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Online education: for a more inclusive and less unequal future

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Online education: for a more inclusive and less unequal future

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Keywords: Online education, Digital divide, Inequality, e-learning, disabilities, higher education, Survey data, Econometric models

Abstract

This paper examines the impact of online education on inclusivity and accessibility, focusing on undergraduate education. It explores how digital platforms address diverse learning needs and promote educational equity, particularly for students with disabilities. While online education offers personalized learning and enhanced engagement, it also highlights challenges such as digital literacy and access to reliable internet. The study addresses the digital divide, which disproportionately affects students from lower socioeconomic backgrounds, rural areas, and those with disabilities. The paper emphasizes the importance of policy interventions, institutional support, and the adoption of Universal Design for Learning (UDL) to create inclusive educational environments. It concludes by identifying gaps in empirical data and calling for further research to develop comprehensive approaches for equitable e-learning.

1. Introduction

Online education refers to ways of receiving distance learning via the Internet, which has brought about a revolution in distance and flexible learning, accessible at any time. It facilitates the reconciliation of work and family life and allows people to access lifelong learning regardless of their schedules and responsibilities (Paudel, 2021).

Although distance learning has always existed, the COVID-19 pandemic forced the adaptation of all levels of education to the online format (Bacher-Hicks, Goodman & Mulhern,

2021). Quarantine, restrictions and the need to avoid contagion led to the implementation of fully online educational models, the subsequent hybrid format and, today, the implementation of online teacher-student contact systems and educational platforms that partially digitise this educational process.

Moreover, this type of education is of particular interest to older people, people living in rural areas and people with disabilities (Shater, AlMahdawi & Khasawneh, 2023). This education is considered, especially in higher education, to avoid inequalities and to enable people's academic development and avoid inequalities (Subramaniam, Jalaludin, Hen & Yap, 2023).

Therefore, the digital divide of not having the tools to access and benefit from online education is seen as a digital inequality that prevents individuals from accessing better jobs and other services according to their needs (Stantcheva, 2022). This inequality is exacerbated in rural areas and for people with disabilities (CRUE, 2021). Currently, the number of people with functional diversity is increasing in Spanish universities, and this is particularly true in the National University of Distance Education (UNED), which has 37% of these students (UNED, 2020). The UNED also has an important presence in rural areas, allowing people from less densely populated areas to have access to quality education, from home and with reference points close to where these students live.

The results of the Universia Foundation (2021) show that in recent years disabled students in Spanish universities have increased their presence by more than 50% in the last 10 years.

This growth has been clearly manifested in the distance learning options, accounting for 5% of the student body in this educational modality.

These results also support the UNED, which accounts for 80% of disabled distance students and 30% of all students with disabilities. However, among the group of people with disabilities, the majority choose face-to-face options for their university studies (Viñas-Sánchez, Gago-Castro & Sánchez-Pérez, 2023).

Taking all this into account, the aim of this work is to study the relationship between e-learning at different levels and its impact on inequality, digital inequality, considering the different realities that affect the widening of the digital divide in access to e-learning and that motivate inequality, whether it is related to disabilities or the rural impact of this divide. To answer the question: How does the digital divide in e-learning affect inequality and how do the realities of different learners' impact on it?

2. Literature review

The advent of online education has heralded a transformative era in learning, offering unprecedented opportunities for inclusivity and accessibility, particularly in undergraduate education. This literature review explores the intersection of e-learning and disability, examining how digital platforms can cater to diverse learning needs and promote educational equity in higher education (Means, Bakia & Murphy, 2014).

[a] Online education

One of the significant advantages of online education is its ability to provide a personalized learning experience. Through adaptive learning technologies, educational platforms can tailor content to meet the individual needs and learning styles of students. This customization can help students better grasp complex subjects and progress at their own pace, leading to improved educational outcomes. Furthermore, online education often incorporates multimedia resources such as videos, interactive simulations, and discussion forums,

which can enhance understanding and engagement compared to traditional classroom settings (Bernard, Borokhovski, Schmid, Tamim & Abrami, 2014; Jaggars & Bailey, 2010).

However, the shift to online education also presents challenges that need to be addressed to maximize its effectiveness. Issues such as digital literacy, access to reliable internet, and the need for self-discipline and time management skills can impact student success. Institutions must invest in robust support systems, including technical assistance and academic advising, to help students navigate these challenges. Additionally, ensuring the quality of online courses through rigorous accreditation and continuous improvement processes is essential to maintaining high educational standards and credibility (Allen & Seaman, 2013; Martin, Sun, & Westine, 2020; Palloff & Pratt, 2003; Paudel, 2021).

[b] Online education and digital inequality

The rise of e-learning has brought many benefits, including flexibility, accessibility, and the ability to cater to diverse learning needs. However, it has also highlighted and, in some cases, exacerbated the digital divide. The digital divide refers to the gap between individuals who have access to modern information and communication technology and those who do not. This gap can be seen in terms of access to hardware, such as computers and smartphones, as well as reliable internet connections and the necessary digital literacy skills to use these technologies effectively (van Dijk, 2020).

The impact of the digital divide on education is significant. Students from lower socioeconomic backgrounds, rural areas, and marginalized communities often have limited access to the necessary technology and internet connectivity, which hinders their ability to participate fully in online education. This lack of access can lead to poorer educational outcomes, further perpetuating social and economic inequalities. Moreover, the digital divide can disproportionately affect students with disabilities,

who may rely more heavily on specific technologies and assistive tools to access and engage with educational content (Bacher-Hicks, Goodman & Mulhern, 2021; Warschauer, 2004). The "VI Estudio Universidad y Discapacidad" highlights that students with disabilities face additional barriers in accessing digital education, emphasizing the importance of addressing these disparities to promote equal opportunities (Viñas-Sánchez, Gago-Castro & Sánchez-Pérez, 2023).

Addressing the digital divide requires a multifaceted approach. Policy interventions at the governmental level are essential to provide funding and support for expanding internet infrastructure, particularly in underserved areas. Educational institutions must also play a role by ensuring that all students have access to the necessary devices and connectivity, either through loan programs or by creating partnerships with technology providers. Additionally, providing training and resources for both students and educators to develop digital literacy skills is crucial for maximizing the benefits of e-learning and ensuring that all students can participate effectively (Coleman, 2021; Helsper & Eynon, 2010; Selwyn, 2016; Mishra, Gupta & Shree, 2020).

[c] Online education and student with disabilities

Online education for people with disabilities presents unique opportunities and challenges. Digital platforms can cater to diverse learning needs by incorporating features such as screen readers, voice recognition software, and other assistive technologies. These tools can significantly enhance the educational experiences of students with disabilities, promoting greater educational equity in higher education. For instance, screen readers enable visually impaired students to navigate and interact with digital content, while voice recognition software assists those with physical disabilities in writing and communicating more efficiently (Burgstahler & Cory, 2020; Kent, 2016).

Moreover, the principles of Universal Design for Learning (UDL) are instrumental in

creating inclusive online educational environments. UDL advocates for providing multiple means of representation, engagement, and expression, ensuring that educational content is accessible to all students regardless of their abilities. By designing courses that accommodate various learning preferences and abilities from the outset, educators can minimize barriers and enhance the learning experience for students with disabilities. This proactive approach contrasts with traditional reactive measures, where accommodations are made after identifying specific needs (Meyer, Rose, & Gordon, 2014).

Despite these advancements, several barriers to inclusive online education persist. The digital divide remains a significant challenge, as students with disabilities are more likely to lack access to the necessary technology and reliable internet connections. Additionally, there is a need for greater awareness and training among educators regarding the use of assistive technologies and the implementation of UDL principles. Institutions must invest in professional development and provide resources to support faculty in creating accessible online courses. Furthermore, ongoing research and collaboration with the disability community are essential to identify and address emerging issues, ensuring that online education continues to evolve in a way that supports all learners (Crouse & Rice, 2018; Seale, 2013; Shater, AlMahdawi & Khasawneh, 2023; Viñas-Sánchez, Gago-Castro & Sánchez-Pérez, 2023).

[d] Territoriality and online education

A significant conclusion drawn from this study is that current online education initiatives have not sufficiently addressed territorial imbalances. While online education has the potential to bridge geographic gaps by providing access to high-quality education irrespective of location, in practice, these benefits have not been uniformly realized. Students in rural or remote areas continue to face substantial barriers, including limited internet infrastructure and fewer resources to support digital learning (Broadbent &

Poon, 2015; Devkota, 2021).

The lack of robust infrastructure in less urbanized areas often means that students cannot fully participate in online education, exacerbating existing educational disparities. This is particularly true for students with disabilities in these regions, who may face compounded difficulties due to inadequate access to assistive technologies and specialized support services. The "VI Estudio Universidad y Discapacidad" highlights that students with disabilities face additional barriers in accessing digital education, especially in rural and remote areas, emphasizing the importance of addressing these disparities to promote equal opportunities (Viñas-Sánchez, Gago-Castro & Sánchez-Pérez, 2023).

Addressing these territorial and digital divides requires a multifaceted approach. Policy interventions at the governmental level are essential to provide funding and support for expanding internet infrastructure, particularly in underserved areas. Educational institutions must also play a role by ensuring that all students have access to the necessary devices and connectivity, either through loan programs or by creating partnerships with technology providers. Additionally, providing training and resources for both students and educators to develop digital literacy skills is crucial for maximizing the benefits of e-learning and ensuring that all students can participate effectively (Helsper & Eynon, 2010; Selwyn, 2016).

Future research should explore the specific needs and challenges of students in various geographic contexts, aiming to develop tailored strategies that effectively reduce territorial inequalities in education. By addressing these territorial disparities, online education can better fulfil its promise of providing equitable access to learning opportunities for all students, regardless of their physical location. This includes ensuring that students with disabilities in rural and remote areas receive the necessary support to access and engage with digital learning environments effectively (Dhawan, 2020; Fitzpatrick & Trninic, 2023;

Lockee, 2021; Srinivasan, Jishnu & Shamala, 2021).

The reviewed literature underscores the transformative potential of e-learning in enhancing accessibility and inclusivity in higher education. Significant strides have been made in integrating assistive technologies and adopting UDL principles, which have proven effective in creating more accessible educational environments (Al-Azawei, Serenelli & Lundqvist, 2016; Burgstahler & Cory, 2020). However, the digital divide persists as a formidable barrier, particularly for students from lower socioeconomic backgrounds and rural areas, who often lack consistent access to necessary devices and reliable Internet (van Dijk, 2020; Warschauer, 2004). This divide is further exacerbated for students with disabilities, who depend on specific technologies for their educational engagement. The intersectionality of socioeconomic status and disability magnifies these challenges, creating compounded barriers to equitable education (Selwyn, 2016; Viñas-Sánchez, Gago-Castro & Sánchez-Pérez, 2023).

Despite technological advancements and policy recommendations, there is a notable deficiency in empirical data on the long-term efficacy of these interventions. Current research predominantly focuses on technological solutions and policy frameworks, yet there is limited exploration of the practical implementation and sustained impact of these strategies (Bernard et al., 2014; Means, Bakia & Murphy, 2014). Additionally, there is a critical need for more comprehensive training for educators on the use of assistive technologies and UDL strategies to better support students with disabilities (Seale, 2013). Future studies should aim to develop holistic and intersectional approaches that address the multifaceted challenges faced by these students, ensuring that e-learning environments are genuinely inclusive and equitable for all learners (Kelly, Phipps & Swift, 2004).

3. Data and Methodology

The data used in this study come from the

Survey on Adult Population Participation in Learning Activities (EADA) (INE, 2022a). The EADA collects information on individuals aged 18-69 by asking them about educational activities undertaken especially in the 12 months prior to the interview.

In this process it identifies which individuals participate in educational activities, the time spent, the type of activity, its financing, whether they are part of a job-driven training, the barriers they have encountered and the facilities.

This survey is carried out every six years in accordance with the recommendations of the European Union, Regulation (EU) 2019/1700. The implementation consists of a two-stage sampling. The sample consists of 34,000 persons from 2,125 census sections, which are distributed by Autonomous Communities (CCAA) to obtain nationally and regionally representative data (INE, 2022b).

The collection of responses followed the CAWI method, as the first option, with the option of telephone contact (CATI) or individual personal interview (CAPI) if the first option was not available (INE, 2022b).

The survey includes four questions related to online education (e-learning), the first question refers to the presence or not of the last studies undertaken, the second to whether the material was available online and the third and fourth focus on online contact with peers or teachers respectively.

This questionnaire also provides information on the health of individuals, their residence, the size of their municipality and other socio-demographic variables of interest such as their employment, age, gender assigned at birth, educational level and income. These are used as the explanatory variables that allow the estimation of parametric and non-parametric models as required by each specific situation (see Peel, Goode and Moutinho, 1998). Considering the specifications required by the equations and considering the properties of the data and economic theory. To confirm the adequacy of the models, appropriate diagnostics are applied, both for the estimated

coefficients and for the residuals and outliers. White's heteroscedasticity test (White, 1980) is performed. The maximum VIF is shown to confirm that there is no collinearity problem.

Considering that the proposed models have a binary dependent variable, access to e-learning (1, if access to online education and 0, otherwise), the models established for them are the linear probabilistic, the logit or the probit model. For this study, research work will be carried out to understand the first of the variables on online education: the presence or not of the last studies carried out.

In this process, emphasis is placed on the impact of e-learning in its integrative work for individuals with disabilities (Viñas-Sánchez, Gago-Castro & Sánchez-Pérez, 2023) and the role it plays as a structuring element of the territory. This is guaranteed by the inclusion in the models of the variables: 'disabled', 'population density' and 'Autonomous Community'.

This analysis based on a probabilistic regression model is accompanied by a graphic and descriptive study which also analyses the impact of these variables on the mean of the variable 'e-learning', online education, carried out with Student's t-tests for those dichotomous explanatory variables, and ANOVA tests for those which differentiate three or more differentiated subsamples (St & Wold, 1989).

Table 1 below presents the main variables used in this study.

Table 1. Main Statistics

Table 1 opens with the dependent variable 'Study online', e-learning, a binary variable, which takes the value 1 if the respondent uses online education and 0 otherwise. It is answered by 3711 people who will be the individuals who will allow us to carry out this study.

The variable 'gender at birth' refers to the gender assigned to the individual at birth, being 1 if it corresponds to 'male' and 0 if it corresponds to 'female'. The variable 'age' refers to the age of the

respondent, the variable 'university' to whether the last studies completed are provided by a university.

'Years of education' is a variable that covers any level of studies available in Spain, from illiteracy to doctoral level, assigning them a number of specific years of education, from 1 to 20 years of education.

The variable 'employed' is a binary variable taking value 1 if the respondent is currently employed. 'Income' is the last socio-demographic variable indicating with different levels the monthly household income threshold of the respondent, ranging from the lowest level of 475 euros per month, up to 7500 euros.

Closing the explanatory variables, the two most relevant in this study and the only ones that will be treated in a varied way to see their impact on 'online education', either with their own contrast tests or with interaction variables together with 'university', should be commented on.

Among these is the variable 'disabled', a variable that indicates 1 if the individual has a disability, and 0 otherwise. This group brings together those disabled people who are currently unable to be active in the labour market and those who are working and claim to have medium or very severe disabilities.

Finally, the variable 'population density' is divided into three categories, the first one indicating a very low level of population density, up to a very high level of population density.

The first is the variable 'CCAA' which reflects the origin of the individual who responds to the questionnaire among the 17 Spanish Autonomous Communities and the two autonomous cities, Ceuta and Melilla. The second variable is the one that reflects the reasons for studying in adulthood, as shown in figure 1.

Figure 1. Why do adults study?

Figure 1 shows the reasons why Spanish adults claim to continue their studies. The four most relevant reasons, all with a frequency of response close to 20% of respondents, are, firstly, to improve

future job prospects, and after this: 'to increase knowledge', 'to have a degree' or 'to get a job'.

After this, the most relevant are 'to improve in employment', answered by one in ten people, 'for fun' or 'to start a business', with 5% of respondents.

People who say they are obliged to study and those who have 'other' reasons are the least represented.

Once the data are known, it is necessary to check for multicollinearity in the data, as shown in table 2.

Table 2. Correlation matrix

The correlation matrix shows no problems of multicollinearity, as all correlations are less than 0.7 (see table 2).

Section 4 will show the results of the analysis of the data presented using the proposed methodologies.

4. Results

This section will discuss the results of the analyses carried out with respect to e-learning and e-learning users. Figure 2, related to the variable presented in Figure 1, shows the relationship between the reasons for studying as an adult and the propensity to study online.

Figure 2. Which motives are most linked to e-learning?

Within the results of figure 2 it can be seen that the motives most linked to online education, e-learning, are: 'not to be fired', 'to start a business', 'to increase knowledge' and 'to improve at work', the first two, with 5% of the respondents studying online. On the other hand, the least related are: 'for fun', 'for obligation' and 'other'.

Figure 3 graphically analyses the relationship between being disabled or not and the levels of disability and studying online.

Figure 3. Disabled people and e-

learning.

Figure 3 shows that the average number of users who study online increases among disabled people compared to non-disabled people and also increases among disabled people with higher needs and dependency.

Following this, figures 4 and 5 study the propensity to study online and geographical variables, the former with respect to the population density of the municipality and the Autonomous Communities.

Figure 4. Population density and e-learning.

Figure 5. e-Learning by CCAA.

Figure 4 shows that the higher the population density of the municipality, the more likely it is to study online. On the other hand, figure 5 shows large territorial differences in the use of e-learning, but these are not related to the size of the population or territorial distribution. The Balearic Islands", "Catalonia", which links with figure 4 by highlighting the most populated areas, and "Murcia" stand out among those who use e-learning the most. On the other hand, among those using online education the least are 'País Vasco', 'Cantabria' and 'Galicia'.

Tables 3 and 4 present the differences between subgroups of the sample depending on whether they are disabled or the variables 'population density' and 'CCAA' and the propensity to study online.

Table 3. T-test - e-learning and disability.

Table 3 shows that there are no differences between the means of the disabled and non-disabled groups with respect to the link to online education. Therefore, although there is a higher mean among the disabled, which was already observed in figure 3, it is not significant. Table 4 will be discussed below.

Table 4. ANOVA test - geographical variables.

In the light of the results in table 4, it can be concluded that there are no differences between the means of the propensity to study online when studying 'population density', therefore it is not a significant variable, a priori, in this study. This coincides with the results in table 3, although the graphical analysis of 'population density' versus 'studying online' showed positive results, figure 4, these are not significant in this case. This is not the case for the study of the variable 'CCAA' which does show significant differences and therefore there is an impact between the CCAA and studying online.

The results of the logit models studying the propensity to use e-learning with respect to the socio-demographic variables indicated in section 3, as well as the variables 'disability' and 'population density' and their interactions with the variable 'university' are broken down below in table 5.

Table 5. Results of the e-learning model

The regressions in table 5 present four consistent models with a large proportion of significant variables and adequate goodness-of-fit measures. With samples around 3487 in the model without interactions and 3000 individuals in the rest, the four regressions present pseudo-R² greater than 0.25, indicating a high explanation of the variance of the dependent variable, PCCP 'percentage of correctly predicted cases greater than 80% and AUCR "areas under the ROC curve" greater than 0.8, indicating that the models have high predictive value and are adequate to obtain relevant conclusions.

In all regressions in table 5, the variables 'age' and 'age²' are significant, the former positively and the latter negatively, showing that the age effect implies a higher propensity to online education for middle-aged people, leaving younger and older people behind. The variable 'years of

education' is also positive and significant, the higher the years of education of the individual, the higher the propensity to use e-learning. There is no influence of the variable 'gender (at birth)' indicating that there is no gender gap in this respect.

The variable 'employed' is also positive and significant, with very high odd-ratio values, it is very likely that employed people are the ones who study online. For the model without interaction variables and for the model including interaction variables for disabled and university students the income is positive and significant, for the rest of the models it is not.

Focusing on the second column, which includes interaction variables for disabled and university students, 'disabled university students', this interaction variable is positive and significant.

In the last two columns, the aforementioned interaction variable becomes non-significant, and the significance appears in the variables 'population density' and the interaction variable 'population density and university students'. The latter is positive and significant, indicating that in more densely populated areas and within university education there is a greater tendency to study online. However, the high population density variable is significant and negative, indicating that the option to study at a distance is lower in these more densely populated areas than in less populated areas.

Having closed the commentary on table 5, we now turn to the models for the different reasons for studying as an adult and the role of online education in these. Table A1 shows the regressions corresponding to the motives in which the variable studying online is significant. Studying online is significant and negative, i.e. face-to-face mode is preferred for 'getting a job', 'increasing knowledge', 'getting a degree' and 'for fun'.

For 'getting a job' age has the same relationship as in the results of table 5. In this case income has a negative influence, as does having a job. The variable 'disability' also has a positive and significant influence. Years of education is significantly and positively relevant for the estimation of seeking employment to 'increase

knowledge' or 'obtain a degree'. Age has the opposite influence on the estimation of studying 'for fun', prioritising younger and older people.

On the other hand, in table A2, which studies the reasons for studying as an adult in which 'studying online' is not significant, we find 'to improve at work', 'to improve expectations', 'not to get fired' and 'not to get fired', 'not being fired' and 'entrepreneurship'. In these, only for the last one, 'entrepreneurship', there is a gender gap.

Also noteworthy is the role of the variable 'years of education' which is significant in all regressions, positively in the first two and negatively in the last two respectively.

5. Discussion and Conclusions

The results of the previous section provide an accurate x-ray of individuals' opinions on e-learning, when summarised as studying a complete course from home via the Internet.

Regarding the main variables of interest, 'population density' and 'disability', it can be observed that there is no a priori relevance when considering any type of course, but the relevance of both can be noted when analysing them in relation to the university population. In line with the literature review, having a disability makes one more likely to seek quality online education for their university studies than the rest of the population, demonstrating the integrative usefulness of this mode of education.

These results do not follow the same line as the study of 'population density', which, once contextualised within the university population, gives contradictory results as to whether e-learning is used in more or less populated areas, so that it cannot be affirmed that e-learning has a structuring role in the territory. This is confirmed by the variable "CCAA", which is relevant in the first studies, but which does not show a clear difference between the more rural and less populated areas and the more cosmopolitan ones.

It is interesting to note that, among the reasons for seeking adult education, e-learning only has a significant and negative impact on those that

represent a social or job-seeking task and is therefore more common among those who need to reconcile.

The conclusions drawn from the results obtained by the socio-demographic variables indicate that the profile of the online student is a middle-aged person, to the detriment of the young and the elderly, who has a higher academic education, generally higher income and regardless of their gender at birth. This is a profile of privilege with respect to other groups more vulnerable to social exclusion such as those on lower incomes, those with smaller populations and the elderly.

In addition, considering the role of population density, there is also the phenomenon that university students from populated areas also join online education, i.e. it is used to improve already competitive profiles.

Taking these results into account, some far-reaching policy recommendations can be formulated:

Within the territorial balance and e-learning, the first thing is a communication campaign to promote the image of quality education in distance learning and to turn it into an engine against depopulation or as an attraction to work and train in rural areas.

Nevertheless, this must be accompanied by an investment in equipped study spaces and community learning centres promoted by local institutions.

On the other hand, for people with disabilities, accessibility to all materials must be guaranteed and special training must be provided for teachers in the education of people with special needs.

Beyond these groups, and to retain the most competitive users of e-learning, it is necessary to guarantee the acquisition of recognised and valued certifications in the labour market, as well as updated courses that respond to the needs of today's labour market. These must include collaborations in companies that allow for the continued generation of experiences and labour market insertion.

Some of the limitations faced in carrying out this study were not having longitudinal data such as those used by the Viñas-Sánchez, Gago-Castro and Sánchez-Pérez (2023) or not having data from some distance learning universities such as the UNED or the UOC that would allow us to describe the student body from within the university itself and compare it with disabled students who study in the face-to-face mode.

However, this leaves room for future research possibilities, such as analysing e-learning as a whole course, but also the use of ICT while studying, both for contact with teachers and classmates, as well as for material. This study could also be carried out within the university, reflecting the life of rural areas and disabled people in the university space itself.

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Table 1. Main Statistics

Variable	Obs	Media	Desviación típica	Min	Max
e-learning	3711	.229	.419	0	1
Gender at birth	22162	.486	.499	0	1
Age	22162	45.031	14 .573	18	69
University student	3206	.546	.498	0	1
Years of education	22162	12.592	3.149	1	20
Disabled	22162	.188	.391	0	1
Employed	22162	.596	.490	0	1
Income	20912	2413.95	1466.18	475	7500
Population density	22162	2.372	.727	1	3

Source: Authors' own elaboration with INE (2022a) data.

Table 2. Correlation Matrix

	Study online	Gender at birth	Age	University student	Years of education	Disabled	Employed	Income	Population density
e-learning	1.0000								
Gender at birth	-0.035	1.0000							
Age	0.359	-0.099	1.0000						
University student	0.103	-0.024	-0.212	1.0000					
Years of education	0.367	-0.084	0.316	0.317	1.0000				
Disabled	0.009	-0.026	0.078	-0.078	-0.062	1.0000			
Employed	0.390	-0.034	0.450	-0.079	0.445	-0.025	1.0000		
Income	0.094	0.068	-0.025	0.236	0.228	-0.061	0.139	1.0000	
Population density	0.009	0.036	0.003	0.057	0.071	-0.010	-0.021	0.076	1.0000

Source: Authors' own elaboration with INE (2022a) data.

Table 3. T-test - e-learning and disability.

		e-learning				
		Group	Obs	Mean	Std. Error	
No disabilities	0		3320	.226	.007	
Disabilities	1		391	.248	.022	
diff = mean(0) – mean(1)						
H0: diff = 0						
		Ha: diff < 0	Ha: diff != 0	Ha: diff > 0		
		P-Value=0.165	P-Value=0.329	P-Value=0.835		

Source: Authors' own elaboration with INE (2022a) data.

Table 4. ANOVA test - geographical variables.

Online learning					
Source of variation	Partial SS	Degrees of freedom	Mean square	F	Prob>F
Model	.178	2	.089	0.50	0.605
Population density	.178	2	.089	0.50	0.605
Residual	654.046	3,71	.176		
Total	654.223	3,71	.176		
Model	5.779	18	.321	1.83	0.018
Autonomous Communities	5.779	18	.321	1.83	0.018
Residual	648.444	3,69	.175		
Total	654.223	3,71	.176		

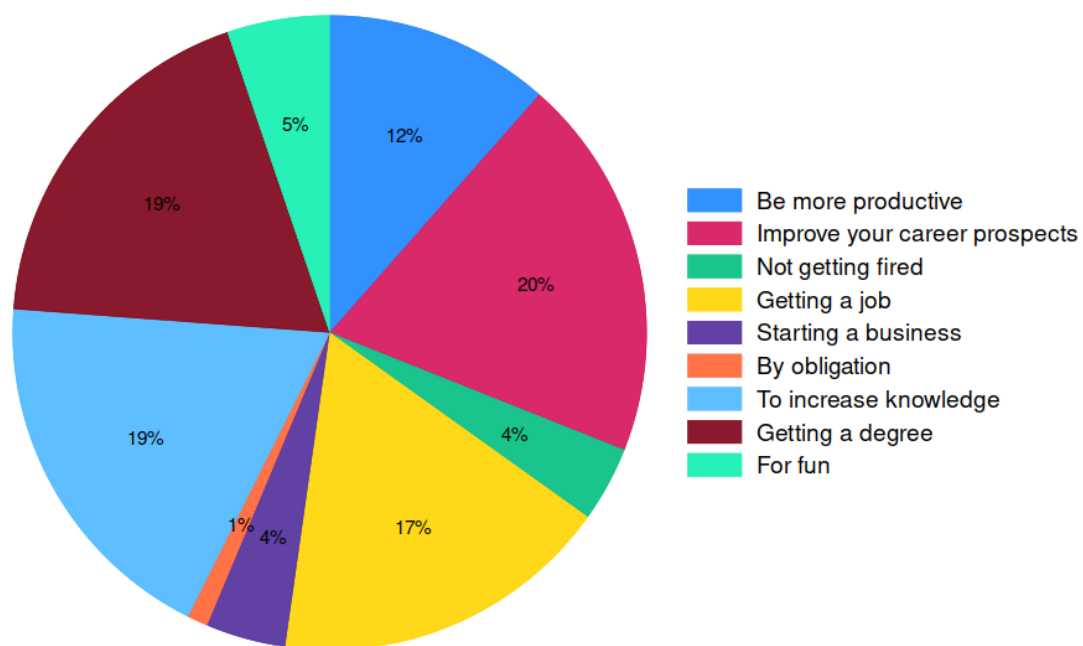
Source: Authors' own elaboration with INE (2022a) data.

Table 5. Results of the e-learning model

	e-Learning			
	Odd-Ratio (std. error)	Odd-Ratio (std. error)	Odd-Ratio (std. error)	Odd-Ratio (std. error)
Gender (at birth)	.949 (.092)	1.031 (.108)	1.038 (.110)	1.038 (.110)
Age	1.470*** (.043)	1.445*** (.046)	1.494*** (.050)	1.494*** (.050)
Age ²	.995*** (.000)	.995*** (.000)	.995*** (.000)	.995*** (.000)
Years of education	1.152*** (.022)	1.161*** (.023)	1.109*** (.024)	1.109*** (.024)
Population density				
Average	1.020 (.159)	.939 (.160)	.781 (.137)	.783 (.137)
High	1.049 (.154)	.972 (.157)	.645** (.112)	.648** (.112)
Income	1.000*** (.000)	1.000** (.000)	1.000 (.000)	1.000 (.000)
Employed	1.919*** (.214)	1.948*** (.241)	2.131*** (.269)	2.131*** (.270)
Disability	1.096 (.160)	.793 (.177)	1.150 (.184)	1.079 (.248)
Disability*University		2.093** (.632)		1.132 (.359)
Population density and university			1.441*** (.071)	1.432*** (.074)
Constant	0.000*** (.000)	0.000*** (.000)	0.000*** (.000)	0.000*** (.000)
N	3487	3000	3000	3000
Pseudo-R²	0.250	0.256	0.273	0.273
PCCP	80.04	80.73	81.97	82.03
AUC R	0.835	0.837	0.844	0.844

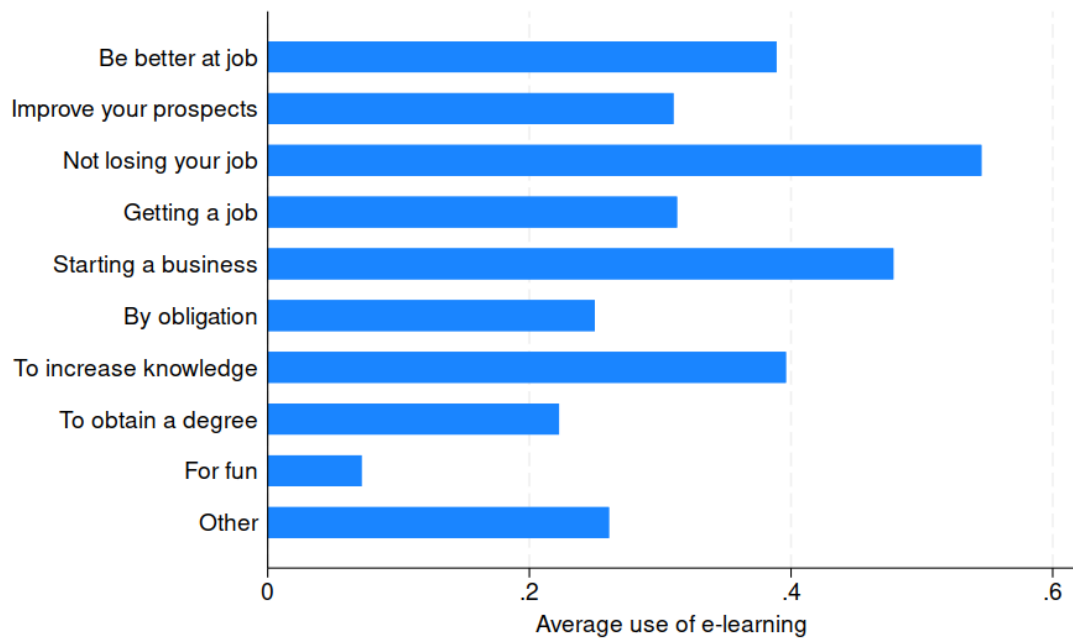
Notes: In parenthesis std. error. * Significant at 10%, ** significant at 5% and *** significant at 1%.

Figure 1. Why do adults study?



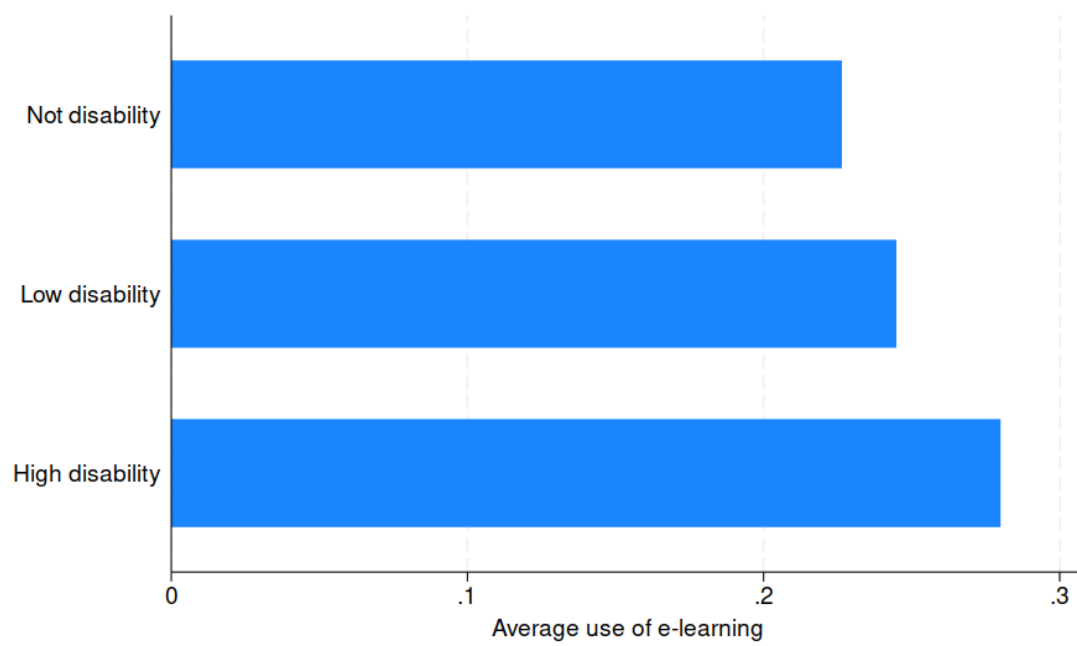
Source: Authors' own elaboration with INE (2022a) data.

Figure 2. What reasons are most linked to e-learning?



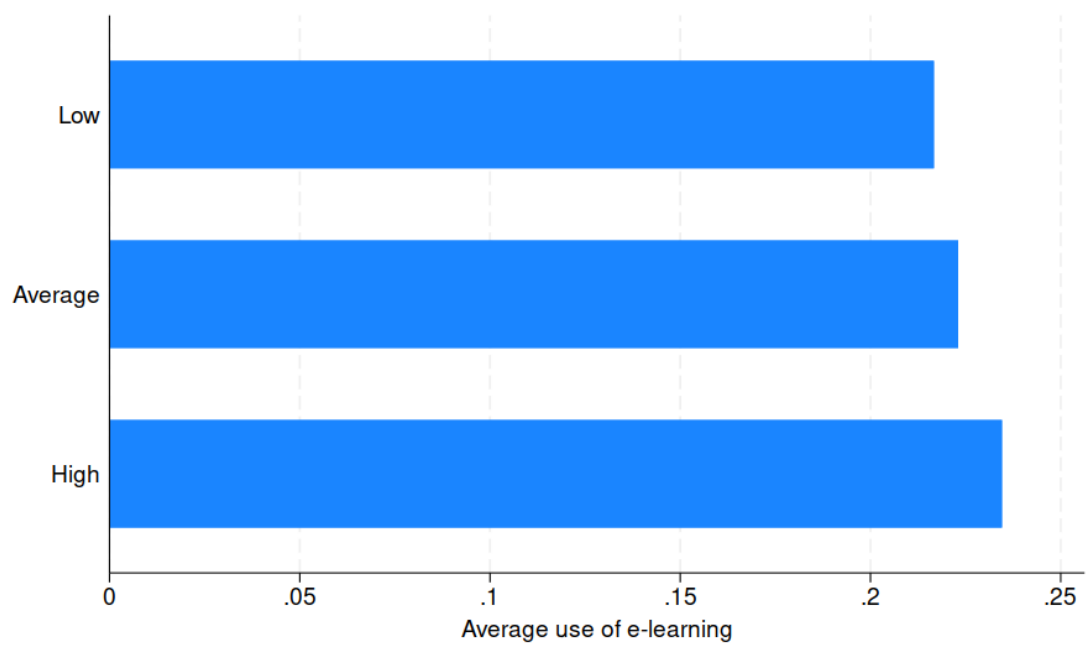
Source: Authors' own elaboration with INE (2022a) data.

Figure 3. Disabilities and e-learning.



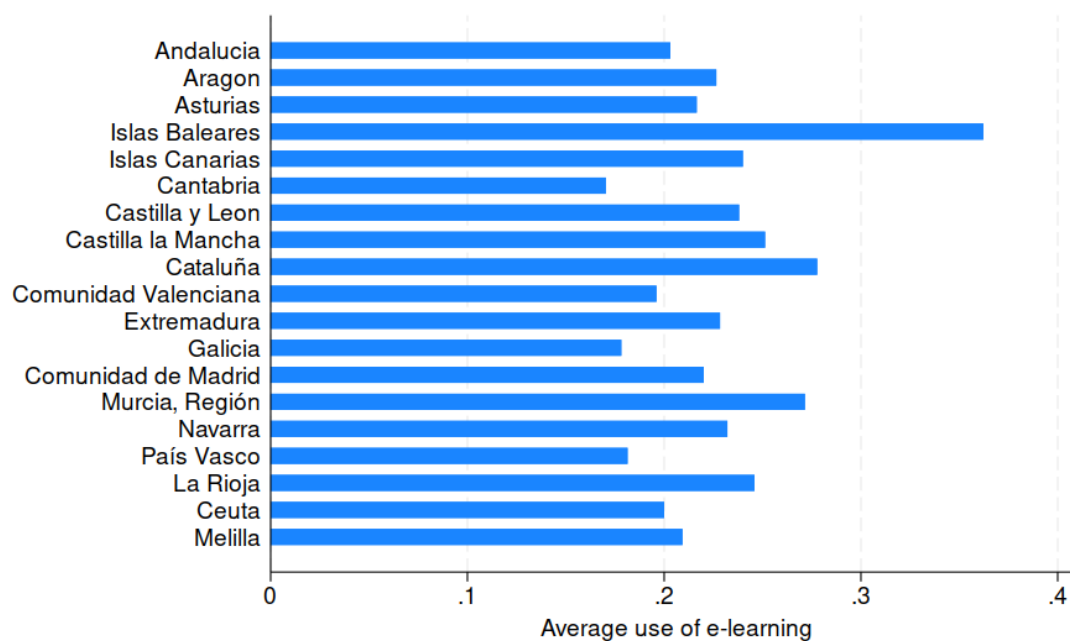
Source: Authors' own elaboration with INE (2022a) data.

Figure 4. Population density and e-learning.



Source: Authors' own elaboration with INE (2022a) data.

Figure 5. e-Learning by Autonomous Communities



Source: Authors' own elaboration with INE (2022a) data.

ANNEXES

Table A1. Results of the motives to study - e-learning model

	Getting a job	To increase knowledge	To have a degree	For fun
Study online	.797** (.080)	.789** (.0836)	.790** (.079)	.310*** (.050)
Gender (at birth)	.906 (.070)	.925 (.072)	.990 (.081)	.996 (.087)
Age	1.094*** (.028)	.999 (.025)	.961 (.023)	.915*** (.026)
Age ²	.998*** (.000)	1.000 (.000)	.999 (.000)	1.001*** (.000)
Years of education	1.020 (.018)	1.043** (.018)	.940*** (.016)	.983 (.021)
Population density				
Average	.922 (.118)	.861 (.110)	1.024 (.135)	.976 (.139)
High	.844 (.101)	.885 (.107)	1.029 (.128)	1.061 (.142)
Income	.999*** (.000)	1.000* (.000)	1.000 (.000)	1.000 (.000)
Employed	.730*** (.071)	1.047 (.105)	.926 (.094)	.829 (.097)
Disability	1.279* (.162)	.947 (.116)	1.137 (.148)	1.019 (.144)
Constant	1.219 (.513)	1.540 (.639)	23.159*** (9.822)	1.550 (.724)
N	3484	3484	3484	3484
Pseudo-R²	0.068	0.057	0.093	0.055

Notes: In parenthesis std. error. * Significant at 10%, ** significant at 5% and *** significant at 1%.

Table A2. Results of the motives to study - e-learning model

	Improve at work	Improve your prospects	Not getting fired	Starting a business
Study online	.871 (.082)	.969 (.110)	1.032 (.137)	1.086 (.149)
Gender (at birth)	1.025 (.072)	1.139 (.094)	1.147 (.110)	1.611*** (.153)
Age	1.008 (.023)	1.171*** (.030)	1.004 (.035)	1.105** (.044)
Age ²	.999 (.000)	.997*** (.000)	.999 (.000)	.998*** (.000)
Years of education	1.091*** (.017)	1.064*** (.019)	.949** (.021)	.944** (.022)
Population density				
Average	.848 (.096)	.884 (.121)	.879 (.133)	1.015 (.156)
High	.902 (.096)	.860 (.112)	.889 (.126)	.998 (.145)
Income	.999 (.000)	.999 (.000)	.999 (.000)	1.000* (.000)
Employed	1.506*** (.136)	1.025 (.111)	1.653*** (.204)	.867 (.108)
Disability	.953 (.107)	.865 (.110)	1.050 (.162)	1.258 (.186)
Constant	.284*** (.107)	.195*** (.096)	.428 (.236)	.090*** (.053)
N	3484	3484	3484	3484
Pseudo-R²	0.019	0.043	0.016	0.035

Notes: In parenthesis std. error. * Significant at 10%, ** significant at 5% and *** significant at 1%.