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Measuring Digital Capital: An empirical investigation

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Abstract

This article develops a Digital Capital Index by adopting the definition provided by Ragnedda, who defines Digital Capital as the accumulation of digital competencies and digital technologies, and the model for measuring it developed by Ragnedda and Ruiu. It aims to develop a measure that can be replicated for comparison in different contexts. This article contributes both theoretically and empirically to the literature by (a) consolidating the concept of Digital Capital as a specific capital and (b) empirically measuring it. A Digital Capital Index is developed through an exploratory factor analysis (EFA) and validated with a representative sample survey of 868 UK citizens. The validation procedure shows that the Digital Capital Index is associated with socioeconomic and sociodemographic patterns, such as age, income, educational level and place of residence, while it appears not to be related to gender.

Keywords

Digital Capital, digital divide, digital inclusion, digital inequalities, exploratory factor analysis

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Introduction

This article develops a Digital Capital Index (DCI) by adopting a definition of Digital Capital as '"a set of internalised abilities and aptitudes" (digital competencies) as well as "externalised resources" (digital technology) that can be historically accumulated and transferred from one arena to another' (Ragnedda, 2018). This definition conceptualises Digital Capital as a specific capital (though intertwined with other capitals). Moving on from this conceptualisation, Ragnedda and Ruiu (2019) proposed some indicators to measure Digital Capital. However, this model construct has hitherto never been tested. This article fills this gap in the literature by exploring the empirical application of these indicators which were developed only at a theoretical level.

To date, a multiplicity of conceptualisations of Digital Capital have been provided. Some definitions simply embed this capital within the framework of other capitals (Emmison and Frow, 1998; Seale et al., 2006), whereas other scholars, despite recognising the independence of this capital, do not provide a clear-cut definition of it (Morgan, 2010). Another line of research refers to a variety of concepts such as techno-capital (Rojas et al., 2004), information capital (Hamelink, 2000) and informational capital (Prieur and Savage, 2013: 261–262), which include those skills and competencies that a user develops through engagement with new technologies. However, although these concepts include some constitutive features of Digital Capital, such as its technological component and its informational character, they still need to be unified under a comprehensive framework and empirically operationalised. Park (2017) moved one step further, introducing Digital Capital as a specific capital, however without providing an empirical model to operationalise it. In a similar way, Ragnedda (2018) provides a definition of Digital Capital as 'the accumulation of digital competencies (information, communication, safety, content creation and problem solving), and digital technology'. Following this conceptualisation, Ragnedda and Ruiu (2019) proposed a model to measure Digital Capital. Therefore, the aim of this article is twofold: first, to apply this model (Ragnedda and Ruiu, 2019) to test the empirical application of its construct to measure Digital Capital and second, to observe its potential interaction with the main axes of social inequalities. Accordingly, this article investigates whether or not Digital Capital can be empirically measured and characterised by specific components that can be quantified. The identification of the constitutive components of Digital Capital is directly connected to the second aim, related to the interplay between this specific capital and a set of demographic and socioeconomic patterns. As further described in the following sections, this research shows the construct validity of the DCI by first applying an exploratory factor analysis (EFA) and then testing the hypotheses of the research by applying bivariate analyses on a representative sample of the UK population (868 UK citizens).

To fulfil these aims, the article is structured in five sections. The first section provides the theoretical background upon which the empirical design has been drawn. The second describes the method used to operationalise the indicators already identified by Ragnedda and Ruiu (2019). The third reports the results of both an EFA, used to investigate constitutive components of Digital Capital, and a bivariate analysis, used to check the construct validity of the DCI by observing its relationship with

socioeconomic and sociodemographic variables. The fourth section discusses the main findings of this study. Finally, some conclusions will highlight the implications and limitations of this study.

Literature review

When the Internet first appeared, early scholars tended to oversimplify the phenomenon of the digital divide by proposing a dichotomic division between those who access the Internet and those who are excluded (Hoffman and Novak, 1999; Katz and Aspden, 1997). They focused on inequalities in accessing the Internet as dependent upon socioeconomic and cultural differences (DiMaggio et al., 2001), what is today known as the first level of the digital divide (Attewell, 2001). Accordingly, these preliminary findings showed how the most socially advantaged people were the first to acquire technologies and access to information and communication technologies (ICTs; DiMaggio et al., 2004). However, with the diffusion of ICTs and the spread of the Internet, some scholars expanded this definition by including the different uses of the Internet and the possession of different grades of digital skills, what is today known as the second level of digital divide (Hargittai, 2002). This second level showed a digital 'stratification' (Peter and Valkenburg, 2006) and inequalities in terms of both Internet usage (Van Dijk, 2006) and online participation. Finally, researchers have also identified the third level of digital divide (Ragnedda, 2017; Wei et al., 2011) that refers to inequalities in terms of the benefits and concrete outcomes that users can gain from ICT usage (Van Deursen et al., 2015).

From different perspectives and angles, these studies showed how inequalities in terms of Internet access (first digital digital divide), digital skills (second digital digital divide) and benefits and opportunities based on access and use of ICTs (third digital digital divide) are strongly intertwined with social inequalities. The literature shows how the uneven distribution of resources and capitals (not only economic but also social and cultural capital) among the population (Van Deursen et al., 2015) is at the base of digital inequalities. However, while looking at the sociocultural and economic background of the population is vital when analysing inequalities in accessing and using ICTs (Blank and Groselj, 2015), this does not fully consider the multidimensionality of digital inequalities (Anthias, 2013). Recently, in an attempt to better understand digital inequalities, scholars have underlined the necessity to conceptualise a new capital, namely Digital Capital, able to capture the 'set of dispositions' that individuals develop to engage with new technologies (Park, 2017) and the internalised ability and aptitude as well as externalised resources that can be accumulated by the individual and used to gain benefits from using ICTs (Ragnedda, 2018).

What is missing in the literature is an attempt to concretely measure and empirically test this specific capital. In fact, as mentioned earlier, no one has tried to measure Digital Capital and test it with sociodemographic and socioeconomic variables. As such, there is no literature in this regard. However, digital inequalities studies have repeatedly pointed out a marked relation between sociodemographic and socioeconomic patterns and inequalities in accessing, using and gaining benefits from ICTs (DiMaggio et al., 2004; Robinson et al., 2015; Zillien and Hargittai, 2009). Literature has, indeed, shown how these variables influence how people access the Internet (Tsatsou, 2011), their digital

skills (Jones-Kavalier and Flannigan, 2008) and their online activities (Hargittai and Hinnant, 2008; Zickuhr and Smith, 2012).

Although Digital Capital is a newly developed concept and has never been measured as a specific capital, we assume that it is interrelated with these five variables, which are in turn connected to the main axes of social inequalities. This general assumption is split into five different hypotheses as follows.

H1. Digital Capital is positively related to income

Income is one of the main features taken into consideration by digital inequalities studies (Mardis, 2013; Ragnedda and Muschert, 2013; Talukdar and Gauri, 2011; Witte and Mannon, 2010). Inequalities in accessing and using ICTs are related to socioeconomic groups and these differences affect people's online and offline welfare (Van Deursen et al., 2017). Furthermore, several authors pointed out how traditional social structures, including income, at the base of social inequalities also influence digital inequalities (Ragnedda and Muschert, 2015; Robinson et al., 2015). Following this line of research, we hypothesise that higher incomes positively influence the level of Digital Capital.

H2. Digital Capital is negatively related to age

Previous findings showed how age influences both access (Dutton and Blank, 2013) and the types of online activities (Blank and Groselj, 2014; Lee et al., 2011), thus affecting the constitutive elements of Digital Capital. Therefore, in line with several studies that showed a negative effect of age on the level and types of digital engagement and activities (Fox, 2004; Hargittai and Hinnant, 2008; Niehaves and Plattfaut, 2014), we expect that age negatively contributes to the level of Digital Capital.

H3. Men are more likely than women to have a higher level of Digital Capital

Earlier research on the digital divide focused on several sociodemographic patterns, including gender (Katz and Rice, 2002; Norris, 2001; Wilson et al., 2003). More recently, some studies have shown how, in developed countries such as the United Kingdom, the gap between men and women in accessing the Internet has been bridged (Blank and Groselj, 2014). This suggests that, with regard to gender, the first level of the digital divide (based on inequalities in accessing ICTs) no longer exists in those countries characterised by a higher level of Internet penetration. However, some forms of digital inequalities can be still identified between men and women in terms of intensity (Hargittai, 2010), frequency of use (Wasserman and Richmond-Abbott, 2005), range of online activities (Haight et al., 2014) and self-assessment of digital skills (Hargittai and Shaw, 2015). Therefore, consistent with these studies, we expect that gender is related to the level of Digital Capital.

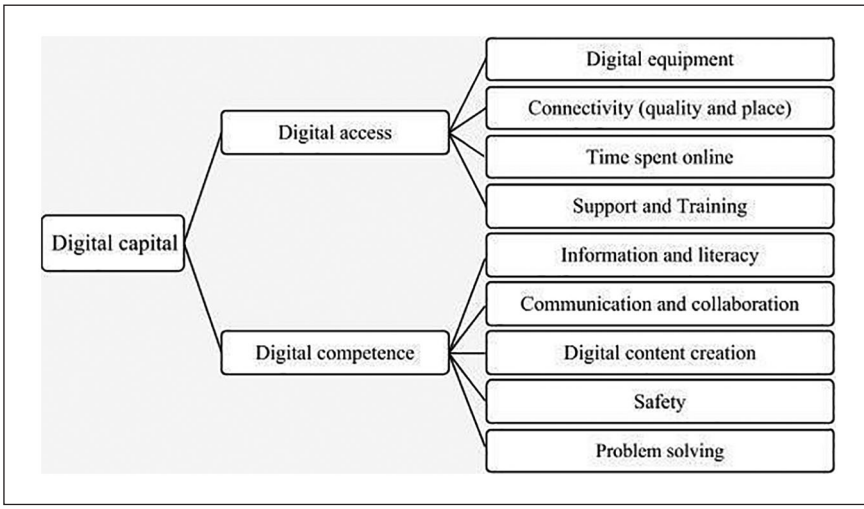


Figure 1. Constitutive components of Digital Capital.

H4. Digital Capital is positively related to educational level

The literature shows that level of education strongly and positively influences access (Attewell, 2001; Clark and Gorski, 2001, 2002), the level of digital engagement (Mossberger et al., 2007; Shelley, 2009) and type of online activities (Blank and Groselj, 2014; Van Deursen and Van Dijk, 2013; White and Selwyn, 2013). Since these three features (access–engagement–activities) are captured by the DCI, we assume that higher levels of education positively influence the level of Digital Capital.

H5. Urban users are more likely to have higher Digital Capital than rural users

This hypothesis is supported by research that found that Internet penetration is higher in urban areas than in rural areas (Crang et al., 2006; Townsend et al., 2013) and that the lack of broadband connection in some rural areas has negative effects on several social issues (Ashmore et al., 2015; Philip et al., 2017). We, therefore, expect to observe a higher level of Digital Capital among those living in urban areas, compared to those living in small towns or rural areas.

Research design

The conceptualisation of Digital Capital has been operationalised by adopting the model developed by Ragnedda and Ruiu (2019), as shown in Figure 1.

By using this theoretical and empirical model, we aimed to (a) measure Digital Capital through an index resulting from a multivariate analysis and (b) test the hypotheses reported in the 'Literature review' section.

According to this model, Digital Capital includes two sub-dimensions represented by Digital Access and Digital Competence.

Digital Access includes four subcomponents that have been proved to play a key role in determining the quality and type of digital experience, namely digital equipment (Akiyoshi and Ono, 2008; Mossberger, et al., 2012; Murphy et al., 2016; Napoli and Obar, 2014; Van Deursen and Van Dijk, 2019; Van Dijk, 2005), connectivity (Kyriakidou et al., 2011; Peter and Valkenburg, 2006; Riddlesden and Singleton, 2016), support and training (Ruiu and Ragnedda, 2017; Selwyn, 2004) and time spent online (Hargittai, 2003, 2010). The last subcomponent, as specified by Ragnedda and Ruiu (2019), refers to the historical time spent online, rather than the daily time (which is problematic to quantify), and this contributes to capturing the 'historical accumulation' of Digital Capital.

Digital Competence, however, focused on the interiorised digital abilities of the individual and has been developed upon the DigComp 2.1 proposal identified by The European Digital Competence Framework for Citizens (Carretero et al., 2017). More specifically, we have identified five areas of competence: (a) information and data literacy, (b) communication and collaboration, (c) digital content creation, (d) safety and (e) problem solving.

Research method, sample and data collection

We adopted a quantitative approach to test our hypotheses, by developing an online survey. The research unit of analysis is represented by individuals above 18 years of age living in the United Kingdom. These methodological choices (online survey and unit of analysis) are consistent with the research purposes of involving respondents with at least a minimum level of technological competence and access and are supported by the fact that in 2018, around 90% of the population in the United Kingdom used the Internet (Office for National Statistics, 2018). Given its high Internet penetration, in line with Northern European countries, the United Kingdom is a favourable context in which inequalities in terms of digital opportunities/benefits can be observed. In fact, since the DCI may help understand how individuals use the Internet (the second level of the digital divide) and obtain benefits and tangible outcomes from its use (the third level of the digital divide), we focused on a country in which the first level of digital divide (inequalities in accessing the Internet) has almost been eliminated.

The research sample was built with a proportional random procedure, and it was stratified according to gender, age and education with the purpose of being representative of the UK population on these variables. Respondents were selected by Toluna digital market research group. A software checked for missing responses and then prompted users to respond. An online pre-test survey was conducted with 20 Internet users over two rounds. Amendments were made based on the feedback provided. The average time required to complete the survey was 25 minutes. In total, 868 responses were collected over a 2-week period in January 2019. The sample size (868 respondents) was calculated as having a 3.33% margin of error at 95% confidence level.

Table 1 shows the distribution of the sample by gender, age and level of education.

Table 1. Sample demographics ($n = 868$).

Variable		Count	%
Gender	M	434	50.0
	F	434	50.0
Age (years)	18–24	94	10.8
	25–34	151	17.4
	35–44	141	16.2
	45–55	157	18.2
	55+	325	37.4
Education	Some high school, no diploma	94	10.8
	High school graduate	222	25.6
	Some college credit, no degree	206	23.7
	Bachelor's degree	248	28.6
	Master's degree	68	7.8
	Doctorate degree	30	3.5

Operational definition and measurement

The operational definition of the variables took into account the different nature of the constitutive components of the Digital Capital. Being conceived as factual and behavioural characteristics, the four subcomponents of Digital Access were measured using a mix of open, closed and multiple response questions, as shown in Table 2.

Following Ragnedda and Ruiu's model (2019), the Digital Competence set of questions was conceived as a self-assessment component. In fact, it refers to the digital know-how that people perceive as facilitating their daily life. Accordingly, it was operationalised using two sets of questions (nine items per each set) resembling the competence proposed by the European Union in DigComp 2.1. Respondents were asked to self-assess their Digital Competence on a five-point Likert-type scale, from 'Not at all true of me' to 'Very true of me' (Table 3).

Data analysis

Data analysis was carried out using SPSS 23 following several stages: first, univariate analysis explored the data quality and provided an overview; then bivariate and EFA were performed to test the hypotheses. More specifically, the reason for adopting the EFA is twofold: first, to test the validity of the construct adopted here and second, to create a DCI. A two-step factor analysis approach was adopted to develop the DCI. This two-step approach made it possible to manage a high number of items and to simplify the interpretation of the results (Di Franco and Marradi, 2013). Therefore, after the first extraction, each factor (and related variables) was independently analysed to remove those variables that were not strictly connected to the concepts under analysis.

Table 2. Digital Access: operational definition.

Sub-component	Operational definition and description		Measure
Digital equipment	Devices used to access the Internet	Multiple response set	Nominal
Connectivity	In which of the following settings do you most frequently access the Internet?	Multiple response set	Nominal
Time spent online	How old were you when you used the Internet for the very first time?	Open question	Scale
Support and training	Have you ever had any formal training in using Internet?	Closed question	Nominal
	If you needed help, would there be someone who could help you with using the Internet?		
	Have you looked or asked for help to use the Internet in the past 3 months?		
	Have you helped someone use the Internet in the past 3 months?		

To test our hypotheses, we used one-way analysis of variance (ANOVA) to explore the relationships between Digital Capital and income (hypothesis 1), educational level (hypothesis 4) and place of residence (hypothesis 5). Furthermore, the second hypothesis, which tests the interrelation between Digital Capital and age, was explored using a correlation analysis. Finally, the third hypothesis, aimed at observing potential relationships between Digital Capital and gender, was addressed by performing an independent-samples *t*-test.

Despite its limitations, the bivariate analysis is appropriate to validate the DCI construct in relation to a number of demographic and socioeconomic variables that literature has proved to be tied to digital inequalities.

Results

Building the DCI

The DCI was built by combining the two indexes described above, one measuring Digital Access and the second measuring Digital Competence.

As already highlighted, the Digital Access Index was created by combining four sets of questions related to (a) digital equipment, (b) connectivity, (c) time spent online and (d) support and training (see Table 2). The multiple responses related to digital equipment, connectivity, and support and training were conceived as dummy variables and summarised into single 'variables'. The four variables were included in a factor analysis to test the operational definition of Digital Access and to develop an index to represent it (Table 4).

Following the Kaiser (1960) criterion of retaining only those factors having eigenvalues of 1 or more, results showed that the extraction of one single factor (47.8% of variance explained) was appropriate to represent the factorial solution; moreover, the average size of the factor loadings (over .6) is very good (Comrey and Lee, 1992), and

Table 3. Digital Competence: operational definition.

	Operational definition and description		Measure
First set	I am confident in browsing, searching and filtering data, information and digital content I regularly use cloud information storage services or external hard drives to save or store files or content I regularly verify the sources of the information I find I actively use a wide range of communication tools online communication I know when and which information I should and should not share online I actively participate in online spaces and use several online services (e.g. public services, e-banking, and online shopping) I have developed strategies to address cyberbullying and to identify inappropriate behaviours I can produce complex digital content in different formats (e.g. images, audio files, text, and tables) I can apply advanced formatting functions of different tools (e.g. mail merge, and merging documents of different formats) to the content I or others have produced	Likert-type scale	Ordinal
Second set	I respect copyright and licence rules and I know how to apply them to digital information and content I am able to apply advanced settings to some software and programmes I periodically check my privacy settings and update my security programmes (e.g. antivirus and firewall) on the device(s) that I use to access the Internet I use different passwords to access equipment, devices and digital services I am able to select safe and suitable digital media, which are efficient and cost-effective in comparison with others I am able to solve a technical problem or decide what to do when technology does not work I can use digital technologies (devices, applications, software or services) to solve (non-technical) problems I am able to use varied media to express myself creatively (text, images, audio and video) I frequently update my knowledge on the availability of digital tools	Likert-type scale	Ordinal

this suggests that all the selected variables contribute to define the factor. The factor scores were saved using the regression method and a variable named Digital Access Index was created.

Table 4. Factor loadings of the variables used for the Digital Access Index.

Digital equipment	.73
Connectiveness	.78
Time spent online	.61
Support	.63

Kaiser–Meyer–Olkin (KMO) test = .691; Bartlett's test, $p < .000$.

The Digital Competence Index, however, was built by directly applying the EFA to the set of items shown in Table 3. By implementing the two-step factor analysis and following the Kaiser criterion, we extracted three factors and repeated the second factor analysis (on each single factor) by only including those variables with the highest loadings within the specific factor considered. This double step improved the interpretation of the latent dimension by 'refining' the results and isolating those features that strongly contribute to the factors.

The first step of the factor analysis provided a three-factor solution that explained the 63.9% variance, as shown in Table 5.

The first factor extracted is represented by a high number of variables covering several Digital Competence factors related to the use of a multiplicity of digital contents (.83) and formats/media (.80 and .72); adoption of different software (.79), technologies (.73) and storage services (.61); and capacity to develop strategies to deal with technical problems (.72), deal with other people's inappropriate behaviours (.62) and update personal knowledge (.78). This is why it was labelled as 'Problem Solving'. Considering the items with the highest factor loadings, mainly related to individual confidence to navigate the Internet, respect of rules (.57) and attention to privacy settings (.60) and passwords (.77), the second factor was labelled as 'Safety' competence. Finally, given the prevalence of items concerning the creation of content on different media (.54), the active participation online (.79) and the capacity to select the types of content to share on different platforms (.69), the third factor represents the 'Content-Creation' Competence (see Table 5). These three factors were transformed into three different variables. Finally, these new variables were combined into the Digital Competence Index by repeating the factor analysis and extracting a unique factor.

Table 6 shows a statistically significant correlation between the Digital Access Index and the Digital Competence Index.

The last step of our process was to combine the Digital Access Index and the Digital Competence Index through a further extraction of a single factor representing the DCI (see Table 7). Finally, the index was converted to a range from 0 to 100 to simplify its interpretation.

Testing the DCI

Before testing the newly created DCI against the five hypotheses, we checked whether any of the two sub-indexes, namely access and competences or both, might drive the associations.

Table 5. Factor loadings of the Digital Competence items.

Items	Factors		
	Problem solving	Safety	Content creation
I am confident in browsing, searching and filtering data, information and digital content		.59	
I regularly use cloud information storage services or external hard drives to save or store files or content	.61		
I regularly verify the sources of the information I find			
I actively use a wide range of communication tools online communication			.54
I know when and which information I should and should not share online			.66
I actively participate in online spaces and use several online			.79
I have developed strategies to address cyberbullying and to identify inappropriate behaviours	.62		
I can produce complex digital content in different formats (e.g. images, audio files, text, and tables)	.81		
I can apply advanced formatting functions of different tools to the content I or others have produced	.83		
I respect copyright and licence rules and I know how to apply them to digital information and content		.57	
I am able to apply advanced settings to some software and programmes	.79		
I periodically check my privacy settings and update my security programmes on the device(s) I use to access the Internet		.60	
I use different passwords to access equipment, devices and digital services.		.77	
I am able to select safe and suitable digital media, which are efficient and cost-effective in comparison with others	.61		
I am able to solve a technical problem or decide what to do when technology does not work.	.72		
I can use digital technologies (devices, applications, software or services) to solve (non-technical) problems	.73		
I am able to use varied media to express myself creatively (text, images, audio and video).	.72		
I frequently update my knowledge on the availability of digital tools	.78		
% variance explained by each factor	49.02	7.84	6.54

Kaiser–Meyer–Olkin (KMO) test = .948; Bartlett's test, $p < .000$; factor loadings less than .5 are not shown.

Table 8 reports the relationship between access and competences, and socioeconomic and socio demographic characteristics. The table shows only slight variations in the means of the two constitutive components of Digital Capital in relation to these variables. This is

Table 6. Correlation between Digital Access and Digital Competence.

		Digital Competence
Digital Access	Pearson's correlation	.464**
	Sig. (two-tailed)	.000

**Correlation is significant at the .01 level (two-tailed).

Table 7. Component matrix of the combination between Digital Access Index and the Digital Competence Index.

	Component 1
Digital Access	.855
Digital Competence	.855

in line with the results of the factorial analysis in which the two components have the same weight in determining Digital Capital. This further supports the creation of a new and unique DCI that includes both sub-indexes, since the two components tend to have significant weight in determining Digital Capital and, in turn, its relationship with socio-economic factors.

The applicability of the DCI has been tested by carrying out bivariate analysis with a set of variables that, according to literature, relate to digital inequalities. The hypotheses were tested by performing several bivariate analyses according to the type of variables (i.e. nominal, ordinal or continuous).

H1. Digital Capital is positively related to income. H1 is confirmed by the analysis of the relation between the level of Digital Capital and incomes. The DCI proportionally varies according to the income level of the respondents, as shown in Figure 2. The mean values of the DCI go from 67.7 of the lowest income category (<£10,000) to 81.6 representing the highest income category (>£100,000). The results of the one-way ANOVA show that the differences among income groups are statistically significant.

H2. Digital Capital is negatively related to age. The correlation coefficient between the DCI and age shows a statistically significant negative relationship (−.397, $p < .01$) (Table 9). H2 is, therefore, confirmed, and we can affirm that the level of Digital Capital is on average higher in younger people. However, it must be noted that, grouping the sample per age, the cohort 25–34 shows the highest level of Digital Capital (Figure 3).

H3. Men are more likely than women to have a higher level of Digital Capital. This hypothesis is partially confirmed by the statistical analysis (independent-samples *t*-test) in line with the literature on the relationship between digital inequalities and gender (Blank and Groselj, 2014; Ono and Zavodny, 2007). A small difference between men and women was found: the former appears to be slightly more likely to have a higher level of Digital Capital (+2.41), with the *p*-value slightly above the statistical significance threshold of .05 (Figure 4). However, the differences between genders are not statistically significant.

Table 8. Relationship between access and competences, and socioeconomic and sociodemographic characteristics.

Variable		Index	
		Digital Access	Digital Competence
Income	<£10,000	46.4	67.5
	£11,000–£25,000	46.5	69.8
	£26,000–£50,000	50.1	72.0
	£51,000–£100,000	61.4	76.3
	>£100,000	83.5	81.4
	Total	51.5	72.0
		F = 22,924; Sig. = .000	*F* = 5,354; Sig. = .000
Age	Correlation	−.534**	−.380**
Gender	Male	54.1	74.0
	Female	48.9	70.0
	Total	51.5	72.0
		F = 9,345; Sig. = .002	*F* = 9,369; Sig. = .002
Education	Some high school, no diploma	39.5	62.8
	High school graduate	42.5	69.8
	Some college credit, no degree	52.8	72.5
	Bachelor's degree	55.3	74.0
	Master's degree	62.3	78.3
	Doctorate degree	91.5	84.1
	Total	51.5	72.0
		F = 34,468; Sig. = .000	*F* = 9,689; Sig. = .000
Area	Urban areas	57.0	74.2
	Small towns	49.1	71.3
	Rural areas	43.7	68.5
	Total	51.5	72.0
		F = 12,817; Sig. = .000	*F* = 3,542; Sig. = .014

**Correlation is significant at the .01 level (two-tailed).

Table 9. Correlation between age and Digital Capital.

		Digital Capital
Age	Pearson's correlation	−.397**
	Sig. (two-tailed)	.000

**Correlation is significant at the .01 level (two-tailed).

H4. Digital Capital is positively related to educational level. The one-way ANOVA shows a positive and statistically significant influence of education on Digital Capital, thus confirming H4. On average, the Digital Capital possessed by respondents increases according to higher educational level. These differences are statistically significant (Figure 5).

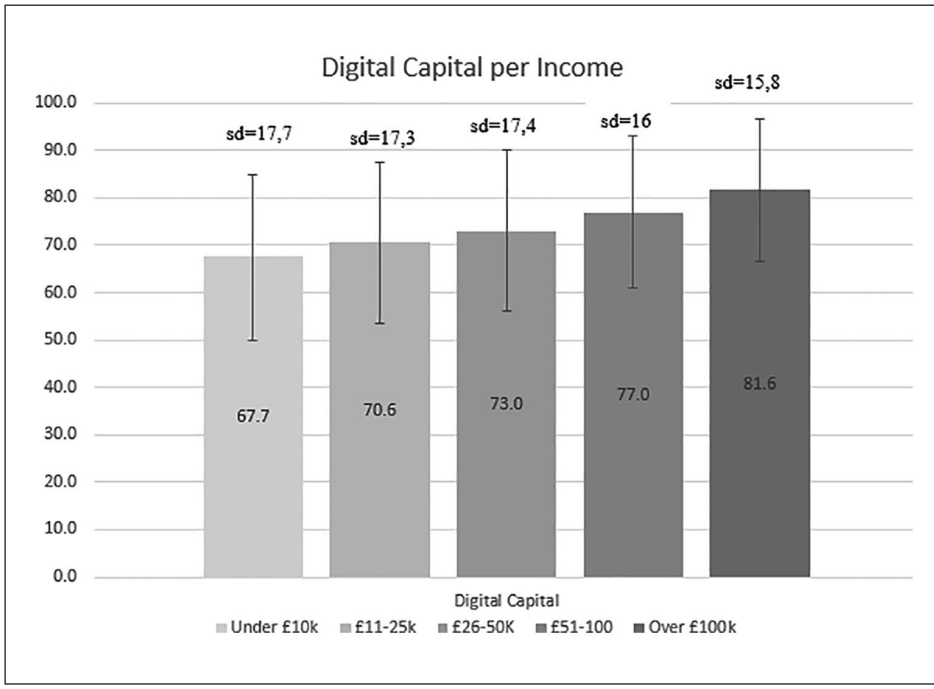


Figure 2. Digital Capital per annual income.
$F = 5{,}347$; Sig. $< .000$.

H5. Urban users are more likely to have higher Digital Capital than rural users. The results of the one-way ANOVA show that Digital Capital relates to the residential area of the respondents: people living in urban areas have higher Digital Capital (75.2) than those living in small towns (72.1) or rural areas (68.6). The differences among this group are statistically significant and allow us to accept H5 (Figure 6).

Discussion

The primary aims of this study were to test the validity of a model construct aimed at measuring Digital Capital and relating it to the principal axes of social inequalities. Overall, the DCI appears to efficiently capture the constitutive components of Digital Capital that facilitate the digital experience and interact with individual sociodemographic and socioeconomic backgrounds.

On the one hand, the theoretical construct of Digital Capital (and its empirical application) adopted in this work is consistent with previous research on digital inequalities that shows a relation between social inequalities axes and how we access, use and gain advantage from ICTs; on the other hand, it suggests that the Digital Capital should be treated as a specific form of capital. Our study, differently than previous research, enabled to isolate the Digital Capital as a specific capital, by identifying, measuring and synthesising specific

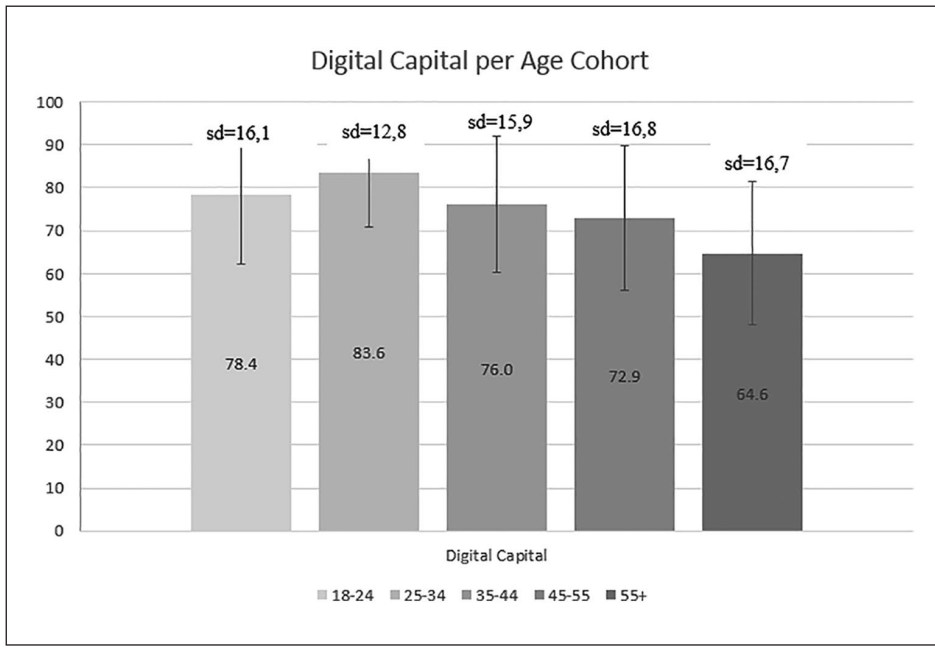


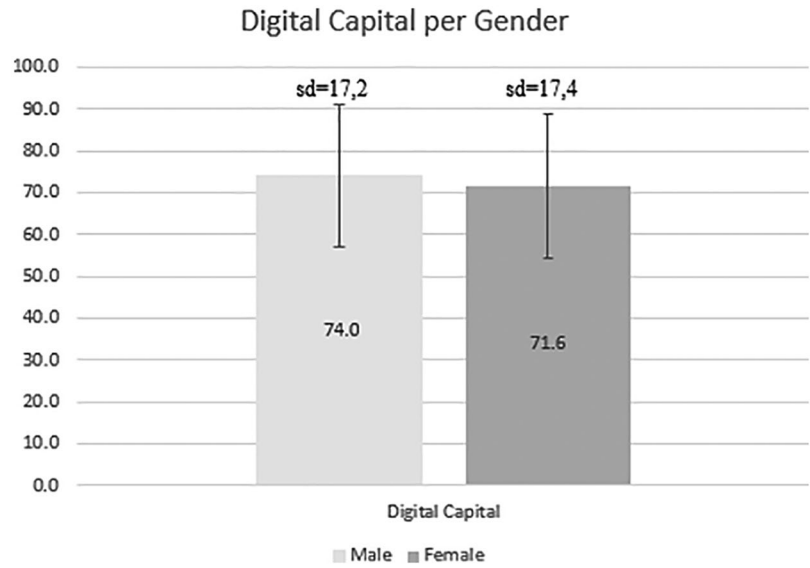
Figure 3. Digital Capital per age cohort.

indicators of it. Accordingly, the originality of this work relies on reconciling previous conceptualisations and results under the umbrella of a unique index that summarises the different components of Digital Capital and empirically tests its validity.

More specifically, the bivariate analysis (despite its limitations) indicates significant associations between Digital Capital and the main axes of social inequalities. The selection of these variables, as discussed above, derived from previous findings which show how gender (Katz and Rice, 2002; Wilson et al., 2003), income (Martin and Robinson, 2007; Ragnedda and Muschert, 2013), education (Clark and Gorski, 2001, 2002) and geographical location (Pearce and Rice, 2013; Zhang, 2013) affect access to the Internet, usage and proficiency (Stern et al., 2009). All these variables, except gender, are related to Digital Capital.

Digging deeper into these analyses, we can see how Digital Capital positively relates to income. In fact, the level of Digital Capital is higher in individuals with higher incomes (see Table 8). More specifically, those with an income above £100,000 a year have the highest level of Digital Capital, whereas those with an income below £15,000 a year have the lowest level. These results confirm previous research that identified income as one of the key variables in influencing both access (Martin and Robinson, 2007) and digital skills and digital literacy (Aesaert et al., 2015; Fraillon et al., 2014; Litt, 2013).

Similarly, and in line with several studies that showed how both access to ICTs and digital skills are influenced by educational level (Van Deursen and Van Dijk, 2013; White and Selwyn, 2013), this research found a positive relationship between Digital Capital



	Levene's test, *f*		*t*-test					
	F	Sig.	*t*	*df*	Sig. (two-tailed)	Mean difference	Standard error difference	95% confidence interval
Equal variances assumed	.245	.621	1.858	706	.064	2.419	1.302	[–0.137, 4.976]
Equal variances not assumed			1.858	705.823	.064	2.419	1.302	[–0.137, 4.976]

Figure 4. Digital Capital per gender.

and educational level. More specifically, this result is in line with specific cases (see, for example, Van Deursen and Van Dijk's [2014] study in the Netherlands, and Blank and Groselj's [2015] study in England) which show how inequalities in Internet use are related to educational level.

Furthermore, the correlation between age and individual levels of Digital Capital suggests the existence of an age-based digital divide (Neves et al., 2018), which is a common aspect in societies where elderly people lack confidence in using ICTs (Jung et al., 2010; Rosenthal, 2008) and, therefore, are disadvantaged by the digital divide

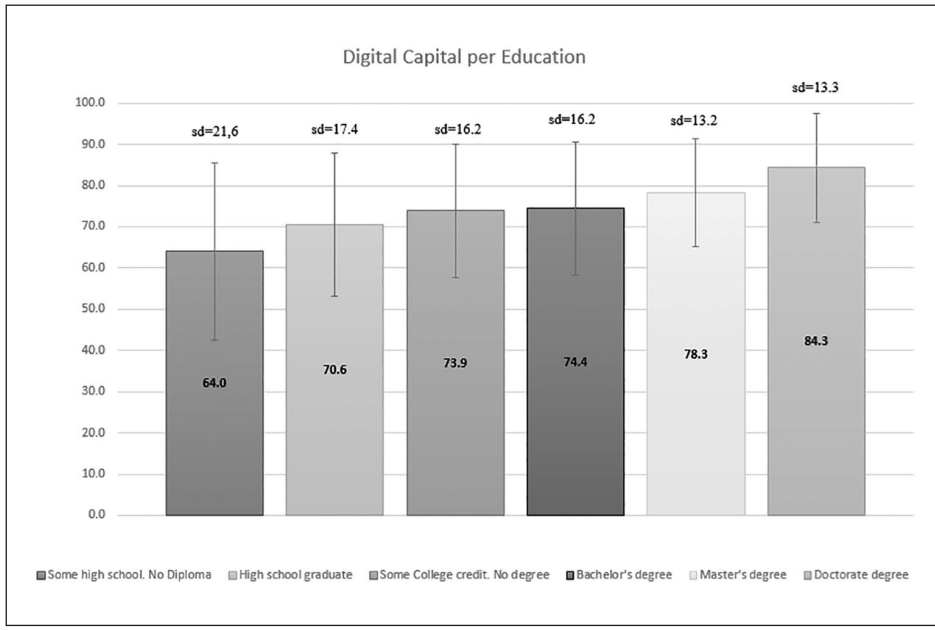


Figure 5. Digital Capital per educational level.
F = 8,859; Sig. < .000.

(Jimoyiannis and Gravani, 2010; Neves et al., 2013). Not surprisingly, younger cohorts are the most intensive Internet users (see, for example, Gerd and Stegbauder, 2005) and tend to be more computer savvy than the older cohorts (Eshet-Alkalai and Chajut, 2010). This is in line with several studies that prove that Internet access and use tend to be higher and different for younger individuals compared to older people (Hargittai, 2010; Lenhart et al., 2008; Palfrey and Gasser, 2008). However, our research shows that the cohort aged 25–34 has the highest level of Digital Capital, even higher than the 18–24 cohort. This result is not surprising if we bear in mind the definition of Digital Capital as 'the accumulation of digital competencies (information, communication, digital content creation, safety, and problem solving), and digital technologies' (Ragnedda, 2018). Therefore, even though bivariate analyses cannot fully explain this result, we suggest three reasons why this cohort has the highest level of Digital Capital. First of all, the group aged 25–34 has had more time and resources (both economic and cultural) to accumulate Digital Competence and digital technologies, thus increasing their level of Digital Capital. Second, this cohort is characterised by a high level of employability that might influence some Digital Competences, specifically those related to 'communication and collaboration'. Third, this cohort has a higher level of education which, as we have seen, is positively related to Digital Capital.

The literature on the geographical related digital divide (Sipior et al., 2002) showed a relationship between digital inequalities and geographical location, for example, identifying geographical inaccessibility as a significant impediment to ICT use (Foster et al.,

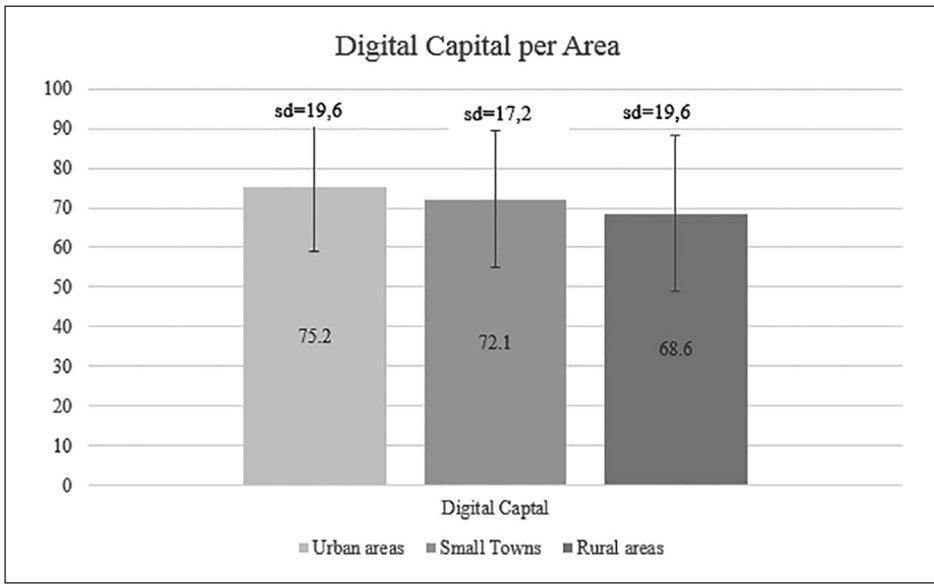


Figure 6. Digital Capital Index per residential area.
$F = 4{,}745$; Sig. $< .003$.

2004), Internet penetration (Crang et al., 2006; Townsend et al., 2013) and diffusion of broadband connection (Ashmore et al., 2015; Philip et al., 2017). These findings are confirmed by exploring the relationship between Digital Capital (which includes both 'externalised resources' – digital technology – and 'internalised abilities/aptitudes' – digital competencies) and the place where users live. In fact, those living in urban areas tend to possess higher levels of Digital Capital compared to those living in small towns or rural contexts. This might be due to the fact that urban areas are often characterised by a higher level of infrastructure development, better opportunities for education and training, a wider range of job opportunities with higher salaries and other patterns related to the broader political economy (Crampton, 2003; Warf, 2001).

Finally, we also explored the role of gender in the context of Digital Capital, and our data show that there is no statistically significant difference between male and female users. The literature suggests that, at least in the United Kingdom and more broadly in the so-called Global North, the gap between genders in accessing the Internet has been closed (Blank and Groselj, 2014). However, despite the disappearance of this gap in terms of access, some studies show the persistence of inequalities, for example, in terms of intensity, range of online activities and self-assessment of digital skills (Haight et al., 2014; Hargittai, 2010; Hargittai and Shaw, 2015; Wasserman and Richmond-Abbott, 2005). Our results, partly in contrast to previous research, suggest that the overall level of Digital Capital (simultaneously considering both access and competence) tends to be equal between the two groups. Henceforth, our findings suggest that gender-related digital inequalities, in a society characterised by a high level of Internet penetration, are

slowly being bridged. Evidently, more studies that take into consideration other factors such as gender-stereotyping processes (Robinson, 2007), countries where users live (Robinson et al., 2015) or include other variables (age, job, income and education) are needed. This is one of the main limits of any bivariate analysis that only takes into account the relationship between two variables and, usually, cannot give an explanation for the relationship between the two variables.

Overall, the results of this study give the first indication about the interaction between Digital Capital and socioeconomic inequalities. These axes of social inequalities are related to DCI, thus reinforcing previous studies that highlighted how social and digital inequalities are intertwined and influence and reinforce each other.

Conclusions and limitations

Overall, this study found that Digital Capital is a specific capital that can be isolated and empirically measured. Furthermore, it showed how Digital Capital is intertwined with the 'traditional axes' of social inequalities. The main implication of this study is the provision of a tool that can also be applied to other contexts. In turn, the measurement of Digital Capital and the investigation of its interaction with other socioeconomic features might help policy-making to identify those areas that need intervention. In fact, a simplified process of measurement of Digital Capital makes it possible to identify and intervene in those gaps that increase digital inequalities (which in turn reinforce social inequalities). The interrelationship between Digital Capital and social inequality patterns makes the measurement of Digital Capital essential to understand and tackle both social and digital inequalities.

However, further research is needed to explore the relation between the level of Digital Capital and other capitals such as social, cultural or political. This might help in understanding how these capitals are also intertwined in relation to the third level of the digital divide, by, for example, considering the benefits individuals can gain from different uses of the Internet. Moreover, this study focused on the United Kingdom, in which around 90% of the population has access and uses digital technologies. Accordingly, the index included variables that might create significant results in this specific context and excluded others that might be important for investigating different socioeconomic stratifications. To address this limit, cross-cultural studies are needed.

Finally, the main limitation of this research is the use of bivariate analyses. These limitations can be overcome using a multivariate analysis approach to better clarify and explain the relationships between more variables. For instance, it might be interesting to further explore the simultaneous influence on Digital Capital of a multiplicity of factors such as gender, income, education and age. However, we tested this model on the main axes of social inequalities that have been proved to be related to digital inequalities to gain a further indication of the validity of this construct.

Overall, this is the first attempt to operationalise and measure a new specific capital, and our main goal was to test the construct validity of a model to measure it that can be used and applied in other contexts. This might represent the basis for studies that aim to develop a more sophisticated and comprehensive analysis.

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