opportunity to attend classes.

Figure 11: Most frequent way of participating in online classes during the pandemic



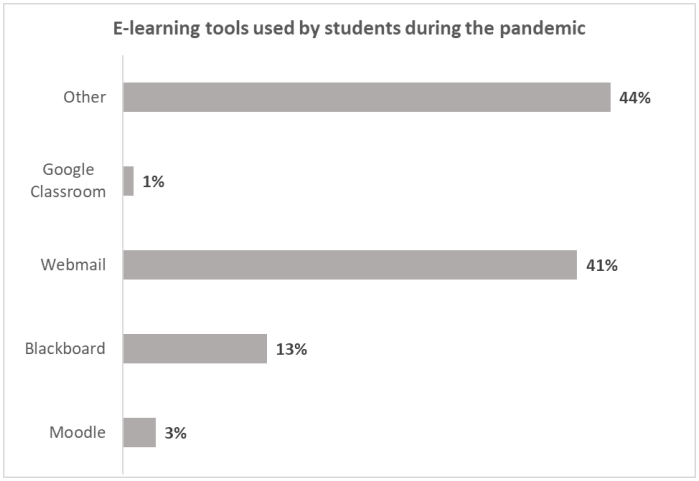
In terms of platforms, the vast majority of students (80%) had their classes on Zoom, followed by Google Meet (32%) and by Microsoft Teams (8%). 4% of students claimed to have used other platforms and when asked in the following question to identify the platform(s) used, the answers were Google Classroom, an e-learning tool that can be used together with an e-learning platform (Google Meet) to attend online classes, but which by itself is not considered a platform, and Jitsi Meet, which is in fact an e-learning platform not very used, to the best of my knowledge.

Figure 12: E-learning platforms used by students during the pandemic



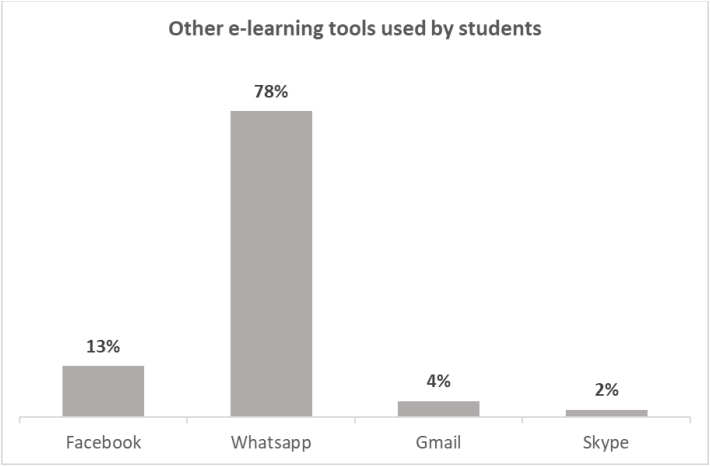
As can be seen in Figure 13, the e-learning tool most used by students during the pandemic was Webmail (41%), followed by Blackboard (13%), Moodle (3%) and Google Classroom (1%). Nonetheless, what really stands out in the responses to this question is the overwhelming number of students who responded with the "other" option (44%).

Figure 13: E-learning tools used by students during the pandemic



When asked in the next question what other tools students used, almost all (78%) answered WhatsApp and 13% answered Facebook, which indicates that the interaction with teachers and the access to the class resources of 91% of the students who answered with the "other" option (equivalent to 41 students, and therefore, 40% from the total of students) was done through social networks, and not in fact through e-learning tools.

Figure 14: Other e-learning tools used by students during the pandemic



The results of the level of satisfaction were very similar for the three variables: e-learning strategy, tools, and platforms.

When evaluating the e-learning strategy adopted by their institution during the pandemic, 46 students, which corresponds to 45% of the total, reported to be *very unsatisfied* and only 10

students, 9% of the total of students, reported to be *very satisfied.* That resulted in an average of 2.27 per student, which corresponds to the label *unsatisfied*.

Half of the students interviewed (51 students) reported to be between *very unsatisfied* and *unsatisfied* with the e-learning tools used during the pandemic, 26 were *neutral* on that question*,* 22 reported to be *satisfied,* and none of the students reported to be *very satisfied.* It is also possible to conclude that on average, students were unsatisfied (2.43) with the e-learning tools they used during the pandemic.

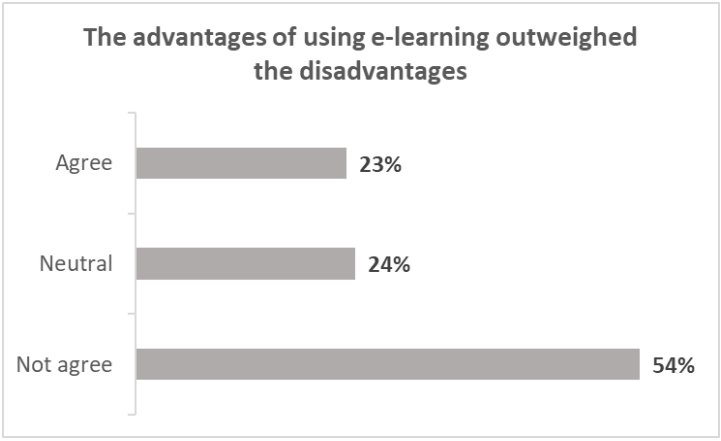
The average level of satisfaction with the e-learning platforms is a bit higher, but also does not show a positive level of satisfaction. In fact, only 32 students (31%) reported to be between *satisfied* and *very satisfied.*

Table 5: Level of satisfaction with the e-learning platforms and tools used during the pandemic

	1	**2**	**3**	**4**	**5**	**Average**
Level of satisfaction with the e-learning strategy adopted by the institution	46	16	20	9	10	2.27
Level of satisfaction with the e-learning tools used during the pandemic	27	24	26	22	0	2.43
Level of satisfaction with the e-learning platforms used during the pandemic	27	15	27	19	13	2.76

In a statement that assesses if the advantages of using e-learning were greater than the disadvantages, 54% of the students disagreed and only 23% agreed. The average of this variable is 2.45, meaning that on average students do not consider that the implementation of e-learning has brought more advantages than disadvantages.

Figure 15: Evaluation of the statement "The advantages of using e-learning outweighed the disadvantages"



4.5 IMPACT OF E-LEARNING ON STUDENTS' ACADEMIC ACHIEVEMENT

Students were asked if e-learning adequately supported their studies during the pandemic. The results, as can be seen in Table 6, indicate that most students, around 68% (69 students), disagree with this statement and only 13% (13 students) agree. The average of 2.04 reinforces this conclusion, indicating that on average students *disagree* that e-learning has adequately supported their studies during the pandemic.

Table 6: Evaluation of the statement "E-learning adequately supported my studies during the pandemic"

	1	2	3	4	5	Average
E-learning adequately supported my studies during the pandemic	49	20	20	6	7	2.04

Students were then asked to reflect on the relationship between e-learning implementation and their academic achievement. It was verified that 60% of students (62 students) consider that their academic achievement was somehow affected by the implementation of e-learning, 21% (21 students) did not register changes (positive or negative) in their academic achievement after the implementation of e-learning, and 19% were neutral on that question.

Table 7: Evaluation of the statement "E-learning implementation affected my academic achievement"

	1	2	3	4	5	Average
E-learning implementation affected my academic achievement	14	7	19	20	42	3.68

To understand in greater depth, the influence e-learning had on students' academic achievement, the statement "*E-learning implementation negatively affected my academic achievement"* was also investigated.

With the simultaneous analysis of the variables *"E-learning implementation affected my academic achievement"* and *"E-learning implementation negatively affected my academic achievement"* it was possible to conclude that 52 students, which corresponds to 51% of the total of students and 84% of the total of students who claimed their academic achievement was somehow affected by the implementation of e-learning, considered that their academic achievement was *negatively* affected by the implementation of e-learning.

Table 8: Simultaneous evaluation of the statements "E-learning implementation affected my academic achievement" and "E-learning implementation negatively affected my academic achievement" on agreement

E-learning implementation affected my academic achievement	**E-learning implementation negatively affected my academic achievement**		
	5	**4**	**5 and 4 (agreed)**
5	31	5	36
4	4	12	16
Total	35	17	**52**

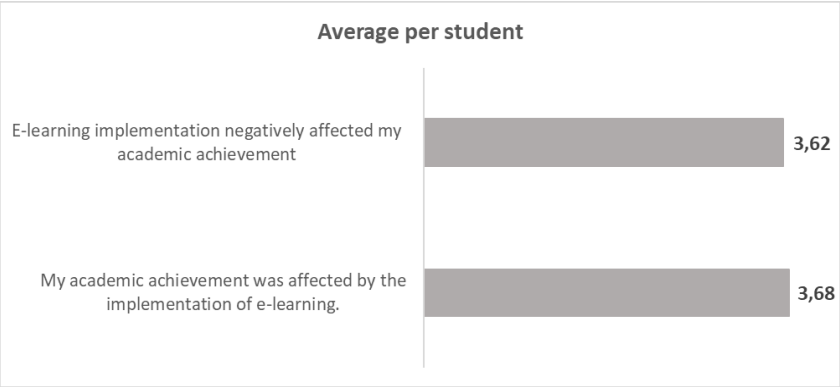
In addition, only 7 students (11% of the 62 students who claimed that e-learning somehow affected their academic performance) considered this influence in their academic performance as positive.

Table 9: Simultaneous evaluation of the statements "E-learning implementation affected my academic achievement" and "E-learning implementation negatively affected my academic achievement" on disagreement

My academic achievement was affected by the implementation of e-learning.	**E-learning implementation negatively affected my academic achievement**		
	2	**1**	**2 and 1 (disagreed)**
5	1	4	5
4	2	0	2
Total	3	4	**7**

The average degree of concordance of approximately 4 in both questions, represented in Figure 16, reinforces these conclusions, showing that, on average students consider not only that their academic achievement was affected by e-learning, but also that its overall impact was negative.

Figure 16: Average degree of concordance per student on the variables "E-learning implementation affected my academic achievement" and "E-learning implementation negatively affected my academic achievement"



Another subject investigated was if students consider that the "forced" implementation of e-learning during the pandemic influenced their academic achievement to the point that they would have to take at least an extra semester in order to finish their degree. The results obtained show that 57% of the students believe that the forced implementation of e-learning delayed their graduation, meaning that they will need more time than anticipated to finish their degree.

Table 10: Evaluation of the statement "E-learning implementation hampered my academic achievement to the point that it took me longer than expected to finish my degree"

	1	**2**	**3**	**4**	**5**	**Average**
E-learning implementation hampered my academic achievement to the point that it took me longer than expected to finish my degree	20	14	10	20	38	3,41

Students' perceptions on some individual academic achievement determinants were also analysed to measure the impact that e-learning may have had on them.

As can be seen in Table 11, the results were very similar to all determinants. Regarding *the amount of time devoted to studies*, only 19% of the total of students agreed that e-learning indeed allowed them to devote more time to studies than the traditional learning approach.

In terms of the e-learning impact on students' *increase of productivity and motivation during classes*, only 13% and 10% of the total of students, respectively, validated that their productivity when studying and motivation during classes indeed increased with the use of e-learning.

Ultimately, students do not consider that e-learning improved the *dynamics of group projects* or the *performance of academic tasks*. Only 21% and 25% of the total of students, respectively, validated these statements.

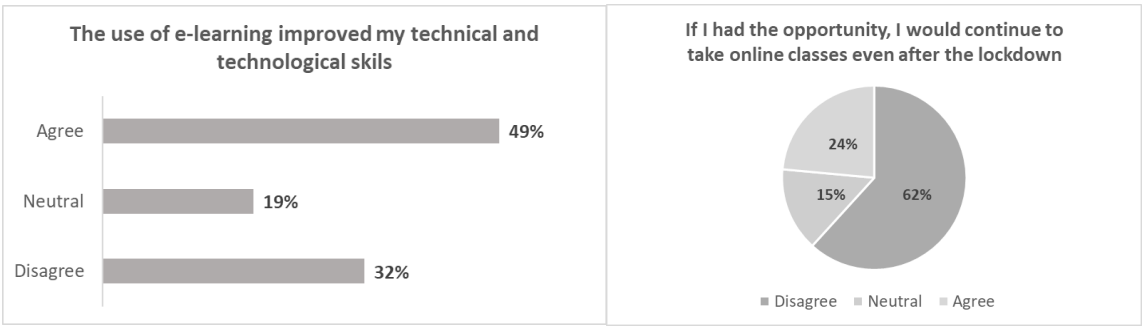
In accordance, it is possible to verify that on average students do not consider that e-learning positively influenced any of the academic achievement determinants identified.

Table 11: Students' evaluation of the impact of e-learning on some important individual academic achievement determinants

Individual AA determinants	1	2	3	4	5	Average
1. E-learning allowed me to devote more time to studies	47	22	14	7	12	2,17
2. E-learning increased my productivity when studying	56	20	13	6	7	1,90
3. E-learning increased my motivation during classes	59	19	14	4	6	1,81
4. E-learning improved the dynamics of group projects	61	5	15	8	13	2,09
5. E-learning improved the performance of academic tasks (projects, assessments, defences)	42	21	13	10	16	2,38

To finish this block of questions, students were asked if their technical and technological skills improved after using e-learning, and their response was very positive, with 49% of the students agreeing with the statement. However, when asked in the next question about their intention to continue to have online classes after the lockdown, most students (62% of the total of students) did not express this will.

Figure 17: Evaluation of the statements "The use of e-learning improved my technical and technological skills" and "If I had the opportunity, I would continue to take online classes even after the lockdown"



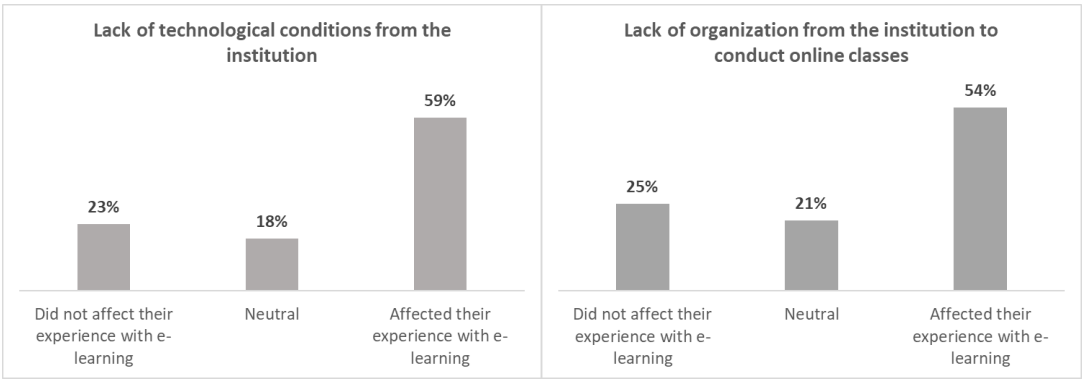
4.6 BARRIERS THAT INFLUENCED STUDENTS' EXPERIENCE WITH E-LEARNING DURING THE PANDEMIC

Students were asked to evaluate if specific e-learning barriers previously identified in the literature influenced their personal experience with e-learning during the pandemic.

Barrier 1- Lack of technological conditions from the institution and *Barrier 2- Lack of organization from the institution to conduct online classes*

Most students (59% and 54%, respectively) considered both the lack of technological conditions from the educational institution and the lack of organization from the institution to conduct online classes barriers that influenced their experience with e-learning during the pandemic.

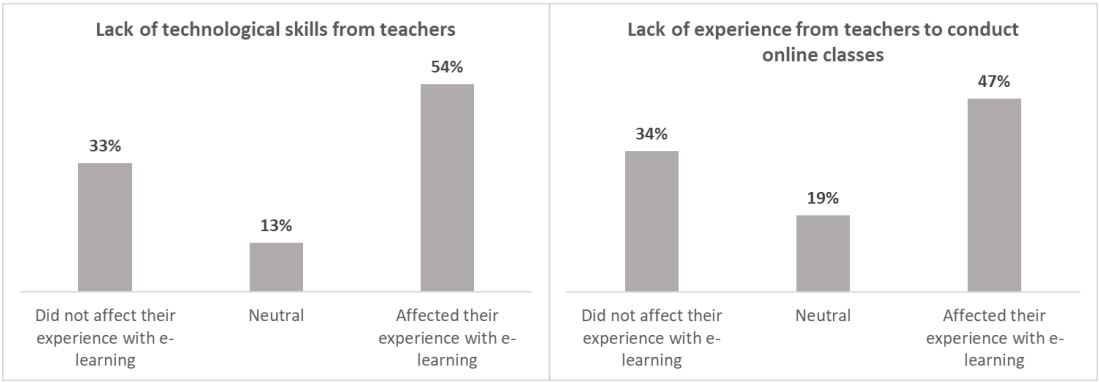
Figure 18: Evaluation of the impact of barriers 1 and 2 on students' experience with e-learning



Barrier 3- Lack of technological skills from teachers and *Barrier 4- Lack of experience from teachers to conduct online classes*

Accordingly, 54% and 47%, respectively considered teachers' lack of technological skills and experience to conduct online barriers that affected their personal experience with e-learning.

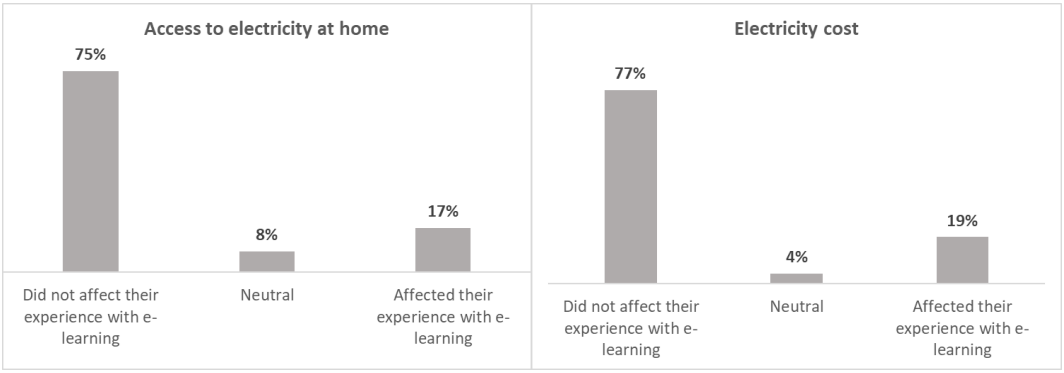
Figure 19: Evaluation of the impact of barriers 3 and 4 on students' experience with e-learning



Barrier 5- Access to electricity at home and *Barrier 6- Electricity cost*

On the other hand, (75% and 77% of students, respectively) do not consider the access to electricity at their residence or the electricity cost as barriers confronted by them during the use of e-learning.

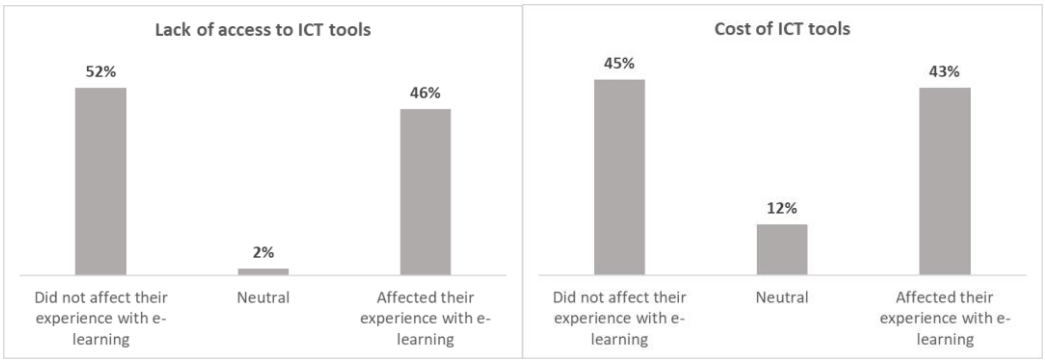
Figure 20: Evaluation of the impact of barriers 5 and 6 on students' experience with e-learning



Barrier 7- Lack of access to ICT tools and *Barrier 8- Cost of ICT tools*

Regarding the access to ICT tools and the costs associated with these tools, there is a balance between the number of students who considered them barriers that affected their experience with e-learning (46% for the access to ICT tools and 43% for their cost) and the number of students who did not (52% for the access to ICT tools and 45% for their cost). However, the number of students who did not consider them barriers prevails.

Figure 21: Evaluation of the impact of barriers 7 and 8 on students' experience with e-learning

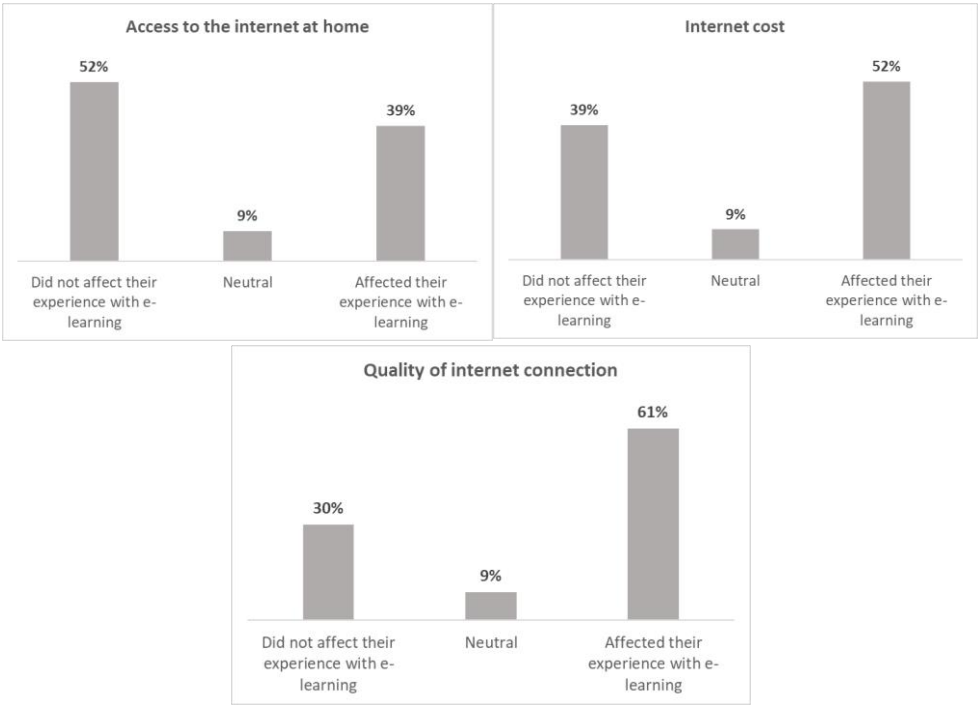


Barrier 9- Access to the internet at home, Barrier 10- Internet cost and *Barrier 11- Quality of internet connection*

Students did not consider the lack of access to the internet a barrier they faced when using e-learning. This result was already expected, since it was verified in the second block of the questionnaire, ICT access, that most students had access to the internet at home.

Nonetheless, the results were the opposite in terms of internet cost and quality of the internet connection. Most students (52% and 61%, respectively) considered both the internet cost and the quality of the internet connection as barriers that affected their experience with e-learning.

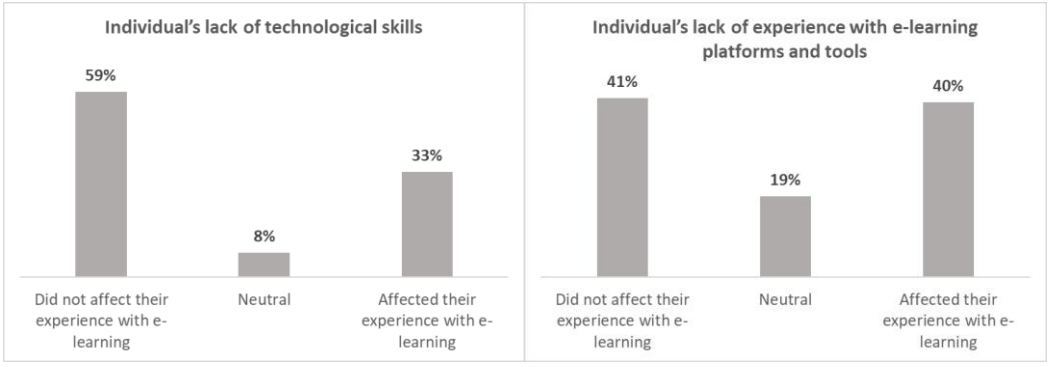
Figure 22: Evaluation of the impact of barriers 9, 10 and 11 on students' experience with e-learning



Barrier 12- Individual's lack of technological skills and *Barrier 13- Individual's lack of experience with e-learning platforms and tools*

When asked about their lack of technological skills, most students (59%) did not consider it a barrier that affected their experience when using e-learning. Regarding their lack of experience with e-learning platforms and tools, the results were more balanced, where 41% of the students did not consider it a barrier and 40% did.

Figure 23: Evaluation of the impact of barriers 12 and 13 on students' experience with e-learning



Barrier 14- Individual's area of residence* and *Barrier 15- Individual's group income

Most students, 52% and 56%, respectively, did not consider their area of residence or group income barriers that influenced their experience with e-learning.

Figure 24: Evaluation of the impact of barriers 14 and 15 on students' experience with e-learning

As can be seen in Figure 25, the barriers from the literature that were validated by most students as indeed barriers that affected their experience with e-learning were:

- ***Barrier 11- Quality of internet connection***- considered by 61% of students.
- ***Barrier 1- Lack of technological conditions from the institution-*** considered by 59% of students.
- ***Barrier 2- Lack of organization from the institution to conduct online classes-*** considered by 54% of students.
- ***Barrier 3- Lack of technological skills from teachers-*** considered by 54% of students.
- ***Barrier 8- Internet cost-*** considered by 52% of students.
- ***Barrier 4- Lack of experience from teachers to conduct online classes-*** considered by 47% of students.

The barriers for which the number of students who validated and did not validate was balanced were:

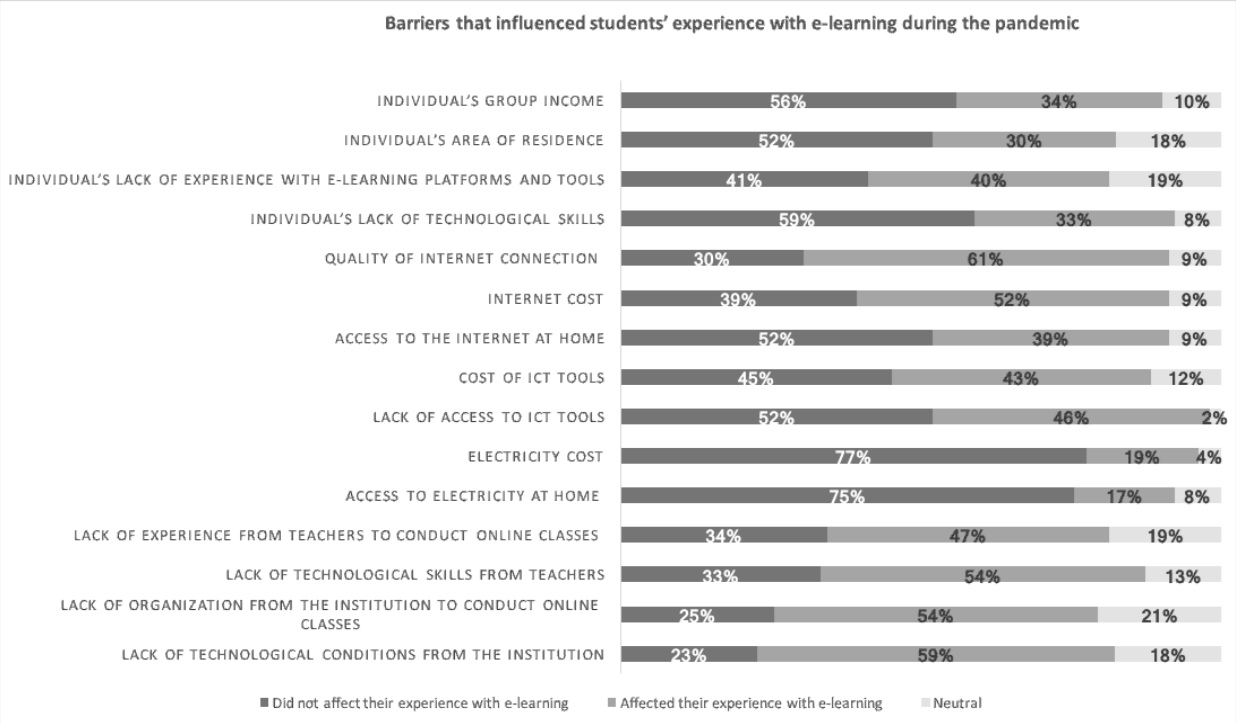
- ***Barrier 13- Individual's lack of experience with e-learning platforms and tools-*** 41% of students did not consider it a barrier that affected their experience with e-learning vs 40% who did.
- ***Barrier 7- Lack of access to ICT tools-*** 52% did not consider it a barrier that affected their experience with e-learning vs 46% who did.
- ***Barrier 8- Cost of ICT tools***- 45% did not consider it a barrier that affected their experience with e-learning vs 43% who did.

And lastly, the barriers that were not validated by the majority of students as events or factors that affected their experience with e-learning were:

- ***Barrier 5- Access to electricity at*** home- not considered by 75% of students.
- ***Barrier 6- Electricity cost***- not considered by 77% of students.

- ***Barrier 9- Access to the internet at home***- not considered by 52% of students.
- ***Barrier 12- Individual's lack of technological skills***- not considered by 59% of students.
- ***Barrier 14- Individual's area of residence-*** not considered by 52% of students.
- ***Barrier 15- Individual's income group***- not considered by 56% of students.

Figure 25: Evaluation of barriers that could have influenced students' experience with e-learning during the pandemic



In order to better understand the results, an additional analysis of the variables that were validated and not validated by a similar percentage of students was performed according to the students' income group. The results are presented in Table 12.

It was verified that 50% of the 40% of students' who considered the *individual's lack of experience with e-learning platforms and tools* a barrier that affected their experience with e-learning were low-income students.

In accordance, of the 46% of students who considered the lack of access to ICT tools a barrier, 93% were low-income students, and of the 43% of students who considered the cost of ICT tools a barrier, 79% were low-income students.

These results demonstrate that these three barriers were indeed barriers for most low-income students, and perhaps they ended up not being considered barriers only due to the quantity of middle- and upper-class students present in the sample.

Table 12: Barriers 13, 7, and 8 by income group

Income group	Considered the individual's lack of experience with e-learning platforms and tools a barrier	Considered the lack of access to ICT tools a barrier	Considered the cost of ICT tools a barrier
Low-Income	50%	93%	79%
Medium-Income	39%	40%	38%
High-Income	38%	25%	38%

4.7 SOLUTIONS TO SUCCESSFULLY INTEGRATE AND MAINTAIN E-LEARNING INITIATIVES IN HIGHER EDUCATION INSTITUTIONS IN ANGOLA

Students were asked in an open question to identify solutions to efficiently integrate and maintain e-learning initiatives in HEI in Angola, according to the personal experience each of them had while using e-learning.

From a sample of 102 students, 82 responded to this question, which gives a response rate of 80%, a very good response rate for an open question. Students' responses were summarized, and similar answers were grouped within the same solution. As a result, a total of 15 different solutions were identified. Since each student could provide more than one solution, an analysis of the number of times each solution was proposed was made and the solutions were classified and ordered according to this number, i.e., the solutions that were mentioned more often were considered the most important solutions to students. In addition, the solutions were categorized in three groups:

1. *ICT related solutions*- includes the country-wide improvement of the quality of the internet connection, energy distribution and network, the reduction of the internet price, and country-wide changes in the cost of ICT tools.

2. *Institutional/governmental solutions*- includes the assistance from the HE institutions or from the government for teachers and students who cannot have access to online learning (through the supply of the means that allow them to actively participate in e-learning from their homes or through the availability at the university of these means), the improvement of the technical and technological conditions within HE institutions such as free and unlimited access to the internet and ICT tools to students and teachers, training on e-learning for teachers to foster the development of appropriate skills and methodologies to conduct online classes, more organization from the higher education institutions, the adoption of a policy of technology integration in education

by the government, more rigidity in the implementation of online classes, and the improvement of the assessment methods used during online learning.

3. *E-learning related solutions*- includes the creation of a platform that integrates: the online classes, the class materials, a forum for student-teacher interaction, a forum for the online assessments and the results of the assessments, the early preparation of students for the use of e-learning technologies, and the maintenance of the continuous use of e-learning tools and platforms (not only in times of crisis, as it was during lockdown).

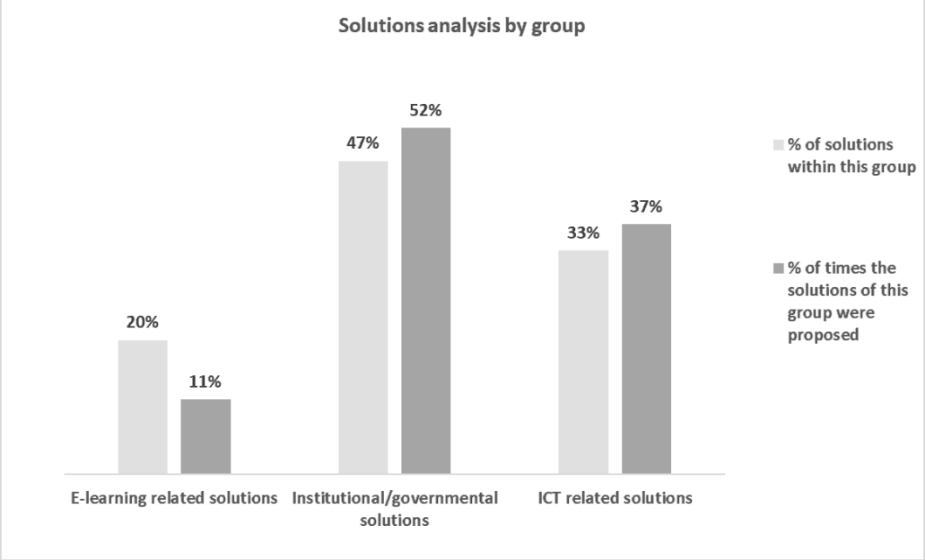
Table 13: Solutions proposed by students to successfully implement and maintain e-learning initiatives in higher education

Solution	Solution group	Number of times this solution was proposed	% of times this solution was proposed
1. Improvement in the quality of the internet connection across the country	ICT related solutions	36	22%
2. Assistance from the HE institutions or from the government for teachers and students who cannot have access to online learning (through the supply of the means that allow them to actively participate in e-learning from their homes or through the availability at the university of these means)	Institutional/governmental solutions	23	14%
3. Improvement of the technical and technological conditions within HE institutions such as free and unlimited access to the internet and ICT tools to students and teachers	Institutional/governmental solutions	22	14%
4. Training on e-learning for teachers to foster the development of appropriate skills and methodologies to conduct online classes	Institutional/governmental solutions	21	13%

5. More organization from the higher education institutions	Institutional/governmental solutions	10	6%
6. Network improvement across the country	ICT related solutions	10	6%
7. Creation of a platform that integrates: the online classes, the class materials, a forum for student-teacher interaction, a forum for the online assessments and the results of the assessments	E-learning related solutions	9	6%
8. Maintenance of the continuous use of e-learning tools and platforms (not only in times of crisis, as it was during lockdown)	E-learning related solutions	8	5%
9. Reduction of the internet price	ICT related solutions	7	4%
10. Country-wide changes in the cost of ICT tools	ICT related solutions	5	3%
11. Adoption of a policy of technology integration in education by the government	Institutional/governmental solutions	4	2%
12. Improvement in energy distribution	ICT related solutions	2	1%
13. More rigidity and seriousness in the implementation of online classes (including the inspection of the content that is provided by teachers on online classes)	Institutional/governmental solutions	2	1%
14. Improvement of the assessment methods used in online learning	Institutional/governmental solutions	1	1%
15. Early preparation of students for the use of e-learning technologies	E-learning related solutions	1	1%

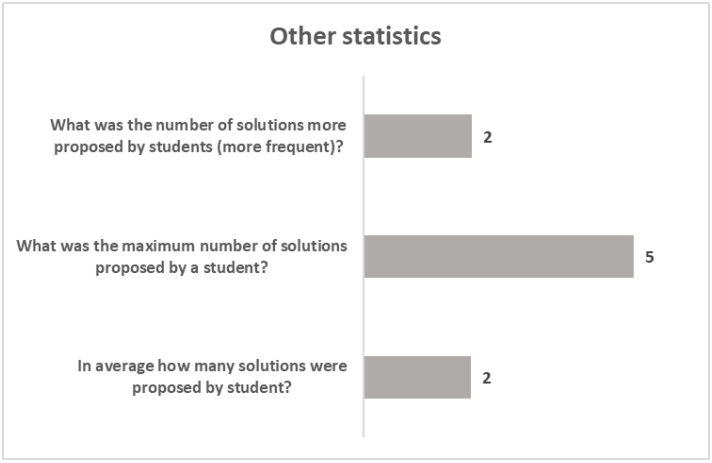
An analysis of the solutions according to the group to which they belong was performed. It was verified that the group with the most solutions (47% of the total of solutions) and that encompasses the most mentioned solutions (cited 52% of the time) is the group referring to the institutional/governmental solutions.

Figure 26: Analysis of the proposed solutions by group



Other statistics evaluated in that question are represented in Figure 27 and include the average number of solutions proposed by student, the maximum number of solutions proposed by a student and the most frequent number of solutions proposed by students.

Figure 27: Other statistics evaluated on the solutions proposed by students



4.8 STUDENTS' PROFILES ACCORDING TO VARIABLES THAT ARE IMPORTANT TO MEASURE THE IMPACT OF E-LEARNING ON STUDENTS' ACADEMIC ACHIEVEMENT

To determine if different sociodemographic characteristics influenced students' adaptation to e-learning and consequently their academic achievement in varying degrees, an analysis that compares some socio-demographic variables according to a set of other variables considered relevant to measure the impact of e-learning on students' academic achievement was carried out.

The socio-demographic variables included in this analysis were the students' *gender* and *income group.* The reason for this choice resides in the fact that Angola is a country with great

gender disparities and a high level of income inequality, which also ends up reflecting in enormous differences in the access of the population to ICT tools and to the internet, thereby perhaps influencing students' adaptation to e-learning and consequently their academic achievement.

To determine the variables important to measure the impact of e-learning on students' academic achievement a thorough analysis was conducted and after analysing and considering all the variables that we have in the study, the variables selected were:

- Percentage of students with access to a smartphone or tablet
- Percentage of students with access to a computer
- Percentage of students who did not participate in online classes
- Percentage of students who reported an increase in their productivity
- Percentage of students who reported an increase in their motivation during classes
- Percentage of students who devoted more time to studies
- Percentage of students who reported that their academic achievement was negatively affected by e-learning

Students' profile: comparison between income group

As seen in Table 14, in terms of access to ICT tools and to the online classes, low-income students perform much more poorly than the students of the other income groups and medium-income and high-income students behave very similarly.

When it comes to the academic achievement, low-income students remain with the poorest performance amongst the three income groups. Only 7% of the low-income students reported observing an increase in their productivity during e-learning, none of them (0%) reported observing an increase in their motivation during classes, and only 14% reported devoting more time to studies during e-learning implementation.

As expected, with all these factors, 71% of the low-income students claimed that e-learning negatively affected their academic achievement, a very high percentage when compared to the other income groups.

The behaviour of medium and high-income students in terms of academic achievement is not as similar as it was in terms of access to ICT tools and online classes. High-income students noticed much more the increase in productivity (38% vs 11% for the medium-income students) and much less the negative impact of e-learning on their academic achievement (28% vs 59% for the medium-income students).

Table 14: Evaluation of the behaviour of important variables according to students' income group

Income group	Access to a smart phone or tablet	Access to a computer	Did not participate in online classes	Increase in productivity	Increase in motivation during classes	Devoted more time to studies	AA negatively affected by e-learning
Low-Income	79%	29%	57%	7%	0%	14%	71%
Medium-Income	95%	70%	31%	11%	11%	20%	59%
High-Income	88%	88%	25%	38%	13%	13%	28%

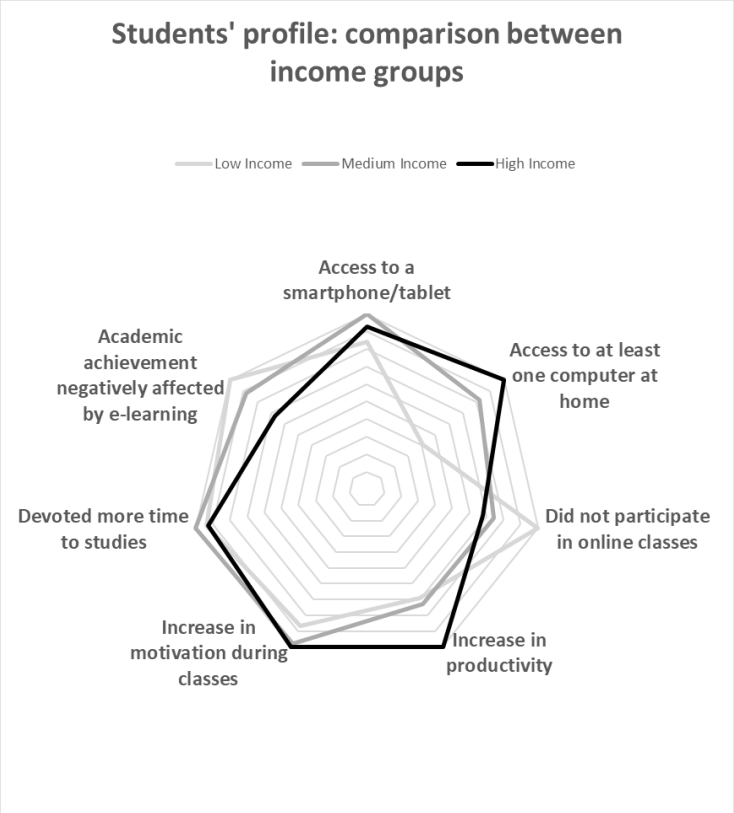
Figure 28 allows us to visualize these conclusions with greater clarity, revealing once again the great differences between the three income groups.

Low-income students, perform most poorly for all variables, except for the time devoted to studies, for which the value observed is very close to the one observed in high-income students.

Medium-income students perform similarly to high-income students in terms of ICT and online classes access. However, regarding the academic achievement determinants, it is easier to differentiate them, especially in the variables increase in productivity and academic achievement negatively affected by e-learning.

The results obtained in this analysis are very important since they show that low-income students were the ones who were most affected with the e-learning implementation. They have less access to ICT tools, they participated less in online classes, they did not observe increases in important individual academic achievement determinants when using e-learning, and consequently they were the students who most considered e-learning as a teaching approach that negatively affected their academic achievement.

Figure 28: Students' profile: comparison between income group



Students' profile: comparison between genders

In terms of ICT access, 91% and 93% of the female and male students, respectively, have access to a smartphone/tablet, and 70% and 63% have access to a computer. When it comes to online classes, it was verified that 21% and 44% of the female and male students', respectively, did not attend the online classes during the period during which e-learning was implemented.

These numbers illustrate that there are small differences regarding ICT and online classes access for the female and male students interviewed, and that in fact the percentage of female students with access to computers and who attended online classes is even a bit higher than the percentage of males.

Regarding the academic achievement determinants, although females perform more poorly overall than males, there are also no considerable differences between the two genders. 9% of the female students reported an increase in their productivity, while in the case of male students it was approximately 15%. In terms of motivation during classes, 7% of the female students and 12% of the male students, claimed that e-learning increased their motivation. Regarding the increase in the amount of time devoted to studies, the percentage was equal for both genders (19%).

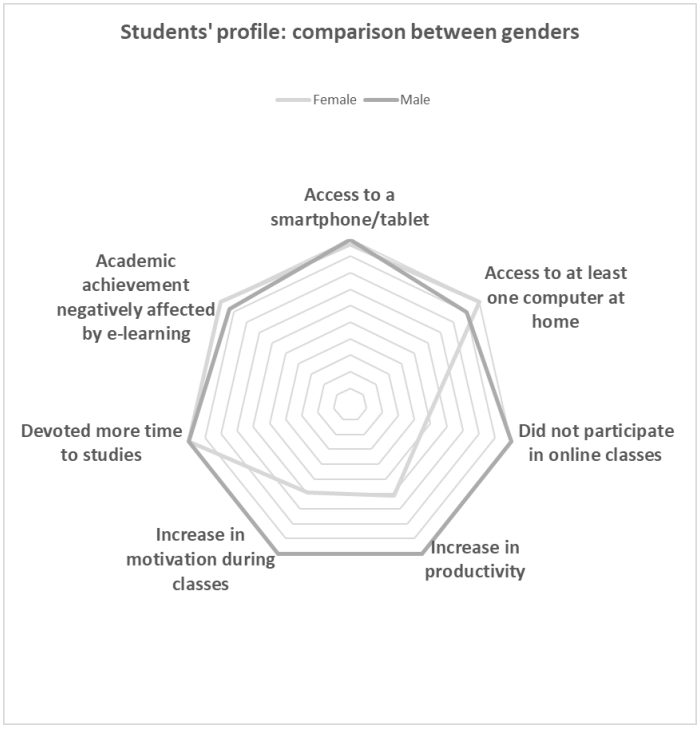
Accordingly, 65% of the female students reported that e-learning negatively affected their academic achievement and 54% of the male students agreed with that statement, indicating, once again that although females perform a bit more poorly, there are not considerable differences between the genders.

Table 15: Evaluation of the behaviour of important variables according to students' gender

Gender	Access to a smart phone or tablet	Access to a computer	Did not participate in online classes	Increase in productivity	Increase in motivation during classes	Devoted more time to studies	AA negatively affected by e-learning
Female	91%	70%	21%	9%	7%	19%	65%
Male	93%	63%	44%	15%	12%	19%	54%

Figure 29 helps to illustrate the findings reported above. As can be seen female and male students are very close in terms of access to a smartphone/tablet and in terms of devoting more time to studies. Females perform slightly better in terms of access to computers and online classes and poorer in terms of the academic achievement variables.

Figure 29: Students' profile: comparison between genders



5. DISCUSSION OF THE RESULTS

Unquestionably, higher education plays an essential role in people's lives, especially in developing countries, where the privilege of attending a university represents a huge opportunity for citizens to grow and improve their living conditions. As seen previously, it has been demonstrated in many studies that the adoption of e-learning technologies in higher education can bring many advantages to students and even enhance their academic achievement, but *could this also be a reality in a developing country where there is a low ICT development?* To answer this question, the perceptions of Angolan students' who used e-learning technologies during the covid-19 pandemic were analysed.

Students were asked to evaluate how the e-learning implementation affected their own academic achievement and how it affected some important individual academic achievement determinants such as their *productivity*, their *motivation during classes*, the *time they devoted to studies*, the *dynamics of group projects,* and the *performance of academic tasks/activities.* Findings point out that the academic achievement of most students was negatively affected by the e-learning implementation– from the total of students' who claimed that their academic achievement was affected by the e-learning implementation, 84% stated that it was negatively affected and only 11% considered the impact of e-learning on their academic achievement as positive– and that none of the academic achievement determinants mentioned were positively affected by the e-learning implementation, i.e., e-learning did not contribute to the improvement or increase of any of the academic achievement determinants examined.

In accordance with this evidence, it was verified that most students consider that e-learning did not adequately support their studies during the pandemic, that they would not enjoy using e-learning as a permanent teaching method, and that e-learning implementation brings to students more disadvantages than advantages.

After becoming aware of the fact that the e-learning implementation in higher education institutions of Angola did not properly occur from the students' point of view, it became even more important to understand the reasons behind students' negative opinions, i.e., the main barriers or challenges they faced during the use of e-learning technologies. One of the issues that students reported was the *quality of the internet connection* combined with the *internet price.* This happens mainly because in Angola the more one pays for the internet, the higher the quality of the internet connection, and therefore although students had access to the internet at home, the price they could afford to access the internet did not allow them to have a connection suitable to support e-learning.

The other barriers considered by students were in general institutional ones. Students pointed out *the lack of technical and technological conditions from their institution to support e-learning* (including the lack of adequate e-learning tools and the lack of provision of ICT tools and internet to the teachers and students with no access), *the lack of organization from their*

institutions to implement e-learning (including the lack of organization regarding the timetable and the contents taught in classes and the lack of organization regarding the assessment methods) and *the lack of technological skills and of experience from teachers to conduct online classes* as the main barriers they faced when using e-learning.

Contrary to expectations, students' access to the internet and to core ICT tools were not considered by the majority of students to be an issue they faced when using e-learning. Since these two barriers had a proportional number of students validating and not validating them, a deep analysis was conducted, and it was found that the overwhelming majority of students who did validate them as barriers (93% and 79%, respectively) were low-income students. As the sample is composed mostly by medium and high-income students who usually do not face these challenges when using e-learning, they ended up not being considered barriers in the study. Nevertheless, they highlight the huge economic disparities present in Angola and a digital divide that stems from these disparities.

This evidence reveals the need to differentiate how e-learning affected students' academic achievement according to their income level. It was verified that low-income students perform much more poorly than medium and high-income students in terms of access to ICT tools and to online classes. Consequently, they were the group of students who less reported experiencing an increase in their productivity, in their motivation and in the time they devoted to studies, and the group with a higher percentage of students' considering that their academic achievement was negatively affected by e-learning.

Following that same order, the medium-income students were the second group of students with lower levels of access to ICT tools and to online classes and with a higher percentage of students reporting to have their academic achievement negatively affected by the e-learning implementation. A similar analysis aiming to differentiate how e-learning affected students' academic achievement according to their gender was conducted, but the differences were not as pronounced.

Another subject that drew attention was the fact that in addition to being unsatisfied with the e-learning strategy adopted by their university, most students also reported being unsatisfied with the e-learning tools they used. When asked about which tools they used, most of them chose the "other" option, and then, openly responded WhatsApp (78%) and Facebook (13%), indicating that the interaction between students and teachers and the access to the classes' resources of 91% of the students who answered the "other" option (equivalent to 40% from the total of students interviewed) is done through social networks, and not in fact through e-learning tools.

Research on the inclusion of social networks in e-learning is slightly new, especially in developing countries. However, the literature indicates that in locations with low access to electricity and ICT tools, poor internet connection, and no institutional or government support in terms of e-learning tools, social networks offer technological and pedagogical advantages

and are considered useful tools in the learning dissemination. While most e-learning tools are associated with exorbitant data costs and require training and a stable broadband connection, social networks are available without charge, easy to use (little training is required), and supported in low-connectivity locations. Despite all of these advantages, the successful incorporation of social networks in e-learning still depends on several factors and its impact on students' academic achievement remains unclear.

To finish, students identified possible solutions to successfully integrate and maintain e-learning initiatives in higher education institutions of a country with low ICT development. The solutions provided by students address a set of different issues, and we categorized them into three groups: ICT related solutions, institutional or governmental solutions and e-learning related solutions.

The group of solutions that were mentioned by students the most was the group referring to the institutional or government solutions. Students have previously mentioned that they faced mainly institutional barriers during their experience with e-learning, and it therefore makes perfect sense that most of the proposed solutions fall within this scope.

The proposed solutions include more assistance from the higher education institutions and from the government to support both teachers and students who cannot have access to e-learning, the improvement of the ICT infrastructure within higher education institutions, the improvement of the quality of the internet connection, energy distribution and network, training on e-learning for teachers, and the creation and maintenance of an e-learning platform that integrates the online classes, the class materials, a forum for student-teacher interaction, a forum for the online assessments, and the results of the assessments.

6. CONCLUSIONS AND IMPLICATIONS

The findings of this study, in accordance with many others (Abou El-Seoud et al., 2014; Chee Meng Tham & Werner, 2005; Alakklouk, 2012), suggest that the full benefits of e-learning are not perceived by students if there are institutional barriers (such as the lack of technical and technological conditions from the educational institutions to support e-learning, the lack of organization from the educational institutions to implement e-learning, and the lack of technological skills and experience from teachers to conduct online classes) and ICT barriers (such as the quality of the internet connection and the internet price) preventing its adequately implementation and maintenance, and fortify the evidence found by (Adarkwah, 2021) indicating that the e-learning implementation in a country with low ICT development is unlikely to successfully occur and can in fact negatively affect students' academic achievement.

A digital divide that stems from the extensive social and economic inequality present in Angola is also highlighted in this study, revealing that students with lower income levels have less access to core ICT tools and to the internet, which impacts their ability to access the e-learning tools and classes and consequently compromises their academic achievement. This evidence is in agreement with a study developed in Kenya by Neema-Abooki & Kitawi (2014) in which it was demonstrated that due to a digital divide in disfavour of poor students, their academic achievement when using e-learning ended up being more compromised than the academic achievement of students' with better economic conditions.

Lastly, this study reinforces that in order for e-learning to thrive and be beneficial to students, much more than a computer and a connection to the internet are necessary. The majority of the students interviewed in fact had access to a computer and to the internet during the time they used e-learning, nonetheless, other barriers such as institutional matters and the price-quality ratio with regard to the internet directly influenced their experience, proving to be issues equally or more important.

In accordance with the perceived barriers, most of the solutions provided by students to successfully integrate e-learning in higher education institutions were institutional or governmental solutions and ICT related solutions, including: the improvement of the quality of the internet connection, the reduction of the internet price, assistance from the HEI or from the government for teachers and students who cannot have access to online learning, the improvement of the technical and technological conditions within HEI, training in e-learning for teachers, more organization from the HEI, etc.

This thesis provides evidence for higher education teachers, higher education policymakers, and the Ministry of Education of Angola, as it raises awareness about how e-learning was implemented by higher education institutions during the Covid-19 pandemic, identifying the main barriers faced by students during the use of e-learning and providing a set of solutions that can contribute to enhance students' future experience with e-learning.

In addition, few studies address the impact of the e-learning implementation on students' academic achievement in a country with low ICT development and in a pandemic context, in which e-learning was the only teaching method available. It is hoped that this study acts as a valuable resource to the responsible entities, encouraging them to revisit the e-learning strategy adopted, as it provides evidence that the poor implementation of e-learning can present to students serious disadvantages and even harm their academic achievement.

7. LIMITATIONS AND PERSPECTIVES FOR FUTURE STUDIES

This study was conducted in Luanda, the capital of Angola, which is characterized by a population with a better socio-economic status compared to the population of the other 17 provinces. It therefore does not capture the reality of the whole country. In addition, the data were collected at a private university, which is attended mostly by higher and medium income students.

These two limitations clearly have implications in the results of the study because the sample collected is composed of students who are homogenous in terms of income level. A clear example of this bias is the fact that some e-learning barriers such as the access to ICT tools ended up not being validated in this study because most of the students who responded to the questionnaire had an economic level that allowed them to access them with ease.

It was a choice to conduct the study with these two limitations, addressing only a specific niche of the target population because the implementation of e-learning in Angola was not a reality for students in many provinces– especially in rural provinces– and in many universities– especially in public universities. However, for future research, hopefully e-learning is a reality faced by students in more universities and provinces and it will be possible to obtain results that fully cover the country's reality, encompassing more low-income students.

Another limitation of the study is that it is focused on obtaining evidence only through students' perceptions on e-learning. To ascertain the real impact of e-learning implementation on students' academic achievement, it is necessary to use statistical tests to compare the results between the students that used e-learning and those that used the traditional teaching approach.

Although the questionnaire includes an open-response question focused on identifying possible solutions to implement e-learning in an efficient way in higher education institutions in Angola according to the students' perceptions, this topic was not deeply explored. The conduction of individual in-depth interviews aiming to present the results obtained in the questionnaire to experts in the field of the education would provide a more accurate set of solutions.

To finish, the data used in this study were collected through a paper-based questionnaire. Although it was a choice to conduct the study with this limitation in order to obtain a sample as varied as possible, including students' with and without access to the internet, the process of transcribing the questionnaire was very long and exhaustive and there may be transcription errors, which would not exist if it were an online questionnaire.

8. BIBLIOGRAPHICAL REFERENCES

Abdel Jawad, Y. A. L., & Shalash, B. (2020). The Impact of E-Learning Strategy on Students' Academic Achievement. Case Study: Al- Quds Open University. *International Journal of Higher Education*, *9*(6), 44. https://doi.org/10.5430/ijhe.v9n6p44

Abou El-Seoud, M. S., Taj-Eddin, I. A. T. F., Seddiek, N., El-Khouly, M. M., & Nosseir, A. (2014). E-Learning and Students' Motivation: A Research Study on the Effect of E-Learning on Higher Education. *International Journal of Emerging Technologies in Learning (IJET)*, *9*(4), 20. https://doi.org/10.3991/ijet.v9i4.3465

Adarkwah, M. A. (2021). "I'm not against online teaching, but what about us?": ICT in Ghana post Covid-19. *Education and Information Technologies*, *26*(2), 1665–1685. https://doi.org/10.1007/s10639-020-10331-z

Alakklouk, S. A. A. (2012). *Universiti Utara Malaysia*. 17.

Al-Azawei, A., Parslow, P., & Lundqvist, K. (2016). Barriers and Opportunities of E-Learning Implementation in Iraq: A Case of Public Universities. *The International Review of Research in Open and Distributed Learning*, *17*(5). https://doi.org/10.19173/irrodl.v17i5.2501

Al-Fadhli, S. (2008). Students' Perceptions of E-Learning in Arab Society: Kuwait University as a Case Study. *E-Learning and Digital Media*, *5*(4), 418–428. https://doi.org/10.2304/elea.2008.5.4.418

Algahtani, A. (2011). *Evaluating the Effectiveness of the E-learning Experience in Some Universities in Saudi Arabia from Male Students Perceptions*. 328.

Antonio, A., & Tuffley, D. (2014). The Gender Digital Divide in Developing Countries. *Future Internet*, *6*(4), 673–687. https://doi.org/10.3390/fi6040673

Arkorful, V., & Abaidoo, N. (2015). *The role of e-learning, advantages and disadvantages of its adoption in higher education.*

Ayu, M. (2020). ONLINE LEARNING: LEADING E-LEARNING AT HIGHER EDUCATION. *Online Learning*, 9.

Barbante, C. J. S. (2020). *PERSPECTIVAS DE IMPLEMENTAÇÃO DA MODALIDADE DE ENSINO A DISTÂNCIA NO ENSINO SUPERIOR, EM ANGOLA*. 17.

Barbante, C. J. S. (2021). PROJETOS DE INCLUSÃO DIGITAL NA EDUCAÇÃO EM ANGOLA: AVANÇOS E RECUOS. *Revista Brasileira de Estudos Africanos*, *6*(11). https://doi.org/10.22456/2448-3923.104401

Boumedyen, Kaneez, Rafael, & Victor. (2011). *E- Learning: An effective pedagogical tool for learning.pdf*.

Brotherton, J. A., & Abowd, G. D. (2004). Lessons learned from eClass: Assessing automated capture and access in the classroom. *ACM Transactions on Computer-Human Interaction*, *11*(2), 121–155. https://doi.org/10.1145/1005361.1005362

Castellan, C. M. (2010). Quantitative and Qualitative Research: A View for Clarity. *International Journal of Education*, *2*(2). https://doi.org/10.5296/ije.v2i2.446

Central Intelligence Agency. (2020). https://www.cia.gov/the-world-factbook/countries/angola/#introduction

Chee Meng Tham, & Werner, J. M. (2005). Designing and Evaluating E-Learning in Higher Education: A Review and Recommendations. *Journal of Leadership & Organizational Studies*, *11*(2), 15–25. https://doi.org/10.1177/107179190501100203

DiMaggio, P., Hargittai, E., Celeste, C., & Shafer, S. (2004). *From Unequal Access to Differentiated Use: A Literature Review and Agenda for Research on Digital Inequality*. 73.

Dublin, L. (2003). *If You Only Look Under the Street Lamps... Or Nine e-Learning Myths*. 7.

Elfaki, N. K., Abdulraheem, I., & Abdulrahim, R. (2019). *Impact of e-learning vs traditional learning on students' performance and attitude*.

Henderson, A. J. (2003). *The E-Learning Question and Answer Book: A Survival Guide for Trainers and Business Managers.* AMACOM.

Henry, P. (2001). E-learning technology, content and services. *Education + Training*, *43*(4/5), 249–255. https://doi.org/10.1108/EUM0000000005485

Holmes, B., & Gardner, J. (2006). *E-Learning: Concepts and Practice*.

INE, G. de A. (2014). *Resultados Definitivos Censo Geral 2014*.

International Telecommunication Union. (2017). *ICT Development Index 2017*. https://www.itu.int/net4/ITU-D/idi/2017/index.html

Khan, S. H., Hasan, M., & Clement, C. K. (2012). BARRIERS TO THE INTRODUCTION OF ICT INTO EDUCATION IN DEVELOPING COUNTRIES: THE EXAMPLE OF BANGLADESH. *International Journal of Instruction*, 20.

Luminita, D. C. (2011). Information security in E-learning Platforms. *Procedia - Social and Behavioral Sciences*, *15*, 2689–2693. https://doi.org/10.1016/j.sbspro.2011.04.171

Mamattah, R. S. (2016). *Students' Perceptions of E-Learning*. 52.

Mothibi, G. (2015). A Meta-Analysis of the Relationship between E-Learning and Students' Academic Achievement in Higher Education. *Journal of Education and Practice*, 5.

Neema-Abooki, P., & Kitawi, A. (2014). Impact of E-Learning Strategy on Students' Academic

Performance at Strathmore University, Kenya. *Makerere Journal of Higher Education*, *6*(1), 99. https://doi.org/10.4314/majohe.v6i1.6

Nneka Eke, H. (2010). The perspective of e-learning and libraries in Africa: Challenges and opportunities. *Library Review*, *59*(4), 274–290. https://doi.org/10.1108/00242531011038587

Sangrà, A., Vlachopoulos, D., & Cabrera, N. (2012). Building an inclusive definition of e-learning: An approach to the conceptual framework. *The International Review of Research in Open and Distributed Learning*, *13*(2), 145. https://doi.org/10.19173/irrodl.v13i2.1161

Tarus, J. K., Gichoya, D., & Muumbo, A. (2015). Challenges of implementing e-learning in Kenya: A case of Kenyan public universities. *The International Review of Research in Open and Distributed Learning*, *16*(1). https://doi.org/10.19173/irrodl.v16i1.1816

Tegegne, K. M. (2014). *The Influence of E-Learning on the Academic Performance of Mathematics Students in Fundamental Concepts of Algebra Course: The Case in Jimma University*. 19.

The Cross-Border Road Transport Agency. (2021). *Angola-Country-Profile-Report-March-2021.pdf*. Cross Border.

Tîrziu, A.-M., & Vrabie, C. (2015). Education 2.0: E-Learning Methods. *Procedia - Social and Behavioral Sciences*, *186*, 376–380. https://doi.org/10.1016/j.sbspro.2015.04.213

Trakru, M., & Jha, T. K. (2019). *E-Learning Effectiveness in Higher Education*. *06*(05), 7.

Trucano, M. (2005). *What do we know about the effective uses of information and communication technologies in education in developing countries?* 77.

UNDP. (2016). *Human Development Report 2015: Work for human development*. UN. https://doi.org/10.18356/ea1ef3b1-en

UNDP. (2018). *2018_human_development_statistical_update.pdf*.

UNDP (Ed.). (2020). *The next frontier: Human development and the Anthropocene*. United Nations Development Programme.

UNESCO. (2019). *Participation in Education*. http://uis.unesco.org/country/AO

World Bank. (2020). *Angola Poverty Assessment*. World Bank, Washington, DC. https://doi.org/10.1596/34057

Zhang, D., Zhou, L., Briggs, R. O., & Nunamaker, J. F. (2006). Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness. *Information & Management*, *43*(1), 15–27. https://doi.org/10.1016/j.im.2005.01.004