education sciences

MDPI

Article

Assessment of Digital Competencies of University Faculty and Their Conditioning Factors: Case Study in a Technological Adoption Context

Javier Jorge-Vázquez [1,*], Sergio Luis Náñez Alonso [1,*], Washington Raúl Fierro Saltos [2,*] and Silvia Pacheco Mendoza [3]

[1] DEKIS Research Group, Department of Economics, Catholic University of Ávila, 05005 Avila, Spain
[2] Faculty of Administrative Sciences, State University of Bolivar, Guaranda 020101, Ecuador
[3] Faculty of Education Sciences, State University of Bolivar, Guaranda 020101, Ecuador; spacheco@ueb.edu.ec
* Correspondence: javier.jorge@ucavila.es (J.J.-V.); sergio.nanez@ucavila.es (S.L.N.A.); wfierro@ueb.edu.ec (W.R.F.S.)

Abstract: The rise of digital technologies and their educational applications increasingly require the development of digital skills among university faculty. This study focuses on examining the level of digital competencies of university faculty and identifying their conditioning factors. To achieve this objective, an ex post facto methodological design with surveys is used. A sample of 216 university teachers from different regions of Ecuador was used. The non-parametric Chi-square test was used to validate the hypothesis of independence of the variables. The results obtained show that university faculty have a mostly intermediate level of digital skills, which is independent of gender, but dependent on the generational cohort. In particular, it is found that younger teachers (millennials) have a more advanced level of digital skills, although this relationship is not very strong. On the other hand, we observe the positive influence of the university's strategic leadership in terms of technological adoption on the development of teachers' digital skills. Universities with better technological resources and with training plans focused on the pedagogical application of technology have teachers with a more advanced level of digital skills. All of this leads to the recommendation that education policies should prioritise actions that promote the development of digital competencies among university faculty

Keywords: digital competences; higher education; technology adoption; digital literacy; teacher training; digital skills

Citation: Jorge-Vázquez, J.; Náñez Alonso, S.L.; Fierro Saltos, W.R.; Pacheco Mendoza, S. Assessment of Digital Competencies of University Faculty and Their Conditioning Factors: Case Study in a Technological Adoption Context. *Educ. Sci.* **2021**, *11*, 637. https://doi.org/10.3390/educsci11100637

Academic Editors: José Gómez Galán, Jose Ángel Martínez-López and Cristina Lázaro-Pérez

Received: 31 August 2021
Accepted: 7 October 2021
Published: 13 October 2021

1. Introduction

The incessant development of digital infrastructures, together with the universalisation of increasingly faster and more secure network access and interconnection, is favouring the configuration of a global digital ecosystem in which multiple disruptive processes are taking place [1]. This dizzying digitalisation is questioning the traditional forms and balances of economic and social organisation. The education sector is no stranger to this disruptive dynamic. On the contrary, in the last decade the use of digital technology in educational centres has grown exponentially. Recently, the health crisis brought about by COVID-19 has accelerated this process of digital transformation in university education. This new paradigm based on new digital technologies opens up a wide range of opportunities to be explored in the teaching–learning process in higher education [2].

Numerous studies have investigated this phenomenon in the educational context, especially since the approval of the Digital Agenda for Europe within the framework of the Europe 2020 Strategy [3], which prioritises digital literacy and the acquisition of digital skills for the entire population. Particularly noteworthy are the studies that analyse competences in the use of Information and Communication Technologies (ICT) among

university students, such as [4–11]. Numerous studies have also been published examining digital skills among university factuly and the factors that influence the pedagogical adoption of ICT [12–17]. Others, such as [18], have focused on exploring methods to address "the urgent problems of creating and functioning of virtual societies in universities".

Numerous studies have also addressed the importance of training in the development of teachers' digital competencies. Instefjord and Munthe [19] examine in their study the integration of digital competence in Norwegian teacher education curriculum documents and conclude that digital competence is not yet considered as an important component of teachers' professional competence.

Numerous studies have also addressed the importance of training in the development of teachers' digital competencies. Instefjord and Munthe [19] examine in their study the integration of digital competence in the curriculum documents for teacher education in Norway and conclude that digital competence is not yet considered as an important component of teachers' professional competence. Gudmundsdottir and Hatlevik [20] explore the training of newly qualified teachers to use information and communication technologies. In their study, they identify a deficiency of ICT training during teacher education. Fernández-Batanero et al. [21], after a systematic review of the literature on digital competencies and professional development, conclude that most studies reveal insufficient ICT teacher training. In short, most of the published works coincide in pointing out the importance of improving and increasing ICT teacher training as a priority of educational policies. This training must place digital competence as a basic pillar of the pedagogical competencies of university faculty [22].

Concerning the definition of the concept of digital competence in the literature, a large number of approaches can be found. For example, Flores-Lueg et al. [23] consider it to be a type of multidimensional competence that can be defined as the "ability to mobilise those skills and abilities that allow one to search for, critically select, obtain and process relevant information using ICT to transform it into knowledge, while at the same time being able to communicate this information through the use of different technological and digital supports, acting responsibly, respecting socially established norms and taking advantage of these tools to inform, learn, re-solve problems and communicate in different scenarios of interaction". Ilomäki et al. [24] argue that digital competence is an evolving concept that is conditioned by the "development of digital technology and the political aims and expectations of citizenship in a knowledge society". These authors define digital competence as the set of skills and knowledge necessary for citizens to participate in and contribute to a digitised knowledge society. Other authors, such as Starkey [25], after a review of the literature on digital competences in teaching, identify three different ways: generic digital competencies, digital teaching competencies and professional digital competencies three different ways. His study develops professional digital competence, which he defines as "the ability of the teacher to work in the context of a digitally infused schooling education system, including teaching, manage the digital learning environment and the professional work of being a teacher."

At the institutional level, the European Union (EU) has promoted the development of digital competences in various frameworks, including DigCompEdu [26], which aims to capture these educator-specific digital competences. For its part, the European Commission [27] considers digital competence as one of the nine key competences that enable citizens to participate actively in society and defines it as: "the confident, critical and responsible use of and engagement with, digital technologies for learning, at work and for participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property related questions, problem solving and critical thinking". Other institutions have also expressed their views on the subject. For UNESCO [28], "it is essential that teachers have the competencies to integrate ICT in their professional practice to ensure the equity and quality of learning". In this context, UNESCO has developed an ICT Competency

Framework for Teachers which covers a wide range of competencies necessary for teachers to integrate ICT in their professional practice. This e-skills framework will be adopted as a reference for this study.

However, despite efforts to promote the integration of ICT in teaching practice, some studies [29] warn that effective technological adoption by teachers is often not achieved. As Santos [30] points out, "this movement is not always technologically aligned with the available infrastructure, as teachers do not always opt for this effective adoption". Several studies point to a lack of teacher acceptance of integrating technology into teaching. For example, Howard [31] points out that such acceptance is influenced by three factors: "negative affective responses to technology, general risk-aversion in teaching and the perceived value of technology in teaching". Others, such as Somekh [32], point to technophobia or teacher scepticism as possible causes. For their part, Christensen and Knezek [33] identify three fundamental factors that condition the pedagogical adoption of ICT: i) the willingness (attitude) of teachers, their level of skill (digital competence) and access to technology. In this context, this research focuses on the study of two of these conditioning factors, in particular, the level of digital competence of university faculty and access to technology assessed through the technological endowment of the educational institution and the availability of specific training plans on digital competences.

Based on the review of the research background and the current status of the issue raised, the following research assumptions are made for subsequent contrast:

Hypothesis 1 (H1): *The age and gender of university faculty condition their level of digital competencies.*

Hypothesis 2 (H2): *Institutional leadership exercised through technological resources and the offer of specific training programs in the digital field is a conditioning factor in the degree of acquisition of digital competencies by university teachers.*

In short, this study aims to characterise the level of digital competences of university faculty and to analyse some of the conditioning factors. In particular, it aims to examine the influence of certain sociodemographic characteristics, such as gender or generational cohort, on the level of digital skills achieved by teachers. In addition, the study aims to identify whether the technological endowment of the educational institution and the type of digital skills training provided predict to some extent a higher or lower level of digital competence of university faculty.

Finally, this research adopts Ecuador as the territorial unit of analysis. Ecuador is still far from reaching average levels of digital connectivity in Latin America and the Caribbean (LAC) and is far from Organisation for Economic Cooperation and Development (OECD) levels. Furthermore, it ranks relatively low among South American countries in terms of the penetration of mobile and Internet services according to data published by the International Telecommunication Union (ITU) [34]. Despite this, the country's telecommunications sector has considerable potential for development in the coming years. The efforts of the government and operators to develop digital infrastructures are remarkable and so are the public policies adopted to reduce the digital divide [35]. A good example of this is the launch in 2019 of the "Ecuador Digital Strategy", whose main purpose is to improve the connectivity and digital literacy of the population and the country's productive sectors [36]. All these characteristics make Ecuador a territorial unit of analysis of great interest. As stated by Melo Fiallos et al. [37], "Ecuador is a country with a growing number of institutions with access to technology and connectivity". In this context, the creation of digital literacy programmes in education is key. It is not only the provision of digital infrastructure that is fundamental but also the training of teachers and the certification of their digital skills [36].

2. Materials and Methods

A cross-sectional, descriptive and correlational analytical observational study was carried out.

2.1. Sample

The population considered in the study consisted of 20,466 teachers working in public universities and polytechnic schools in Ecuador [38]. Stratified random probability sampling was used to select the sample [39], with a confidence level of 95% and a sampling error of 6.64%, with p and q values of 0.5 and calculated as follows:

$$n = \frac{N \cdot Z_a^2 \cdot p \cdot q}{d^2 \cdot (N-1) + Z_a^2 \cdot p \cdot q} \quad (1)$$

where:

n = sample size;
N = population size;
Z = confidence level;
p = probability of success or expected proportion;
q = probability of failure (1-p);
d = precision (maximum admissible error in terms of proportion).

Thus, the study sample is representative and consists of n=216 university teachers. The characterisation of the sample is shown in the Table 1.

Table 1. Characterisation of the sample.

Gender (Percentage)	Average Age (Years)	Level of Education: Highest Level of Education (Percentage)	Area of Knowledge (Percentage)	Area of Residence (Percentage)
Male: 62% Female: 38%	46.3 years	Ph.D: 20% Higher education: 77% Middle-higher: 3%	Agricultural Sciences: 6% Medical Sciences and Health: 9% Natural Sciences: 7% Social Sciences: 39% Humanities: 13% Engineering and Technology: 25%	Urban: 94% Rural: 6%

2.2. Variable Selection

The variables selected for this study were: age, gender, technological endowment of the university and type of digital skills training provided by the university (Table 2).

Table 2. Selected variables.

Variable	Description
Gender	Male/Female
Age	Years/Generational cohorts
Type of training received in digital skills. Characterisation of the sample.	Training outside the university centre/Training provided by the university centre itself
Technological endowment of the university centre	Low technology endowment/Medium technol-ogy endowment/High technology endowment

Additionally, the degree of acquisition of digital competences was included in the study. For this purpose, digital competences were selected by adopting the ICT competences framework for teachers proposed by UNESCO (2018) [28]. These competences are listed in Table 3.

Table 3. Digital literacy according to the framework proposed by UNESCO (2018). Source: Own development based on [28].

Leves Code | Description	Competences Code | Description
N1. Knowledge Acquisition	C.1.1 Articulate how their classroom practices correspond to and support institutional and/or national policy. C.1.2. Analyse curriculum standards and identify how ICT can be used pedagogically to support attainment of the standards. C. 1.3. Make appropriate ICT choices to support specific teaching and learning methodologies. C.1.4. Identify the function of hardware components and common productivity software applications and be able to use them. C.1.5. Organize the physical environment to ensure technology supports different learning methodologies in an inclusive manner. C.1.6. Use ICT to support their professional development.
N2. Knowledge Deepening	C.2.1. Design, modify and implement classroom practices that support institutional and/or national policies, international commitments (e.g., UN Conventions) and social priorities. C.2.2. Integrate ICT across subject content, teaching and assessment processes and grade levels and create a conducive ICT-enhanced learning environment where students, supported by ICT, demonstrate mastery of curriculum standards. C.2.3. Design ICT-supported project-based learning activities and use ICT to facilitate students to create, implement and monitor project plans and solve complex problems. C.2.4. Blend varied digital tools and resources to create an integrated digital learning environment to support students' higher-order thinking and problem-solving skills. C.2.5. Use digital tools flexibly to facilitate collaborative learning, manage students and other learning partners and administer the learning process. C.2.6. Use technology to interact with professional networks to support their own professional development.
N3. Knowledge Creation	C.3.1. Critique institutional and national education policies alike, suggest revisions, design improvements and speculate on the impact of these changes. C.3.2. Determine how best to incorporate student-centred and collaborative learning to ensure mastery of multidisciplinary curriculum standards. C.3.3. While determining learning parameters, encourage student self-management in student-centred and collaborative learning. C.3.4 Design knowledge communities and use digital tools to support pervasive learning. C.3.5. Play a leadership role in devising a technology strategy for their school to turn it into a learning organization. C.3.6. Continually develop, experiment, coach, innovate and share best practices to determine how the school can best be served by technology.

Subsequently, the aggregate variable "level of digital competences" (CD) was obtained as the average of all the scores obtained in each of the 18 digital competences that were assessed. This variable takes three possible categories: beginner level, intermediate level and advanced level.

2.3. Data Collection and Processing

An ex post facto survey design was used. The information is collected in a standardised way using a questionnaire that allows the intra-group analysis of the sample. This questionnaire includes, under an organised structure, the different indicators of the variables involved in the survey. The design of the questions in the questionnaire took into consideration their capacity to report reliable and quantifiable responses following the empirical variables for which precise information was to be obtained. The measurement instrument comprised three sections: firstly, the sociodemographic profile, environment and digitisation, digital profile and competences, educational digitisation and teaching practice. Data collection was carried out in the first half of the year 2021.

Finally, the statistical procedure was carried out using SPSS statistical software [40]. To assess the reliability of the instrument used in the study, Cronbach's $\propto$ was used [41]. Descriptive statistics using means, standard deviations and ranges were used for the quantitative variable "age", while frequencies and percentages were calculated for the

qualitative variables. To test the hypotheses of independence between categorical variables, we used Pearson's Chi-Square (X^2) statistical tests, the calculation of which allows us to observe, with 95% confidence intervals, whether the levels of the qualitative variables influence the levels of the categorical variable analysed, all this for a p-value < 0.05. The null hypothesis to be tested will therefore be the independence (H0=independence) between the factors, the alternative hypothesis (H1=association) being the dependence between them.

The following expression was used to calculate the Chi-Square:

$$X^2 = \frac{\sum_i^I \sum_j^J (F_{ij} - f_{ij}) \cdot 2}{F_{ij}} \quad (2)$$

where F_{ij} is the observed frequencies and f_{ij} is the expected frequency.

In conclusion, to assess statistical significance, the Pearson Chi-Square calculation is used and the p-value of the test is examined; if the p-value is below a specified significance level (α) of 0.05, the difference can be said to be statistically significant and the null hypothesis of the test can be rejected.

3. Results

The analysis of the information collected through the questionnaire shows that the majority of university teachers have an intermediate level of digital competences. In particular, 32% of the individuals in the sample have an advanced level; 65% a medium level; and the remaining 3% a beginner or low level (Figure 1).

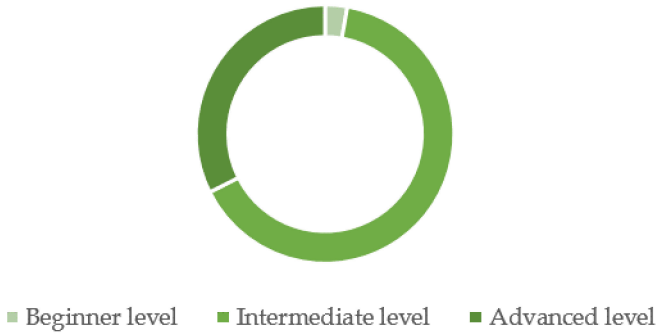

Figure 1. Distribution of the sample according to the level of digital skills achieved. Source: Own development.

These results are conditioned by the level of digitalisation of the country and the digital skills of the population. In this context, the general perception of university teachers is that the level of digitalisation in Ecuador is medium. Only 13.5% of teachers consider this level to be low, compared to 4% who consider it to be high.

On the other hand, the development of a comparative analysis exercise with the results on digital skills obtained in other neighbouring countries allows us to enrich this study and identify Ecuador's main weaknesses and strengths in this area. To this end, we use statistics published by various institutions such as the Economic Commission for Latin America and the Caribbean (ECLAC) [42], the International Telecommunication Union [43] and the World Bank [44].

The results show that Ecuador maintains a position close to the top in terms of the population's digital skills. From the comparative analysis carried out, Ecuador ranks third in terms of the percentage of the population with advanced digital skills and fourth in terms of intermediate skills. On the other hand, it is the country with the second lowest percentage of the population with basic digital skills. Despite this, it is still far behind Mexico, the country with the best results (Figure 2).

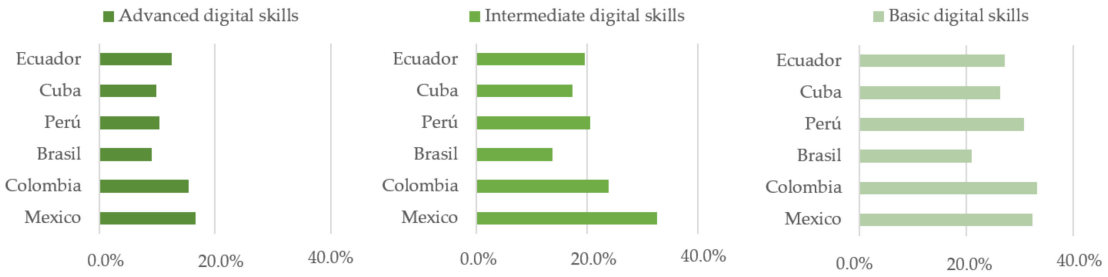

Figure 2. Digital skills of the population (2019). Source: Own elaboration based on [42–44].

The results obtained are presented below, ordered according to the different dependence/independence relationships between the variables examined. The data analysed are presented in Appendix A.

3.1. Relationship between Age and Level of Digital Skills

In this study, the sample was grouped according to generational cohorts determined by age range. For this purpose, the classification proposed by [45] is adopted according to the Table 4.

Table 4. Classification of the sample according to generational cohort. Source: Own development based on [45].

Generational Cohort	Age Range	% of Total Sample
Baby Boomers	55–73 years	25%
Generation X	39–54 years	48%
Millennials	23–38 years	27%
Generation Z	7–22 years	0%

The analysis of the data collected in the survey shows no significant differences in the level of digital skills according to age. However, when classifying university faculty according to generational cohorts, we observe some small differences. The youngest teachers (millennial generation) do not have a beginner profile. Fifty-one per cent of them have an advanced profile compared to 49% who have an intermediate profile. On the other hand, among the Baby Boomers and Generation X, there is a group of teachers—albeit relatively small—with a beginner level. In the case of the Baby Boomer generation, this group accounts for almost 10% of the total (Figure 3).

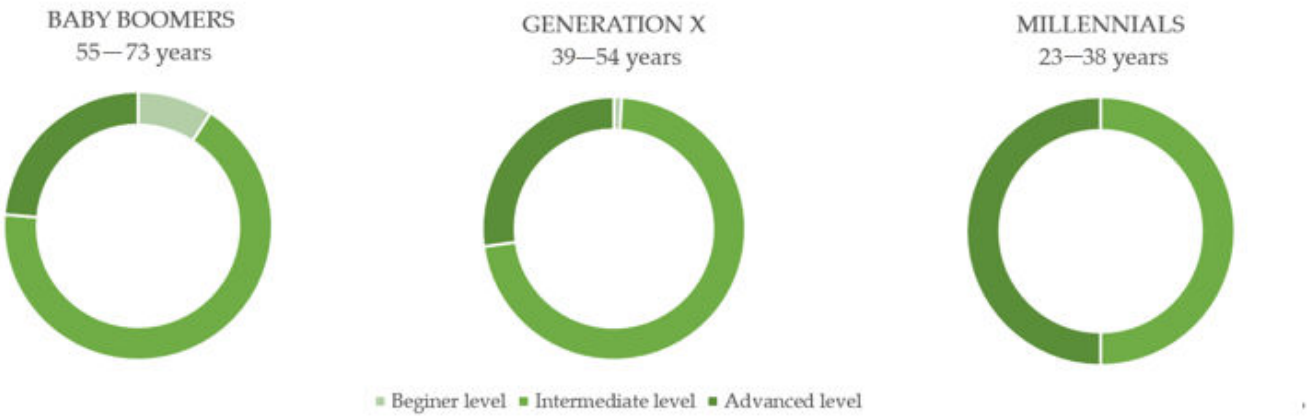

Figure 3. Profile of teachers' digital skills according to the generational cohort. Source: Own development.

The results of the Chi-Square test for the related variables of age and level of digital skills show statistical significance. Therefore, the null hypothesis (independence) is rejected and the alternative hypothesis (dependence) is accepted.

$$X^2\ (4) = 21.23,\ p < 0.05.$$

3.2. Relationship between Gender and Level of Digital Skills

According to the analysis of the data collected: no significant differences are observed concerning the average level of digital competences of university faculty according to gender. The average score obtained among men is 3.53 points out of 5, while among women the result is 3.52 points. There are also no differences between the average scores obtained in the different levels of technological adoption by teachers (acquisition, deepening and creation of knowledge) according to gender (Figure 4).

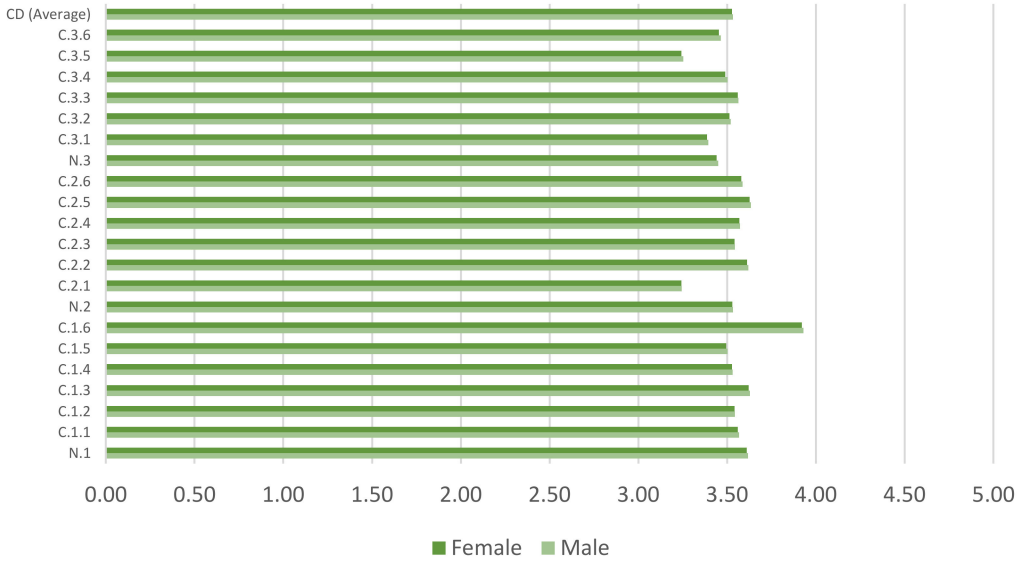

Figure 4. Digital competences of university faculty according to gender. Source: Own development.

On the other hand, among teachers with an advanced level of digital competences (score above 4 out of 5 points), a small difference can be observed. Of the total number of women, 27% have an advanced level of digital skills compared to 25% of men.

Finally, the result of the Chi-Square test reflects the existence of a statistically non-significant association between gender and teachers' level of digital skills, which forces us to accept the null hypothesis of independence.

3.3. Relationship between the Educational Centre's Technological Resources and the Level of Digital Competences

Based on the information gathered in the questionnaire, the universities can be classified according to three degrees of technological endowment: insufficient or scarce, medium and high. According to this classification, around half of the university faculty in the sample work in universities have a high level of technological provision. Thirty-five per cent of them work in educational centres with a medium technological endowment. The remaining 14% work in universities with an insufficient or scarce technological endowment (Figure 5).

On the other hand, 70% of the teachers in the sample with an advanced profile in digital competences work in universities with a high technological endowment, compared to 4.3% who work in universities with insufficient technological endowment (Figure 6).

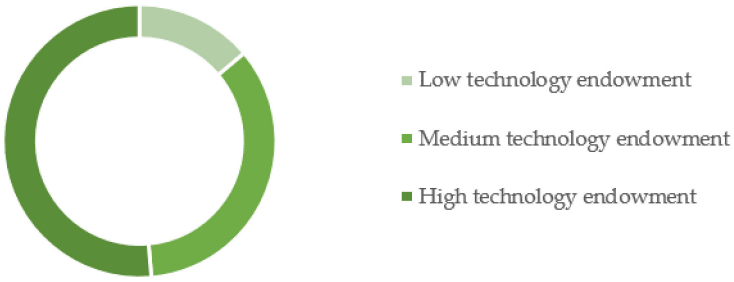

Figure 5. Distribution of the sample according to the technological equipment of the university educational centre. Source: Own development.

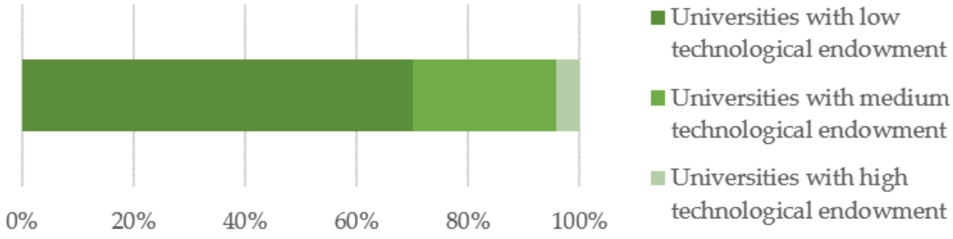

Figure 6. Distribution of university faculty with an advanced profile in digital competences according to the technological equipment of the university educational centre. Source: Own development.

Finally, Chi-square tests conclude that there is a statistically significant association between the level of the technological endowment of the higher education institution and the level of digital competences of university faculty.

$$X^2\ (4) = 28{,}99,\ p < 0.05.$$

3.4. Relationship between Type of Training Received Versus Level of Digital Skills

The results obtained in the questionnaire show that 68.5% of university faculty report that their university centres have training programmes for the use of digital technologies. In contrast, the remaining 31.5% say that they do not have access to such training programmes on a recurrent basis.

On the other hand, the data collected show the positive influence of the type of training on the level of digital skills achieved by university faculty. In particular, 80% of teachers with an advanced level of digital skills receive regular training in digital skills provided by their educational institution. In contrast, teachers with a lower level of digital skills do not have access to this type of training (Figure 7).

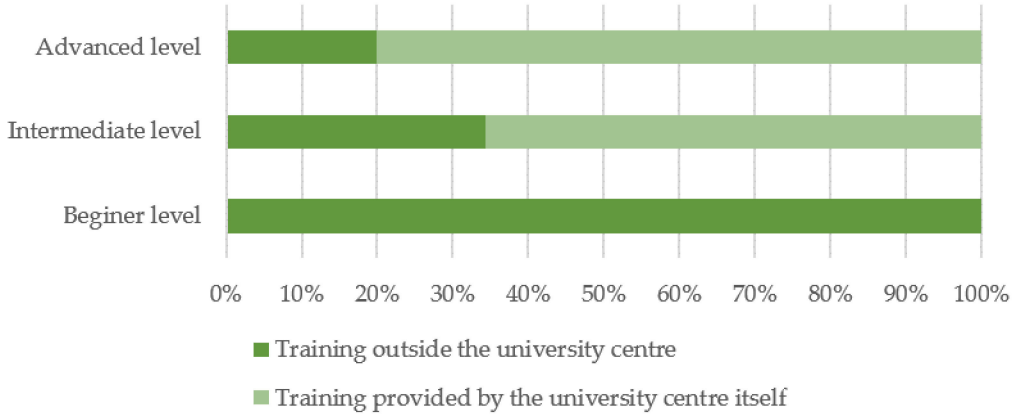

Figure 7. Distribution of university faculty by level of digital skills and main type of digital skills training received. Source: Own development.

Finally, a statistically significant association was found between the type of digital skills training received and the level of digital competence achieved.

$$X^2\ (2) = 17{,}85,\ p < 0.05.$$

4. Discussion

This study had two main objectives: on the one hand, to find out descriptively the level of digital competence of university faculty for each gender and generational cohort and, on the other hand, to examine whether there is a statistically significant association between this level and the involvement of the educational institution in promoting technological adoption. For this purpose, their technological endowment and the digital skills training programmes provided were examined.

Concerning the first purpose, the results obtained indicate that the average profile of university faculty in Ecuador is characterised by an intermediate level of digital competences, regardless of gender. These results are similar to the findings of previous studies such as Cabero-Almenara et al. [46] or Orozco et al. [47], whose results show an intermediate level of digital competence for both men and women. The study by Basantes-Andrade [48] also concludes that gender does not condition the level of digital skills of teachers. For their part, Guillén-Gámez and Mayorga-Fernández [49] point out that teachers have an average level of digital pedagogical competence, but they argue that this level "is still insufficient to meet current educational demands". Along these lines, Cahua Huerlo et al. [50] note that the number of educators with sufficient digital skills is currently relatively insufficient in Ecuador. A similar result is obtained by Blayone et al. [51] who point out the urgency of making the development of digital competencies an educational priority.

On the other hand, the results obtained show the influence of the generational cohort on the level of digital skills achieved. In particular, it is found that younger teachers belonging to the millennial generation have a more advanced profile in digital skills. In contrast, older teachers (Baby Boomers) have a lower level of digital skills. This result corroborates the existence of a certain generational digital divide among university teachers, in line with previous work [37]. On the other hand, although these results show that there is a negative relationship between generational cohort and the determination of digital competence, the results observed in other previous studies are not conclusive in this regard. For example, Basantes-Andrade et al. [48] point out the dependence between the digital skills of teachers and the generation to which they belong. These authors conclude that younger teachers (Generation Z) have the best results in digital skills. A similar result is observed in the work of Cabero and Barroso [52]. Other authors such as Gudmundsdottir and Hatlevik [20] conclude that younger teachers are more willing to incorporate technology into the teaching–learning process. On the other hand, other studies such as [53,54] have found that older teachers who can be included in generation X are more digitally competent.

Concerning the type of training received, a positive influence is observed between teachers' level of digital competence and access to specific and regular training in digital skills provided by their educational institution. These results are corroborated by other previous studies: Santos et al. [30] argue that teachers with a higher level of training have a higher level of digital competence. Fernández-Márquez et al. [55] identify a lack of training as a conditioning factor for the effective use of ICT in teaching. Another interesting finding is that younger teachers have access to more training in digital skills. In line with this result, Fernández [56] argue that younger teachers have a better ICT teacher training profile. A similar result is obtained in the work of Garzón-Artacho et al. [57]. On the other hand, the percentage of university teachers without access to digital training programmes in universities is high in Ecuador. These results are in line with those obtained in previous studies on Latin America and the Caribbean. In particular, Arias, E. et al. [58] conclude that 38% of teachers say that they do not have training programmes for the use of digital technologies at their university. They also verify that the availability of digital training

programmes is higher in private universities (66%) than in public universities (44%). In addition, this study identifies the lack of teacher training as one of the main obstacles to the implementation of digital technologies for learning.

All of this highlights the importance of training to boost the level of digital competences of university faculty. As Vázquez-Cano [59] points out, this training "must also go hand in hand with the didactic and socio-educational changes that are being generated at all times. Hence the importance of ongoing teacher training". In this context, the research carried out by Cabero-Almenara et al. [16] points to the need to promote specific training plans for university faculty in digital competences to achieve effective pedagogical technological adoption. The effectiveness of teacher trainers should also be promoted given their positive influence on the acquisition of digital skills [60].

Finally, the introduction of ICT in educational institutions has been particularly relevant in recent years, especially in the wake of the health crisis caused by COVID-19. The results obtained in our study show a relationship of dependence between the level of digital skills of university faculty and the degree of technological equipment of the universities where they work. Thus, it is found that universities with a better technological endowment employ teachers with a higher level of digital competences. In this context, although research on digital competence related to infrastructures and strategic leadership is still scarce [61], there are several studies [61–63] that point to the importance and influence of infrastructures in the integration of technology and the development of digital competences in educational contexts. Mumtaz [64], after reviewing the literature on teachers' technological adoption, points out that access to technological resources and training are factors that influence teachers' decisions to integrate ICT into their teaching. On the other hand, other authors have also identified a relationship between the pedagogical use of technologies and their provision in educational institutions. Thus, Lillejord et al. [65] found that the digital resources available were usually adapted to existing educational practices. In any case, investment in digital infrastructures has often not been accompanied by training programmes on the use and pedagogical exploitation of such technologies. Consequently, this effort in the technological equipment of educational centres has not been reflected in effective adoption by university faculty. This has limited the scope and transformative potential of digital technologies in the teaching–learning process.

5. Conclusions

This research showed the importance of digital literacy at universities. The study points to the consolidation of an emerging paradigm in higher education characterised by the configuration of increasingly complex learning environments conditioned by technological innovation. In this new paradigm, university faculty must have the ability to "develop innovative ways of using technology to enhance the learning environment and to encourage knowledge acquisition, knowledge deepening and knowledge creation" [28].

In this context, one of the main contributions of this article has been to assess the degree of development of digital competencies in the acquisition, deepening and creation of knowledge in a representative sample of university teachers according to the competency framework proposed by UNESCO [28]. The identification of conditioning factors for the development of digital teaching skills has also been another relevant contribution.

The results obtained in this study have revealed that university faculty mostly have an intermediate level of digital skills, which is more advanced in the generational cohorts that include younger teachers, regardless of their gender. The technological endowment of the university centre and the offer of specific training plans on the pedagogical application of digital technologies have been identified as conditioning factors in the development of digital skills by university faculty.

On the other hand, the analysis and discussion on the conceptualisation of digital competence and digital literacy in higher education have been based on the study of the existing literature on the state of the art. We have tried to apply the theoretical perspectives and ideas of the most representative empirical studies to guide our line of argumentation.

However, the lack of specific studies examining the digital competencies of university teachers according to the framework recently proposed and updated by UNESCO in 2018 has been a major limitation. The development of a comparative analysis with results obtained in other countries and regions would help to contrast the generalisability of the results obtained in this study. Therefore, a future line of research will be to extend the study to other latitudes.

Finally, the importance of digital competencies as a fundamental pillar of pedagogical competencies in the context of higher education has been highlighted. The need to improve the level of digital skills among university faculty is indisputable. All this leads us to recommend that educational policies include among their priorities an increase in investment in technological equipment and the promotion of specific teacher training plans on the application of digital technologies in teaching practice.

Author Contributions: Conceptualization, J.J.-V., S.L.N.A., W.R.F.S. and S.P.M.; methodology, J.J.-V. and S.L.N.A.; software, J.J.-V.; validation, J.J.-V. and S.L.N.A.; formal analysis, J.J.-V.; investigation, J.J.-V., S.L.N.A., W.R.F.S. and S.P.M.; resources, J.J.-V.; data curation, J.J.-V., W.R.F.S. and S.P.M.; writing—original draft preparation, J.J.-V.; writing—review and editing, J.J.-V.; visualization, S.L.N.A.; supervision, J.J.-V. and S.L.N.A.; project administration, J.J.-V. and W.R.F.S.; funding acquisition, S.L.N.A. All authors have read and agreed to the published version of the manuscript.

Funding: The APC was partially funded by the incentive granted to the authors by the Catholic University of Ávila.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Distribution of the sample according to the level of digital skills achieved [Dataset]. Source: Own development.

Level of Digital Skill	Frequency
Beginner level	6
Intermediate level	140
Advanced level	70
Total	216

Table A2. Profile of teachers' digital skills according to the generational cohort [Dataset]. Source: Own development.

	Generational Cohort			
Teacher's Digital Skill	**Baby Boomers (Frequency)**	**Generation X (Frequency)**	**Millennials (Frequency)**	**Total**
Beginner level	5	1	0	6
Intermediate level	37	74	29	140
Advanced level	13	28	29	70

Table A3. Distribution of the sample according to the technological equipment of the uni-versity educational centre [Dataset]. Source: Own development.

Low Technology Endowment (Frequency)	Medium Technology Endowment (Frequency)	High Technology Endowment (Frequency)	Total
30	75	111	216

Table A4. Distribution of university faculty with an advanced profile in digital competences according to the technological equipment of the university educational centre [Dataset]. Source: Own development.

	Universities with Low Technological Endowment (Frequency)	Universities with Medium TechnoLogical Endowment (Frequency)	Universities with High Technological Endowment (Frequency)	Total
Advanced profile in digital competences	49	18	3	70

Table A5. Distribution of university faculty by level of digital skills and main type of digital skills training received [Dataset]. Source: Own development.

		Training Outside the University Centre (Frequency)	Training Provided by the University Centre Itself (Frequency)	Total
Level of Digital Skill	Beginer level	6	0	6
	Intermediate level	48	92	140
	Advanced level	14	56	70
	Total	68	148	216

References

1. Jorge-Vázquez, J.; Chivite-cebolla, M.P.; Salinas-ramos, F. The Digitalization of the European Agri-Food Cooperative Sector. *Deter. Factors Embr. Inf. Commun. Technol.* **2021**, *11*, 514.
2. Jorge-Vázquez, J.; Náñez-Alonso, S.L.; Sanz-Bas, D.; Chivite-Cebolla, M.P. Nuevas tecnologías educativas al servicio del enfoque pedagógico Flipped Learning. In *Contribuciones De La Tecnología Digital En El Desarrollo Educativo Y Social*; REDINE, Ed.; Adaya Press: Eindhoven, NL, USA, 2020.
3. European Commission A Digital Agenda for Europe. *Communication* **2010**, *5*, 42.
4. Ordóñez-Olmedo, E.; Vázquez-Cano, E.; Arias-Sánchez, S.; López-Meneses, E. Las Competencias en el uso de las Tecnologías de la Información y la Comunicación en el alumnado universitario. *Pixel Bit. Rev. Medios Y Educ.* **2021**, *60*, 153–167. [CrossRef]
5. Vázquez-Cano, E.; León Urrutia, M.; Parra-González, E.; Meneses, E.L. Analysis of Interpersonal Competences in the Use of ICT in the Spanish University Context. *Sustainability* **2020**, *12*, 476. [CrossRef]
6. Mehrvarz, M.; Heidari, E.; Farrokhnia, M.; Noroozi, O. The mediating role of digital informal learning in the relationship between students' digital competence and their academic performance. *Comput. Educ.* **2021**, *167*, 104184. [CrossRef]
7. Guzmán-Simón, F.; García-Jiménez, E.; López-Cobo, I. Undergraduate students' perspectives on digital competence and academic literacy in a Spanish University. *Comput. Human Behav.* **2017**, *74*, 196–204. [CrossRef]
8. López-Gil, M.; Bernal Bravo, C. El perfil del profesorado en la Sociedad Red: Reflexiones sobre las competencias digitales de los y las estudiantes en Educación de la Universidad de Cádiz. *IJERI* **2019**, *11*, 83–100.
9. Burgos-Videla, C.G.; Castillo Rojas, W.A.; López Meneses, E.; Martínez, J. Digital Competence Analysis of University Students Using Latent Classes. *Educ. Sci.* **2021**, *11*, 385. [CrossRef]
10. Gómez-Galán, J.; Martínez-López, J.Á.; Lázaro-Pérez, C.; del Mar Fernández-Martínez, M. Usage of Internet by University Students of Hispanic Countries: Analysis Aimed at Digital Literacy Processes in Higher Education. *Eur. J. Contemp. Educ.* **2021**, *10*, 53–65. [CrossRef]
11. Concepción Rosa, J.D.; Veytia Bucheli, M.G.; Gómez Galán, J.; López Meneses, E. Integrating the Digital Paradigm in Higher Education: ICT Training and Skills of University Students in a European Context. *Int. J. Educ. Excell.* **2019**, *5*, 47–64. [CrossRef]
12. Zhao, Y.; Pinto Llorente, A.M.; Sánchez Gómez, M.C. Digital competence in higher education research: A systematic literature review. *Comput. Educ.* **2021**, *168*, 104212. [CrossRef]
13. Esteve-Mon, F.M.; Llopis-Nebot, M.A.; Adell-Segura, J. Digital Teaching Competence of University Teachers: A Systematic Review of the Literature. *Rev. Iberoam. Tecnol. Aprendiz.* **2020**, *15*, 399–406. [CrossRef]
14. Brevik, L.M.; Gudmundsdottir, G.B.; Lund, A.; Strømme, T.A. Transformative agency in teacher education: Fostering professional digital competence. *Teach. Teach. Educ.* **2019**, *86*, 102875. [CrossRef]
15. Garzón-Artacho, E.; Sola-Martínez, T.; Romero-Rodríguez, J.M.; Gómez-García, G. Teachers' perceptions of digital competence at the lifelong learning stage. *Heliyon* **2021**, *7*, e07513. [CrossRef]
16. Cabero-Almenara, J.; Gutiérrez-Castillo, J.J.; Palacios-Rodríguez, A.; Barroso-Osuna, J. Development of the teacher digital competence validation of DigCompEdu check-in questionnaire in the University context of Andalusia (Spain). *Sustainability* **2020**, *12*, 94. [CrossRef]

17. López Belmonte, J.; Pozo Sánchez, S.; Morales Cevallos, M.B.; López Meneses, E. Competencia digital de futuros docentes para efectuar un proceso de enseñanza y aprendizaje mediante realidad virtual. *Edutec. Rev. Electrón. Tecnol. Educ.* **2019**, *67*, 1–15. [CrossRef]
18. Syerov, Y.; Fedushko, S.; Loboda, Z. Determination of development scenarios of the educational web forum. In Proceedings of the 2016 XIth International Scientific and Technical Conference Computer Sciences and Information Technologies (CSIT), Lviv, Ukraine, 6–10 September 2017; pp. 73–76.
19. Instefjord, E.; Munthe, E. Preparing pre-service teachers to integrate technology: An analysis of the emphasis on digital competence in teacher education curricula. *Eur. J. Teach. Educ.* **2016**, *39*, 77–93. [CrossRef]
20. Gudmundsdottir, G.B.; Hatlevik, O.E. Newly qualified teachers' professional digital competence: Implications for teacher education. *Eur. J. Teach. Educ.* **2018**, *41*, 214–231. [CrossRef]
21. Fernández-Batanero, J.M.; Montenegro-Rueda, M.; Fernández-Cerero, J.; García-Martínez, I. Digital competences for teacher professional development. Systematic review. *Eur. J. Teach. Educ.* **2020**, *0*, 1–19. [CrossRef]
22. Pérez, K.V.P.; Torelló, O.M. The Digital Competence as a Cross-cutting Axis of Higher Education Teachers' Pedagogical Competences in the European Higher Education Area. *Procedia Soc. Behav. Sci.* **2012**, *46*, 1112–1116. [CrossRef]
23. Flores-Lueg, C.; Roig-Vila, R. Personal factors influencing future teachers' self-assessment about the pedagogical dimension of ICT use. *Rev. Iberoam. Educ. Super.* **2019**, *10*, 151–171. [CrossRef]
24. Ilomäki, L.; Paavola, S.; Lakkala, M.; Kantosalo, A. Digital competence–an emergent boundary concept for policy and educational research. *Educ. Inf. Technol.* **2016**, *21*, 655–679. [CrossRef]
25. Starkey, L. A review of research exploring teacher preparation for the digital age. *Cambr. J. Educ.* **2020**, *50*, 37–56. [CrossRef]
26. Redecker, C. *European Framework for the Digital Competence of Educators: DigCompEdu*; Publications Office of the European Union: Luxembourg, Luxembourg, 2017; ISBN 978-92-79-73494-6.
27. The Council of the European Union. Council recommendation of 22 May 2018 on key competences for lifelong learning (text with EEA relevance). *Off. J. Eur. Union* **2018**, 1–13.
28. Fallis, A. *Unesco Ict Competency Framework for Teachers [Marco de Competencias de Los Docentes Enmateria de TIC UNESCO]*; United Nations Educational, Scientific and Cultural Organization: París, France, 2018; Volume 53, ISBN 9788578110796.
29. Olofsson, A.D.; Lindberg, J.O.; Fransson, G. What do upper secondary school teachers want to know from research on the use of ICT and how does this inform a research design? *Educ. Inf. Technol.* **2017**, *22*, 2897–2914. [CrossRef]
30. Santos, C.; Pedro, N.; Mattar, J. Assessment of the proficiency level in digital competences of higher education professors in Portugal. *Rev. Educ.* **2021**, *46*. [CrossRef]
31. Howard, S.K. Risk-aversion: Understanding teachers' resistance to technology integration. *Technol. Pedagog. Educ.* **2013**, *22*, 357–372. [CrossRef]
32. Somekh, B. Factors Affecting Teachers' Pedagogical Adoption of ICT. In *International Handbook of Information Technology in Primary and Secondary Education.*; Voogt, J.K.G., Ed.; Springer: Boston, MA, USA, 2008.
33. Knezek, G.; Christensen, R. The Importance of Information Technology Attitudes and Competencies in Primary and Secondary Education. In *International Handbook of Information Technology in Primary and Secondary Education. Springer International Handbook of Information Technology in Primary and Secondary Education 2017 Volume 2*; Voogt, J.K.G., Ed.; Springer: Boston, MA, USA, 2008.
34. I.T.U. *Measuring the Information Society Report*; International Telecommunication Union (ITU): Geneva, Switzerland, 2017; Volume 1, ISBN 9789261245115.
35. International Telecommunication Union (ITU). *Measuring the Information Society Report 2017. Volume 2*; ICT country profiles; International Telecommunication Union: Geneva, Switzerland, 2017; Volume 2, ISBN 978-92-61-15291-8.
36. Zapata, C.R.; Rodríguez, E.I.; Zaballos, A.G. Estado actual de las telecomunicaciones y la banda ancha en Ecuador. *Banco Interam. Desarro* **2020**, *65*, 1–62.
37. Melo Fiallos, D.F.; Silva Chávez, J.A.; Indacochea Mendoza, L.R.; Núñez Campaña, J.H. Tecnologías En La Educación Superior: Políticas Públicas Y Apropiación Social En Su Implementación. *Rev. Digit. Investig. Docencia Univ.* **2017**, *11*, 193–206. [CrossRef]
38. Dirección Nacional de Gestión de la Información (DNG). *Estadística Docentes Universidades y Escuelas Politécnias en Ecuador*; Secretaría de Educación Superior, Ciencia, Tecnología e Innovación: Quito, Ecuador, 2021.
39. Hair, J.B.R.P.; Busch, R.P.; Ortinau, D.J. *Investigación de Mercados*; McGrawHill: México City, Mexico, 2010.
40. IBM Corp. *IBM SPSS Statistics for Windows*; Version 27.0.; IBM Corp.: Armonk, NY, USA, 2020.
41. George, D.; Mallery, P. *SPSS/PC + Step by: A Simple Guide and Reference.*; Wadsworth Publishing Company: Belmont, CA, USA, 1995.
42. Comisión Económica para América Latina y el Caribe (CEPAL). *Datos y Hechos Sobre la Transformación Digital*; Comisión Económica para América Latina y el Caribe (CEPAL): Santiago, Chile, 2021.
43. International Telecommunication Union. *Development Sector Measuring Digital Development. Facts and Figures 2020*; ITU Publ.: Geneva, Switzerland, 2020; pp. 1–15.
44. World Bank GCI 4.0: Digital Skills among Population -TCdata360. Available online: https://tcdata360.worldbank.org/indicators/h945a9708?country=BRA&indicator=41400&viz=line_chart&years=2017,2019 (accessed on 25 September 2021).
45. Center, P.R. Where Millennials end and Generation Z Begins. Available online: https://www.pewresearch.org/fact-tank/2019/01/17/where-millennials-end-and-generation-z-begins/ (accessed on 1 July 2021).

46. Cabero-Almenara, J.; Guillén-Gámez, F.D.; Ruiz-Palmero, J.; Palacios-Rodríguez, A. Digital competence of higher education professor according to DigCompEdu. Statistical research methods with ANOVA between fields of knowledge in different age ranges. *Educ. Inf. Technol.* **2021**, *26*, 4691–4708. [CrossRef] [PubMed]
47. Orozco Cazco, G.H.; González, M.C.; Abad, F.M.; Martín, A.M.V.; Cazco, G.H. Digital competence of the University faculty: Case study of the Universidad nacional de Chimborazo. *ACM Int. Conf. Proceeding Ser.* **2016**, 147–154. [CrossRef]
48. Basantes-Andrade, A.; Cabezas-González, M.; Casillas-Martín, S. Digital competences relationship between gender and generation of university professors. *Int. J. Adv. Sci. Eng. Inf. Technol.* **2020**, *10*, 205–211. [CrossRef]
49. Guillén-Gámez, F.D.; Mayorga-Fernández, M.J. Prediction of factors that affect the knowledge and use higher education professors from spain make of ict resources to teach, evaluate and research: A study with research methods in educational technology. *Educ. Sci.* **2020**, *10*, 276. [CrossRef]
50. Cagua Huerlo, G.A.; Moreta Velasco, K.M.; Arce Cuesta, M.F. Competencias digitales del profesorado: Pilares claves para una educación virtual de calidad frente a la pandemia en Ecuador. *Rev. Inclus.* **2021**, *8*, 224–241.
51. Blayone, T.J.B.; Mykhailenko, O.; vanOostveen, R.; Grebeshkov, O.; Hrebeshkova, O.; Vostryakov, O. Surveying digital competencies of university students and professors in Ukraine for fully online collaborative learning. *Technol. Pedagog. Educ.* **2018**, *27*, 279–296. [CrossRef]
52. Cabero, J.; Barroso, J. Formación del profesorado en TIC: Una visión del modelo TPACK. *Cult. Educ.* **2016**, *28*, 633–663. [CrossRef]
53. John, S.P. The integration of information technology in higher education: A study of faculty's attitude towards IT adoption in the teaching process. *Contad. Adm.* **2015**, *60*, 230–252. [CrossRef]
54. Siddiq, F.; Scherer, R.; Tondeur, J. Teachers' emphasis on developing students' digital information and communication skills (TEDDICS): A new construct in 21st century education. *Comput. Educ.* **2016**, *92–93*, 1–14. [CrossRef]
55. Fernández-Márquez, E.; Leiva-Olivencia, J.J.; López, E. Digital Competences in Higher Education Professors. *Rev. Digit. Investig. en Docencia Univ.* **2017**, *12*, 213–231. [CrossRef]
56. Fernández, F.J.; Díaz, J.F. Los docentes de la Generación Z y sus competencias digitales-Generation Z's Teachers and their Digital Skills. *Rev. Comun.* **2016**, *24*, 97–105.
57. Garzón-Artacho, E.G.; Martínez, T.S.; Ortega Martín, J.L.; Marín Marín, J.A.; García, G.G. Teacher training in lifelong learning-the importance of digital competence in the encouragement of teaching innovation. *Sustainability* **2020**, *12*, 2852. [CrossRef]
58. Arias Elena, E.J.; López Angela, P.L. *Covid 19, Tecnologías Digitales y Educación. ¿Qué Opinan los Docentes ?* Banco Interamericano de Desarrollo y Tecnológico de Monterrey: Monterrey, Mexico, 2020.
59. Vázquez-Cano, E. El reto de la formación docente para el desarrollo de una metodología ubicua en la Educación Superior. *Perspect. Educ.* **2015**, *54*. [CrossRef]
60. Instefjord, E.J.; Munthe, E. Educating digitally competent teachers: A study of integration of professional digital competence in teacher education. *Teach. Teach. Educ.* **2017**, *67*, 37–45. [CrossRef]
61. Pettersson, F. On the issues of digital competence in educational contexts–a review of literature. *Educ. Inf. Technol.* **2018**, *23*, 1005–1021. [CrossRef]
62. Vanderlinde, R.; van Braak, J. The e-capacity of primary schools: Development of a conceptual model and scale construction from a school improvement perspective. *Comput. Educ.* **2010**, *55*, 541–553. [CrossRef]
63. Wastiau, P.; Blamire, R.; Kearney, C.; Quittre, V.; Van de Gaer, E.; Monseur, C. The Use of ICT in Education: A survey of schools in Europe. *Eur. J. Educ.* **2013**, *48*, 11–27. [CrossRef]
64. Mumtaz, S. Factors affecting teachers' use of information and communications technology: A review of the literature. *J. Inf. Technol. Teach. Educ.* **2000**, *9*, 319–342. [CrossRef]
65. Lillejord, S.; Børte, K.; Nesje, K.; Ruud, E. *Learning and Teaching with Technology–A Systematic Review*; Knowledge Centre for Education: Oslo, Norway, 2018; ISBN 9788212037038.