Article

Digital Learning Is an Educational Format towards Sustainable Education

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Abstract: The year 2020, due to the pandemic, was a milestone in the history of digital technology in the education sector, allowing a sustainable education although the world was facing a pandemic crisis without precedents. Therefore, in a few days occur a transformation from traditional classroom teaching to online teaching and consequently forced to use digital learning. Nevertheless, more researches are needed to know how was this experience and if there is the intention to maintain the online format. The main goal of this article is to study how digital learning can be an educational format focused on sustainable education. This paper presents a systematic literature review on digital learning through PRISMA methodology, based on a literature search and field research aimed to analyze the significant predictors related to the digital learning experience on the likelihood of choosing to "keep" the online format in the next academic year. An online survey was conducted with 173 university students. The results obtained showed that the significant predictors were factor 1-"Characteristics of online classes; factor 2-"Support from the School and Professors; factor 3-"Online classes vs. face-to-face classes" and gender. The probability of choosing to keep online classes increases exponentially with the characteristics of online classes, with Support from school and teachers; Online classes vs. Face-to-face classes, and keeping factors 1, 2, and 3 constant the probability if a man chooses the online format compared to a woman is higher. This online format thus acquires central importance in the contemporary sustainability debate. The kind of life, education, and society we will have in the future will depend on the quality, depth, and extent of the learning processes we can create and exercise individually and socially. Education, and educators in particular, who concentrate on the tasks of designing and implementing social teaching and learning models, have a unique responsibility in this process. Although the reduced sample size the present work can provide strategic information for university staff, contributing to designing and implementation a sustainable education.

Keywords: digital learning; sustainable education; systematic literature review; university education

1. Introduction

Due to the COVID-19 pandemic, Universities were forced to fast transition from traditional classroom teaching to online learning. The development of new online teaching formats is challenging, time-consuming, and demands the availability of a proper IT infrastructure. Students and faculty members should be offered learning opportunities for the acquisition of digital skills (e.g., training in pedagogical methods and/or IT abilities [1–3]. Nevertheless, the main benefit of online learning identified was the flexibility of platforms and the main barriers were family-study balance and difficulties with internet connectivity [1]. Communication interactions, student assessment, use of technology tools, online

experience, pandemic-related anxiety or stress, time management, and technophobia were identified as the main challenges of online education [4].

In this context the goal of this article is to study how digital learning can be an educational format focused on sustainable education, being the research questions: Rq1: Which were the main experiences of digital learning during the period of the COVID-19 lockdown? Rq2: Is it sustainable to maintain the online format in the next academic year?

Higher education and sustainability are now widely recognized as closely related concepts. In today's culture, higher education, in addition to its two traditional responsibilities of research and teaching, has a responsibility and a crucial role to play in reshaping education for sustainability [5]. Technology, on the other hand, has made accessing resources much easier for people across the country and the world. The adoption and use of educational technology [5,6] in the education systems of countries in the COVID-19 era generated a new pedagogy that demanded the inclusion of digital platforms in the teaching process for a better understanding [6]. This is called digital learning and is considered one of the engines for the development of skills, which probably helps organizations in the transformation process [6].

Online learning has taken the place of traditional teaching with face-to-face interactions (lectures, laboratory sessions). For the sustainability of digital education, some technical advancements are being developed to utilize virtual reality, as it is becoming increasingly important for online learning in a variety of sectors, including health (e.g., patient simulation) [3,7,8]. In addition, a variety of instructional strategies were used, including flipped classroom teaching, gamification, massive open online courses (MOOCs), digital learning, and hybrid learning. Classes were held online, with digital technologies such as augmented reality, graphic design, and diversified interaction platforms offering interactivity between teachers and students. In this context, students should take advantage of opportunities to use ICT for learning digital as sustainability [5].

Numerous studies have acknowledged the necessity of integrating online platforms into teaching practices following a pandemic [1,4]. For example, in the curricula of computer science and data science courses, expanding and accrediting e-learning/teaching infrastructure is a must-do in the future to increase undergraduates' competencies and skills in information and communication technologies (ICT) [2].

Challenges to online education must be assessed and explored in light of a new and sustainable educational paradigm [4,9]. Several studies have already demonstrated that active student integration with technologies has numerous benefits: it integrates problem-solving approaches that motivate students, improve their collaborative skills, train self-study skills, and embrace the diversity of a student population in addition to promoting sustainable practices [5]. Create strives to understand how individuals learn and how to better design instructional systems and resources to promote this learning, according to new instructional trends.

In this regard, the purpose of this study was to combine a thorough evaluation of e-learning approaches with a questionnaire distributed to students during the pandemic of COVID-19. As a result, this article will conduct a PRISMA review of the literature on digital learning, using inclusion and exclusion criteria to gain a better understanding of the concept. In addition to the literature study, a survey was conducted and distributed via Google Forms to 173 university students between August and October 2020. The methodological approaches, which included a comprehensive literature review and field research, were designed to identify the major predictors of "maintaining the online format in the next academic year" based on the digital learning experience.

2. Digital Learning Overview

To make an overview of the digital learning experience a systematic literature review was made following the guidelines detailed by the PRISMA methodology.

2.1. Timeframe and Database

A systematic search online in Science Direct was conducted at the end of July 2021. These databases comprise a significant number of updated and peer-reviewed papers, which have justified their selection. The timeframe was from 2015 to 2021, to consider the most recent articles with studies on digital education.

2.2. Eligibility Criteria–Inclusion and Exclusion Criteria

The search was made using several queries, containing the terms "Digital learning", and "Higher Education". The criteria for this study's selection were the following: (a) studies about digital learning in higher education; (b) there were also restrictions on language (only English). Moreover, the papers need to (c) have full-text available and (d) be published after 2015.

More specifically the new research and trends in higher education selection were based on the first criteria of Keywords: "digital learning" and "Higher Education", which have resulted in 183 articles. The second criteria related to Peers-reviewed journals resulted in 125 articles, and the language as English criteria totally 124 articles. The fourth criteria are regarding the type of publication, and all were excluded besides the review articles (6), and the research articles (93), resulting in a total of 99 articles (Table 1). Finally, the fifth criteria were based on scientific papers in Science Direct since 2015, (2015–2021) resulting in 49 articles to be analyzed.

2.3. Results

The analysis of articles is presented in the VOSViewer software to show the co-authorship network, keyword networks used in title expressions, and the abstract and title expressions. VOSviewer uses the technique of mapping VOS (visualization of similarities) and in the construction of maps based on distance, which are maps in which the distance between two items reflects the strength of the relationship between them. A shorter distance generally indicates a stronger relationship.

2.3.1. Keyword's Occurrence

In the Keyword's occurrence network (Figure 1), nodes and major words reflect their highest occurrence, the colors indicate the clusters, and the lines show the interrelationship of the keywords.

From the clusters, one can assume the interrelationship theme that characterizes specific areas or applications of user studies. In a preview of the network, it can be seen that the nodes of the clustered and close clusters, characterize the interchange and diversity of user studies.
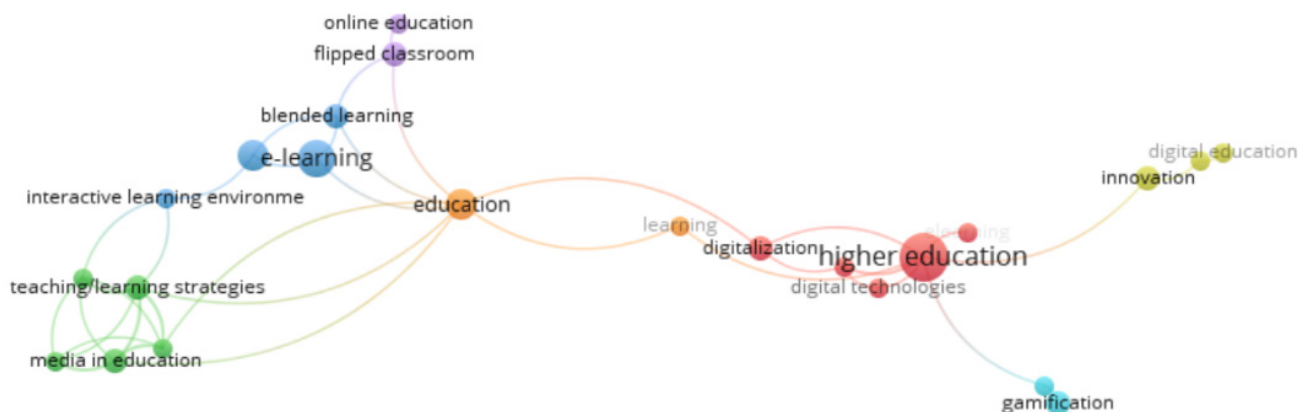

Figure 1. Keywords.

The analysis shows 7 clusters grouping the keywords as follows: the blue cluster is regarding the types of learning processes (Figure 2); the green cluster is focused on

the teaching and learning strategies; the orange cluster is focused on the education and learning processes; the red cluster is focused in digital transformation in higher education; the yellow cluster is focused on the innovation in education, and the light blue cluster is focused on introducing gamification in the learning process.

The distance between the terms (according to Figures 1 and 2) that effectively relate demonstrates a small distance among the nodes, which tends to reflect the higher number of published studies on the subject. As per the research attributes studied by the researchers according to digital education are organized as follows: the red cluster-id focused on the relation between the learning actors—The student and the instructor/teacher; the green cluster integrated the framework of the higher education institutions; the yellow cluster assumed the effects and impacts of online education; the blue cluster is focused on the benefits and the development of digital education; the orange cluster includes the research regarding the models and the adoption of digital education, and the purple cluster presents the studies focused on the educational theories.

Is observed the term education (according to Figure 3) as the most significant, with the majority of the occurrences in the titles of the articles, but terms as online learning, digital learning, digital transformation in education, digitizing education are also very present in the articles analyzed.

2.3.2. Co-Authorship

Figure 4 performs network analysis concerning co-authorship among all authors referring to the 49 documents analyzed. Each circle represents an author, and the lines connect the authors of the same document, each color assigned to a group means the authors share authorship of some document. Thus, it can be observed that, although the number of documents is small, there is little interaction between them in the development of research.

Table 1. Articles found per query.

Dimension	Topics	Autor	Ano
	Massive Open Online Courses	Ref. [10] Loya, A.; Gopal, A.; Shukla, I.; Jermann, P.; Tormey, R.	2015
	Massive Open Online Courses	Ref. [11] Ortega-Arranz, A.; Bote-Lorenzo, M.L.; Asensio-Pérez, J.I.; Martínez-Monés, A.; Gómez-Sánchez, E.; Dimitriadis, Y.	2019
	Massive Open Online Courses	Ref. [12] Guerrero, M.; Heaton, S.; Urbano, D.	2021
	Computer Usage	Ref. [13] Alothman, M.; Robertson, J.; Michaelson, G.	2017
	Digital Technologies	Ref. [14] Nguyen, D.	2018
	Digital Technology Diffusion	Ref. [15] Nicoletti, G.; von Rueden, C.; Andrews, D.	2020
	Multimedia Tools in the Teaching and Learning	Ref. [16] Abdulrahaman, M.D.; Faruk, N.; Oloyede, A.A.; Surajudeen-Bakinde, N.T.; Olawoyin, L.A.; Mejabi, O.V.; Imam-Fulani, Y.O.; Fahm, A.O.; Azeez, A.	2020
	Digitalization, Education	Ref. [17] Habibi, F.; Zabardast, M.A.	2020
Technology: Learning systems	Digitalization of Learning	Ref. [18] Alsmadi, M.K.; Al-Marashdeh, I.; Alzaqebah, M.; Jaradat, G.; Alghamdi, F.A.; Mustafa A Mohammad, R.; Alshabanah, M.; Alrajhi, D.; Alkhaldi, H.; Aldhafferi, N.; et al.	2021
	Digital Transformation Readiness in Higher Education	Ref. [19] Limani, Y.; Hajrizi, E.; Stapleton, L.; Retkoceri, M.	2019
	Lecture Recordings to Support Learning:	Ref. [20] Morris, N.P.; Swinnerton, B.; Coop, T.	2019
	Agile Model for the Digital Transformation of the University	Ref. [21] Kerroum, K.; Khiat, A.; Bahnasse, A.; Aoula, E.-S.; khiat, Y.	2020
	Mobile Game-Based Learning in Higher Education	Ref. [22] Troussas, C.; Krouska, A.; Sgouropoulou, C.	2020
	Podcasting	Ref. [23] Mobasheri, A.; Costello, K.E.	2021
	Web-Based Learning	Ref. [24] Mehrolia, S.; Alagarsamy, S.; Indhu Sabari, M.	2021
	Game Concepts in Digital Learning	Ref. [25] Schöbel, S.; Saqr, M.; Janson, A.	2021
	Gamification	Ref. [26] Krath, J.; Schürmann, L.; von Korflesch, H.F.O.	2021

Table 1. *Cont.*

Dimension	Topics	Autor	Ano
Digital Learning Methodologies	Self Learning	Ref. [27] El-Hmoudova, D.	2015
	Personalized e-Learning	Ref. [28] Rani, M.; Nayak, R.; Vyas, O.P.	2015
	Face-to-Face Instruction Over Digitally Embedded Instruction	Ref. [29] Kirovska-Simjanoska, D.	2016
	FLIP or Not to FLIP	Ref. [30] Şengel, E.	2016
	Personal Learning	Ref. [31] Marín-Díaz, V.; López-Pérez, M.; Sampedro-Requena, B.E.	2017
	Digital Education Methodologies	Ref. [32] Sousa, M.J.; Carmo, M.; Gonçalves, A.C.; Cruz, R.; Martins, J.M.	2019
Learning Design	Course Design	Ref. [33] Young, C.; Perović, N.	2016
	Developing Digital Educational Materials	Ref. [34] Álvarez-Nieto, C.; Richardson, J.; Parra-Anguita, G.; Linares-Abad, M.; Huss, N.; Grande-Gascón, M.L.; Grose, J.; Huynen, M.; López-Medina, I.M.	2018
	Design, Implementation, and Evaluation of an Inverted (Flipped) Classroom	Ref. [35] Foster, G.; Stagl, S.	2018
	Course Design Process in a Technology-Enhanced Learning Environment.	Ref. [36] Smith, C.; Onofre-Martínez, K.; Contrino, M.F.; Membrillo-Hernández, J.	2021
Digital Learning Environment	Digital Learning and Teaching Environment	Ref. [37] Hofmeyer, A.; Toffoli, L.; Vernon, R.; Taylor, R.; Klopper, H.C.; Coetzee, S.K.; Fontaine, D.	2018
	Digital-Age Learning	Ref. [38] Fleaca, E.; Stanciu, R.D.	2019
	E-Learning Adoption	Ref. [39] Mehta, A.; Morris, N.P.; Swinnerton, B.; Homer, M.	2019
	Online Teaching-Learning	Ref. [40] Sousa, M.J.; Rocha, A..	2019
	E-Learning Application	Ref. [41] Oyediran, W.O.; Omoare, A.M.; Owoyemi, M.A.; Adejobi, A.O.; Fasasi, R.B.	2020
	Network Distance Teaching	Ref. [42] Yao, S.; Li, D.; Yohannes, A.; Song, H.	2021
	Digital Higher Education	Ref. [43] Zheng, F.; Khan, N.A.; Hussain, S.	2020
	Online Education	Ref. [44] Damşa, C.; Langford, M.; Uehara, D.; Scherer, R.	2021
	Online Learning and Teaching	Ref. [45] Downer, T.; Gray, M.; Capper, T.	2021
	Online Teaching and Learning	Ref. [46] Hofer, S.I.; Nistor, N.; Scheibenzuber, C.	2021
	Online Education on Teaching	Ref. [47] Selvaraj, A.; Radhin, V.; KA, N.; Benson, N.; Mathew, A.J.	2021
	Online Education	Ref. [48] Grodotzki, J.; Upadhya, S.; Tekkaya, A.E.	2021
Learning Theories	Connectivism	Ref. [49] Corbett, F.; Spinello, E.	2020
Digital Learning Assessment	Automated Formative Assessment Model for Learning and Teaching	Ref. [50] Barana, A.; Marchisio, M.	2016
	Assessment of the Influence of Adaptive E-Learning	Ref. [51] Hubalovsky, S.; Hubalovska, M.; Musilek, M.	2019
	Effectiveness of the Emergency ELearning	Ref. [52] Roman, M.; Plopeanu, A.P.	2021
	Feedback in Online Learning	Ref. [53] Jensen, L.X.; Bearman, M.; Boud, D.	2021
	Student-Teacher Communication for Effective Learning.	Ref. [54] Liu, W.; Muthu, B.; Sivaparthipan, C.B.	2021
Others	Tendencies in Higher Education.	Ref. [55] Sorokova, M.G.	2020
	Teachers' Digital Information Skills -	Ref. [56] Saikkonen, L.; Kaarakainen, M.-T.	2021
	Learning Difficulties in a Digital Environment	Ref. [57] Hammershøj, L.G.	2019
	Brriers and Drivers of Innovation in Higher Education	Ref. [58] Lašáková, A.; Bajzíková, Ľ.; Dedze, I.	2017

Another point shown in Figure 4 is the relationship between authors, represented by the distance between the groups. The closer they are located, the stronger their connection in terms of co-authorship, and this case, there is little proximity between the groups. In addition, the size of each circle reflects the number of citations by each author, so the larger the circle, the more citations the author has concerning the selected document.
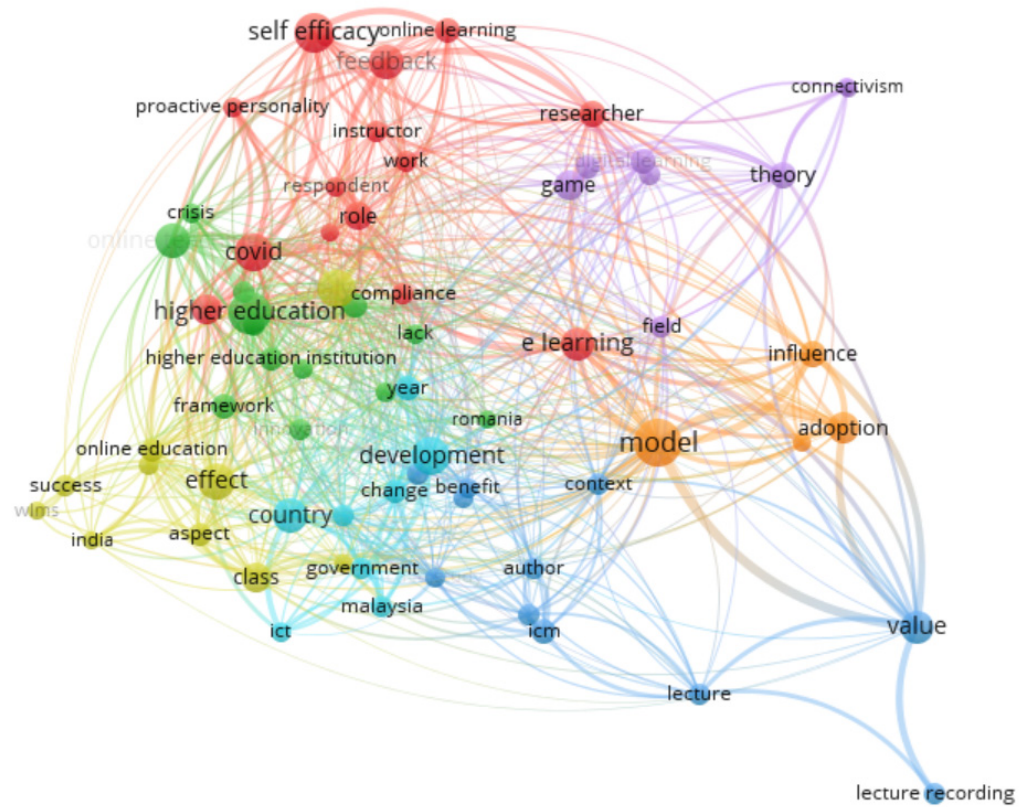
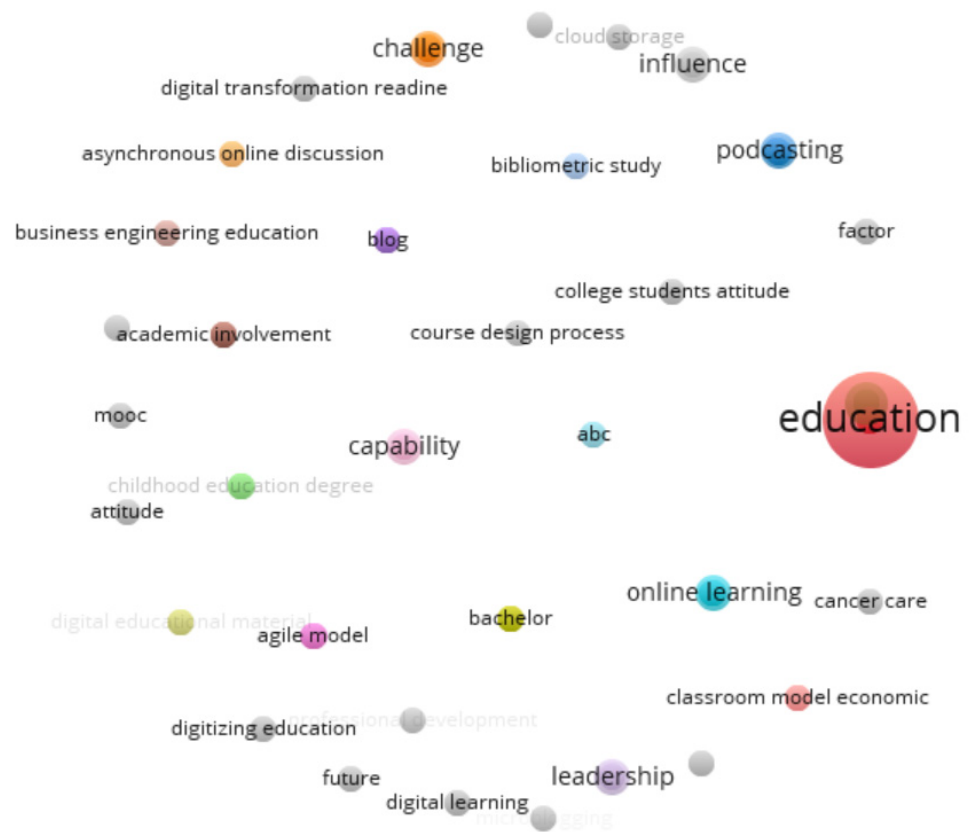**Figure 2.** Research Attributes and expressions in title and abstract.
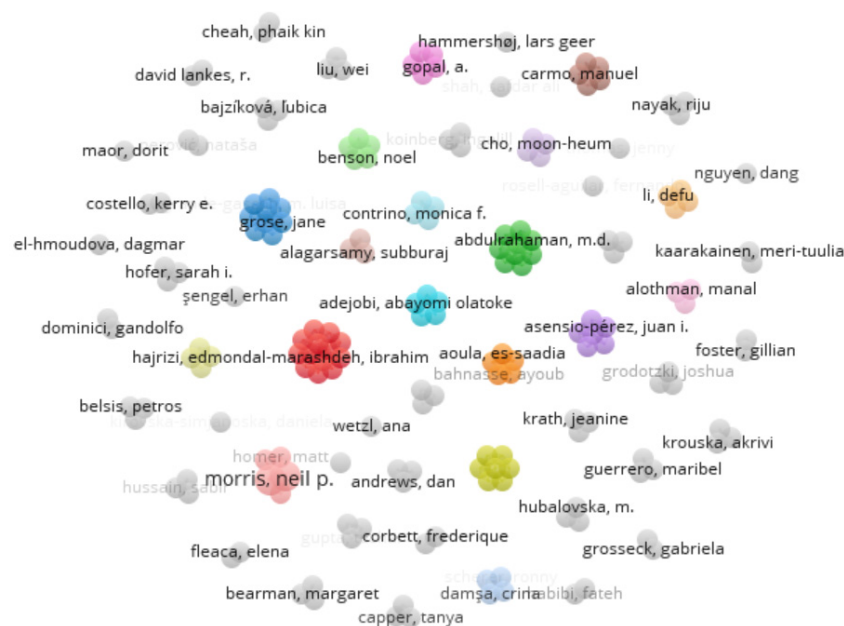

Figure 3. Expressions in title.

Figure 4. Co-authorship.

3. Methods

3.1. Data Collection Procedure

An online survey was developed through Google Forms and sent to higher education students associations with the available online contacts. The survey was active between August and October of 2020. The instrument's application lasted 10 min on average.

The ones who answered were informed of the anonymous and confidential nature of the collected data, noting that their participation in the survey was voluntary and there was no monetary or another kind of reward.

3.2. Instrument

The survey was presented in two sections. The first one is composed by the experience of digital learning during the period of the COVID-19 lockdown, including 18 items regarding the digital learning's experience (e.g., " I felt comfortable having online classes" answer in five points Likert scale 1 = totally disagree a 5 = totally agree), 2 items about the level of preparation and adaptation of the institution concerning the COVID-19 pandemic (1 = Nothing prepared/adapted to 5 = Fully prepared/adapted), 1 item regarding the satisfaction with the online classes format (1 = Not satisfied at all to 5 = Totally satisfied) and one item about the intention of maintenance of the online format in the next school year (answer as yes or no). The second section was related to a sociodemographic and academic characterization group.

3.3. Participants

The global convenience sample included 173 university students. In terms of sociodemographic characteristics, the participants were mostly female (n = 142; 82.1%), single (n = 157; 90.8%) with an average age of 24 years old (SD = 7.42). Majority of the ones inquired are from public universities (n = 151; 87.3%). The most common cycle of studies is the first cycle (n = 116; 67.1%), next is the second cycle (n = 52;30.1%) and lastly is the third cycle (n = 5; 2.9%). From the participating scientific areas of the course, the ones that stood out were Law, Social Sciences and Services (n = 43; 24.9%); Health (n = 34; 19.7%) and Economics, Management and Accounting (n = 21; 12.1%). The school year the participants are in goes from the first one (n = 20; 11.6%); second one (n = 51; 29.5%); third one (n = 63; 25.9%); followed by the fourth until sixth one (n = 39; 22.5%). Only 26.6% (n = 46) are working students.

3.4. Data Analysis Procedure

The variables under study were characterized using descriptive and frequency statistics. Chi-square tests were used to assess whether the percentage distribution of responses in the different categories of the variables under study was significantly different. In all inference analyses, a type I error probability (α) of 0.05 was considered.

An Exploratory Factor Analysis with factor extraction by the principal components' method followed by varimax rotation was applied to the 18 items regarding an agreement with the adaptation to online classes in COVID times. In factor retention, three criteria were simultaneously taken into account: (1) extract the factors that present eigenvalues greater than 1; (2) explain at least 50% of the total variance explained; (3) in line with the inflection point of the Scree plot. Since according to [59], the use of a single criterion may lead to the retention of more or fewer factors than relevant to describe the latent structure. The suitability of the variables to the EFA was assessed through the KMO value=0.841, which is an indicator of a good factorability of the correlations matrix. The subjects' scores on each of the retained factors were obtained by the Anderson-Rubin method and were then used in logistic regression to identify the significant predictors of the likelihood of choosing to hold classes in the online format in the next academic year. In addition to these scores, the sociodemographic variables (Gender, Age, Marital status, Student-worker) and also "the level of adaptation of the institution", "the level of preparation of the institution" and "the level of satisfaction with the assessment format" were used as independent variables in the logistic regression. Logistic regression was performed by the Enter method and the Forward LR variable selection method, the assumptions and the diagnosis of influential cases were validated by graphical analysis of residuals as described in [59]. It was found that 6 observations were outliers' candidates, but it was decided to keep them in the final model since their removal does not significantly improve either the significance or the quality of the model. All analyses were performed using IBM SPSS (v.27).

4. Results and Discussion

4.1. Preparation and Adaptation of Higher Education Institutions

Table 2 shows the perception of the higher education institution's level of preparation and adaptation concerning the COVID-19 pandemic. Regarding the institution's level of preparation, 120 (64.4%) of the inquired reported between nothing and partially prepared. Regarding the level of adaptation, at this moment, most of the answers (n = 90; 52%) are found between very and fully adapted. The results of the Chi-square test ($X^2(4) = 32.155$, $p < 0.001$), show that the two variables are not independent. The Correspondence Analysis (ANACOR) shows the associations between categories: It can be stated that there is an association between well prepared and well-adapted responses; partially prepared and adapted, and between not at all or partially adapted and prepared.

Table 2. Level of preparation and adaptation of the institution concerning the COVID-19 pandemic.

Answers	Level of Preparation		Level of Adaptation	
	Frequency	%	Frequency	%
Nothing prepared/adapted	32	18.5	12	6.9
Poorly prepared/adapted	43	24.9	26	15.0
Partly prepared/adapted	45	26.0	45	26.0
Very prepared/adapted	45	26.0	67	38.7
Fully prepared/adapted	8	4.6	23	13.3
Total	173	100.0	173	100.0

4.2. Satisfaction with Digital Learning

Regarding the course of their studies, the majority of participants were having online classes instead of face-to-face teaching (n = 170; 98.3%), considering that for 94.8%, it was their first experience of online classes. Students are satisfied with the online class format (Table 3). One sample Qui-square results ($X^2(4) = 31.017$, $p < 0.001$) show that

the distributions of responses in the different categories are not homogeneous. Further analysis of standardized residuals (see Table 3) shows that the categories satisfied and totally satisfied (|standardized residual| > 2) differ significantly from the proportion under the null hypothesis.

Table 3. Satisfaction with the online classes format.

Answers	Frequency	%	Standardized Residual
Not satisfied at all	24	13.9	−1.802
Not very satisfied	37	21.4	0.408
Satisfied	60	34.7	4.318
Very satisfied	35	20.2	0.060
Totally satisfied	17	9.8	−4.214
Total	173	100.0	

4.3. Intention to the Maintenance of the Online Format

When questioned about this format's maintenance in the following school year, 56.1% (n = 97) stated yes and 43.9% (n = 76) stated no (Table 4). One sample Qui-square results ($X^2(1) = 2.549$, $p = 0.110$) show that the distributions of responses in the different categories are homogeneous. The issue of the maintenance of the format was complemented with the justification request which was the content analysis' subject. The reasons pointed out for not wanting to maintain the format are associated with the reconciling difficulty of this format with practical classes, technological constraints, especially the internet one, and the need for social proximity with colleagues and Professors. The reasons pointed out to support this format's continuity are associated with the security made possible while in a pandemic and time and location's flexibility.

Table 4. Intention to the maintenance of the online format in the next school year.

	Frequency	%
No	76	43.9
Yes	97	56.1
Total	173	100.0

4.4. Digital Learning's Experience

According to the eigenvalue rule greater than 1, and in line with the scree plot and the percentage of total variance explained, the relational structure of the original variables is explained by 4 latent factors which, in total, explain 68.5% of the total variance. Table 5 shows the factorial weights of each item in each factor, the communalities of each item, the eigenvalues of each factor, and the respective Cronbach's values.

The first factor explains about 34% of the total variability and high internal consistency ($\alpha = 0.88$). The variables that saturate this fact are: "I felt comfortable with online classes", "Online teaching allows me to save time", "The execution of asynchronous tasks is useful for consolidating the learning of the contents of the Curricular Units.", "The execution of asynchronous tasks between synchronous classes facilitates concentration in class" and "Online teaching is more functional in terms of schedules" all with very high factorial weights. This first factor was designated as "Characteristics of online classes". The second factor explains about 118% of the total variability and presents high internal consistency ($\alpha = 0.89$). The variables that saturate this factor are: "Professors have been available to help me", "My higher education institution has been available to help and support me", "My professors have always sought the best for all students" and "My higher education institution has always sought the best for all students", all with very high factor weights. This factor was designated as "School and Professor support". The third factor explains 10% of the total variance and also presents high internal consistency ($\alpha = 0.83$), the variables that saturate in this factor are "I learn better with classes in the online format", " I believe I learn the same in the online format as I do in face-to-face classes ", "I prefer the face-to-face

classes format" and "Most people believe that online teaching is more effective than the usual classroom teaching methodologies" with medium to high factorial weights. Finally, the fourth factor accounts for about 7% of the total variability and presents a high internal consistency ($\alpha = 0.80$). The variables that saturate this factor are: "My family has been concerned about the general situation of my studies", "I have had the emotional help and support I need from my family", "I have had the support of my friends", "I have had someone with whom I can share my joys and sorrows" and "I have had the support of my friends", all with medium to high factor weights. This factor was designated as Support from family and friends.

Table 5. Factor weights (greater than 0.5) of each item in each of the retained factors, Communalities of each of the items in the 4-factor solution, Eigenvalues, % of variance explained, and internal consistency of each of the retained factors.

	Factors				Communalities *
	Characteristics of Online Classes	Support from the School and Professors	Online Classes vs. Face-to-Face Classes	Support from Family and Friends	
I felt comfortable with online classes	0.726				0.712
I learn better with classes in an online format			0.691		0.729
Online teaching allows me to save time	0.810				0.730
The execution of asynchronous tasks is useful for consolidating the learning of the contents of the Curricular Units	0.802				0.689
The execution of asynchronous tasks between synchronous classes facilitates concentration in class	0.729				0.625
Online teaching is more functional in terms of schedules	0.792				0.703
I believe I learn the same in the online format as I do in face-to-face classes			0.654		0.675
I prefer the face-to-face classes format			−0.778		0.751
Professors have been available to help me		0.795			0.722
My higher education institution has been available to help and support me		0.821			0.739
Most people believe that online teaching is more effective than the usual classroom teaching methodologies			0.606		0.481

Table 5. *Cont.*

	Factors				Communalities *
	Characteristics of Online Classes	**Support from the School and Professors**	**Online Classes vs. Face-to-Face Classes**	**Support from Family and Friends**	
My family has been concerned about the general situation of my studies				0.799	0.704
I have had the emotional help and support I need from my family				0.823	0.717
I have had the support of my friends				0.700	0.634
My professors have always sought the best for all students		0.870			0.801
My higher education institution has always sought the best for all students		0.849			0.736
I have had someone with whom I can share my joys and sorrows				0.791	0.630
Online learning requires significant changes for the student			−0.654		0.548
Explained Variance	33.99%	17.82%	10.00%	6.67%	
Eigenvalue	6.199	3.207	1.800	1.200	
α-cronbach	0.887	0.891	0.830	0.802	

* Communalities: The commonality of items or variables corresponds to the fraction of the variance of each variable that is explained by the retained factors. This statistic is a good indicator of how each variable or item is "well explained" by the retained factorial solution (ideally the closer to 1 the better, however it is considered acceptable when the commonality is greater than or equal to 0.5—which means that the percentage of item variation that is explained by the factor solution found is greater than or equal to 50%.

Logistic regression with all predictors (Enter method) and the Forward LR method led to similar regression models. The results obtained showed that the significant predictors were: factor 1 -"Characteristics of online classes (b_{fator1} = 1.636; X^2_{Wald} (1) = 33.479, p < 0.001); factor 2-"Support from the School and Professors (b_{fator2} = 0.553, X^2_{Wald} (1) = 6.072; p = 0.014); factor 3-"Online classes vs. face-to-face classes" ($b_{fator\ 3}$ = 1.594; X^2_{Wald} (1) = 28.532, p < 0.001) and the gender (bgender = 0.343; X^2_{Wald} (1) = 2.027, p = 0.018). The final Logit model showed a good fit to the data (G^2(4) = 96.916, p < 0.001; X^2_{HL} (8) = 7.553, p = 0.478, R_{CS} = 0.431; R^2_N = 0.577, R^2_{MF} = 0.441). Table 6 summarises the model coefficients and their significance.

The odds of choosing the online format (Y = 1) increase if Exp(B) > 1. Thus, the probability of choosing to keep online classes increases exponentially with the characteristics of online classes ((5.134−1) × 100 = 413.4%), with Support from school and teachers ((1.738−1) × 100 = 73.8%); Online classes vs. Face-to-face classes ((4.923−1) × 100 = 392.3%). Keeping factors 1, 2, and 3 constant the probability if a man chooses the online format compared to a woman is higher (4:1, i.e., 334.4%). The percentage of correct classifications is 82.6% which is considerably higher than the proportional percentage of correct classifications by mere chance (49.25%) demonstrating the usefulness of the model in classifying new observations. The model also presents a high sensitivity (83.3%) and specificity (81.6%), as well as a very good discriminant ability (AUC = 0.895, p < 0.001).

Table 6. Logit Coefficients of the Logistic Regression model of the variable "Maintaining the online format in the next school year" as a function of the characteristics of online classes, School and Professor Support, Face-to-face classes vs. online classes, and Gender (results obtained by the Forward LR variable selection method).

Variable	B	S.E.	X^2_{Wald}	d.f.	*p*-Value	Exp (B)	95% C.I. for Exp(B)
Characteristics of online classes	1.636	0.283	33.479	1	<0.001	5.134	]2.950, 8.935[
Support from the School and Professors	0.553	0.224	6.072	1	0.014	1.738	]1.120, 2.698[
Online classes vs. face-to-face classes	1.594	0.299	28.385	1	<0.001	4.923	]2.739, 8.849[
Gender (1)	1.469	0.241	5.635	1	0.018	4.344	]2.739, 8.849[
Constant	0.343	0.241	2.027	1	0.155	1.409	

5. Implications of the Research

5.1. Practical Implications

The research has some practical implications, as:

(1) Promoting digital education insights from the students for the educational leaders to focus on their main concerns, namely, to facilitate the adaption of universities to the specificities of digital learning.

(2) Contributing to developing new learning practices present in the literature and that deserve to be tested in other contexts.

(3) Promoting flexibility of digital learning considering the diversity of the students, and the numerous digital learning technologies and learning platforms.

(4) Pointing out the need for digital competencies development regarding the students and the teachers.

(5) Creating awareness of new pedagogies and methodologies to facilitate innovations in digital education.

(6) Contributing to elaborating scenarios regarding the sustainability of digital education in the near future.

5.2. Societal Implications

The research has some social implications, as focusing on the promotion of new digital educational models, based on a new economic and social paradigm, framed by the public health context. A new concept of digital learning occurs at students' homes for safety reasons and focused on promoting positive learning outcomes in complex contexts, where students need to deal with their emotional and spiritual well-being as necessary elements to their educational development.

The inevitability of learning new competencies to face a new learning situation mediated by technology, and to be open to new learning situations, that leads them to be more autonomous and become more responsible for their learnings, and outcomes.

5.3. Research Implications

The study has also some research implications as it is a new avenue for researchers to analyze in different perspectives, regarding the technological evolution regarding digital learning, the study of new digital competencies and skills for students and teachers, and the dynamism and flexibility of the learning contexts will lead to new possibilities for educational research. Also, new pedagogies and learning models need to be studied and created or adjusted to the new contexts and needs for the student's development and also their engagement in the learning process. The characteristics of digital education are also changing, with the introduction of artificial intelligence in the creation of learning content, leading to new research possibilities regarding ethics in digital education, use of holograms in substituting the teachers, and studying the digital transformation of digital education, maintaining the quality standards of the learning process.

6. Limitations and Future Research

The main limitations regarding the systematic literature review were the reduced number of studies purposing innovative solutions, and also there is a lack of consistency regarding the future sustainability of digital education, as Universities are changing continuously from face-to-face to online learning according to the direction of the pandemic, without a clear vision of the higher education strategy. Also, there is a lack of studies regarding the professor's and students' digital competencies, and also focused on feasible assessment methodologies. In respect to the empirical study, the size of the sample is a limitation, also being a convenience sample, and also the context of a specific country—in the future would be a good research strategy to enlarge the sample including other geographies to make comparisons on the students' perceptions about the digital education experience, and the sustainability of digital education in the near future. Also, could be important to do a longitudinal study to understand the evolution of the perceptions of the students regarding the several mandatory moments of digital education during the COVID-19 pandemic. The adoption of digital education technology in developing countries and the impact of its use in online classes should also be researched, as the digital relationship between students and professors.

7. Conclusions

COVID-19 pandemic has pushed the Universities from presential education to digital education, which was seen till then as education without quality, having numerous barriers and resistances.

The field research was applied in two sections: the first was during the COVID-19 blocking period, including 18 items referring to the digital learning experience. The second section dealt with a group of sociodemographic and academic characterization. The total sample of respondents was university students, predominantly female, single, with an average age of 24 years. The majority of respondents study in public universities, from scientific areas of Law, Social Sciences and Services, Health and Economics, Management, and Accounting. The students represent all the years of the first and second cycle of studies (Bachelor and Master's degrees), being only 26.6% working students.

The questionnaire was structured in several sections, and the questions were focused on four main topics: Preparation and adaptation of higher education institutions, Satisfaction with digital learning, Intention to maintain the online format, Digital learning experience.

Regarding the preparation and adaptation of higher education institutions, namely, satisfaction with digital learning, the students responded that their universities were not prepared for digital education at the beginning of the pandemic. However, nowadays the level of adaptation increased, and according to their perception, the universities are very and fully adapted to the specificities of digital education. Although this perception of the students regarding the fast adaptation of the universities to digital education, the reduced studies regarding the digital competencies' of both students and faculty, shows that there is still a high level of preparation needed, as digital education includes the technology and the infrastructures, but also and mainly the sharing of knowledge and the relationships among those actors, and there is a lack of pedagogical models focused on all the digital educational process, from the learning design process to the courses planning, the creation of digital learning content, the learning activities, and the assessment methodologies, leading to effective learning.

As for satisfaction with digital learning, the student's responses show that they are satisfied with online learning and open to the possibility to maintain the online format, (56.1% of the students). The main reasons for the positive approach to digital education are associated with safety reasons because of the public health situation decurrent from COVID-19, and the flexibility of time and location gave by the use of digital technologies in education.

Respondents explained that the digital learning experience was very positive because, it saves time, adds to the execution of asynchronous tasks are important to consolidate the learning process. In addition, teachers are more available to help with activities, facilitating very positive learning outcomes. The majority of the respondents believe that online teaching methodologies are more effective than traditional face-to-face teaching methodologies. However, the learning process during the beginning of the pandemic was a complex process of adaptation, but the students had the support of their family and friends, sharing with them their anxieties, joys, and sorrows.

The research concludes that the chances of choosing the online format increase due to the benefits of online classes, and because of the support from the universities and teachers. The result pointed to the maintenance of the online format, as it allows the use of different teaching strategies that motivate students and the use of different technological resources. However, to make digital education sustainable the higher education institutions need to define programs of digital competencies development for students and, mainly, for teachers. They also need to invest in the creation of pedagogical models for digital education, including all learning cycles. For the sustainability of digital education. the higher education institutions need to change and adapt the curricula to meet the needs of new social and scientific challenges.

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