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The labour digital divide:
digital dimensions of labour market segmentation

Daniel Calderón-Gómez, Belén Casas-Mas, Mariano Urraco-Solanilla and Juan Carlos Revilla

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ABSTRACT

This paper investigates digitalisation in labour activities within the Spanish population, with the aim of examining its extent and characteristics in relation to the digital divide at work, focusing particularly on access to and use of the internet. It thus aims to analyse the digital dimension of job segregation in the Spanish labour market. Internet use is explored both as an indicator of the type of work carried out and, in aggregate terms, of the broader characteristics of the labour market. The authors argue that a new segmentation of the labour market might be emerging, based on the technological requirements of jobs. The article draws on data from a representative Spanish population survey on how employees access and use the internet at work. Univariate, bivariate and multivariate statistical analyses were performed to describe the correlation between digitalised labour practices and individual sociodemographic conditions. The results show that around a third of Spanish workers are not required to use the internet at work. This population falls into two categories: the 'analogical precariat', in poor socio-economic conditions; and 'traditional analogical labour', in better quality traditional jobs. Digital workers can be classified into three groups: the 'digital precariat' (with a poor economic situation); 'traditional digital labour' (mainly involved in productive digital tasks); and the 'innovative class' (carrying out productive and communicative

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digital tasks). The level of education is by far the most important determining variable, in relation both to general and advanced uses. Young people and women are prominent in less complex uses of the internet (the digital precariat), which are usually related to less qualified jobs. The article argues that this represents a more subtle gender discrimination in the digital sphere than in the analogue one, with women being overrepresented in the digital precariat and underrepresented in the innovative class, while also being overrepresented in traditional analogical labour.

KEY WORDS
digital divide, ICT, labour market, work digitalisation, digital inequality, post-Fordism

Introduction

Many studies of digitalisation are based on analysing the forms of access to and uses that people make of the internet, without differentiating between the social contexts in which this happens. This perspective may lead us to think of inequalities or digital gaps as due to lack of personal abilities or motivation. But what would these inequalities indicate when specifically analysed within the world of labour? As is known, work-related internet uses do not depend so much on individual desires or abilities as on the characteristics of the job and the organisation of work. For this reason, we hypothesise that internet uses at work indicate the type of work carried out and, in aggregate terms, the characteristics of the labour market. They can therefore indicate the digital dimension of job segregation in a given job market. Adopting this approach, this article presents findings from research data collected in a representative sample of the Spanish population in order to carry out an analysis related to the Spanish labour market. The survey focused on respondents' work activities mediated by ICT (Information and Communication Technologies). The article is structured as follows: first, the relation between digitalisation and the (Spanish) labour market is developed; second, the literature on the labour digital divide is revisited from this research perspective; third, the methodology and analysis are explained; fourth, the main results of the analysis are presented; and finally, we discuss these results and elaborate some conclusions.

Digitalisation and the labour market

Many of the terms used to characterise our contemporary society emphasise its informational, digital or technological aspects (Zubero, 1998; Casal, 2000; Volle, 2000; Pérez & Pulido, 2008), because of the importance of the digital transmission of information through the internet and the integration of digital technologies into daily life by any kind of technological device linked to the production and/or management of information, described as 'digitalisation' (Croon Fors, 2013).

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This digitalisation has spread to all social areas and plays a major role in the new informational productive model by allowing connectivity of the different nodes and productive centres, enabling the emergence of an economy based on the management of information flows (Castells, 2010). These new technologies may have decisively contributed to the configuration of a new economic scenario through their role in overcoming the space-time barriers that hampered trade in the past.

In the field of work, the number of productive processes dependent on the intermediation of a technological device connected to the internet continues to increase.

The new forms of work organisation (flexible production, networked companies and so on) benefit from technological change while contributing to their further development (Coriat, 1993; Castells, 2010). Likewise, they support a wide range of business practices – such as offshoring or different forms of outsourcing (Zubero, 1998; Carnoy, 2000; Miguélez, 2003; Castillo, 2005; Lichtenstein, 2006; Recio, 2007; Standing, 2014; Avent, 2016). In this way, the degree of connection among different tasks along the production chains increases, making versatility (flexible specialisation) an increasingly important requirement for workers (Sennett, 1998; Martín Criado, 1999; Carnoy, 2000; Agulló, 2001; Cohen, 2003; Santamaría, 2012). Furthermore, ICTs are regarded as 'general-purpose technologies'; that is to say, they may be applied across a whole range of processes and tasks of the productive system and are not limited to specific sectors or operations (Jimeno, 2008; Menéndez, 2008; Avent, 2016), as the number of tasks involving standard generic computer-related skills is growing rapidly (Huws, 2001). This makes the study of their extension in the labour market more pertinent.

Debates about the impacts of this information have a long history. For some, the changes introduced by the spread of information technology may lead to the 'end of labour' (Rifkin, 1995), or even to an economic growth without employment, or 'jobless growth' (Finkel, 1994; Luttwak, 2000; Hopenhayn, 2001; Miguélez & Prieto, 2009; Avent, 2016). For others, this new economic stage will lead to the creation of new jobs in the informational sector or in others that will absorb the surplus population made redundant by automation (Alonso, 1999; Bell, 1999; Carnoy, 2000). At the very least, the labour market is expected to be divided into two major groups – 'integrated workers', who are hyper-qualified and work in highly productive *information-rich* tasks; and 'excluded workers', who are displaced from regular employment, underpaid and alternate precarious work with recurring periods of unemployment (Hopenhayn, 2001; Michel, 2003; Díaz & Torrent, 2008; Menéndez, 2008). This segmentation – even occurring in the economy's informational sector (Zukerfeld, 2013) – is predicted to lead to an increasing social polarisation between a 'small elite' of 'symbolic analysts' (Rifkin, 1995) and the mass of abundant and precarious workers (Zubero, 1998; Carnoy, 2000; Díaz-Salazar, 2003; Gutiérrez, 2013; Avent, 2016).

This well-known thesis of the polarisation of the labour market takes on specific characteristics as the informational society progress. Huws (2001) observes that the tendency to routinise work processes outweighs the tendency for work to become more creative and varied. At present, jobs based on routine tasks are in danger of disappearing due to the automation of processes, although a polarisation remains between highly qualified workers, who are part of that creative or analyst class, and the

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workers, especially in the service sector, whose manual tasks are impossible to automate (Autor & Dorn, 2013; De la Rica & Gortazar, 2017).

In this way, transfers of jobs from the STEM (Science, Technology, Engineering and Mathematics) sector to non-STEM sectors are taking place – especially in personal services – in addition to a relative decline of the industrial sector, which has historically acted as a provider of many intermediate jobs that limit polarisation (Braña, 2019). This process is underway in most of the world's economies, albeit at different rates and to different degrees, with Spain at a less advanced stage than other Western countries (De la Rica & Gortazar, 2017). Digital skills play an important role in these polarisation processes. ICTs contribute to the decomposition and codification of work tasks (Huws, 2014; Braña, 2019), which enables their subsequent routinisation and eventual automation, while also making work processes more flexible (Valenduc & Vendramin, 2017).

The widespread implementation of ICTs is leading to a situation whereby even in manual jobs the mediation of some electronic device is necessary. Almost any job already needs some kind of generic knowledge or skill in the use of new technologies (Huws, 2014), which are also abundant in the population at present (López-Sintas, Souto & Van Hemmen, 2018). At the same time, other skills are needed. Although they may not be required in such significant numbers, these other skills are decisive for the development of many productive sectors. They include technical, creative, knowledge production and managerial skills that are highly valued by the market, and are therefore well recognised in terms of working conditions (Dueñas & Llorente, 2019). Communication skills occupy a paradoxically intermediate place since, although they are crucial for production in many sectors and under the new forms of work organisation, they are not always adequately recognised, as shown by the precarious employment of call-centre workers (Del Bono, 2005). Digital skills are thus becoming more and more important (Sparks, 2013; Van Laar et al., 2020). Therefore, digital knowledge and competences may be considered to be among the main factors structuring social stratification, factors which play an important role in determining the opportunities of individuals in the labour market (Ragnedda, 2017).

Most studies adopting this approach, however, tend to see the problem as a mere lack of certain digital skills necessary for the market, assuming that workers' skills are put into operation in any work activity. To test this assumption, it is interesting to assess the skills and uses that workers put into practice in a given work environment. Our study was designed to address this question, in the context of the Spanish labour market, with its peculiar characteristics that can produce more or less use of the skills available in the population as a result of their formal and informal training.

Viewed from this perspective, the Spanish labour market can be seen to have some characteristics that might lead to an underuse of the digital skills of the population. Alós (2018) points out that a significant proportion of the working population in Spain is underemployed (around 40%), so that many workers with higher education do not manage to access jobs that can make use of their knowledge. This phenomenon is also reflected in the fact that workers' digital skills are not deployed in the workplace.

This is clearly a consequence of the weaknesses of the Spanish labour market, and its difficulties in producing enough employment in terms of quantity and quality. Indeed, high unemployment is a permanent feature of the Spanish labour market, along

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with high rates of temporary, part-time and precarious employment (Recio, 2018). Furthermore, there is a strong concentration of work in manual sectors such as construction (although this has been quite affected by the crisis) and the hotel/restaurant (hospitality) sector, related to a booming tourism industry (Alós, 2018). Unsurprisingly, the digitalised tasks that are carried out in these manual jobs (López-Sintas, 2018) must be basic in most cases, such as the use of mobile applications to transmit relevant information for work or to communicate with others.

The inequalities in the Spanish labour market are significant. While there are many manual workers using only basic digital skills at work, there are other workers in jobs that require a more intensive use of digital skills, especially when they also require a higher level of technical skills, which is generally associated with higher employment quality in terms of working and contractual conditions (Alós, 2018). Furthermore, these better job positions tend to be occupied by men and not so much by women (Dueñas & Llorente, 2019), who are more present in positions that are more intensive in social or communication tasks. Despite the fact that the gender gap in Spain in the proportion of graduates in STEM areas persists (Fundación Telefónica, 2018), we believe that this situation is not so much a reflection of the lack of digital skills among women, but rather of processes of gender segregation in the labour market, as pointed out by Dueñas and Llorente (2019).

The labour digital divide

The rapid expansion of digital technologies has raised general concerns about the social inequalities linked to their access, giving rise, in the 1990s, to the concept of the 'digital divide', defined as the inequality of technological opportunities – in terms of divide – among those had access to the new information technologies and those who did not (Ghobadi & Ghobadi, 2015:331). By the end of the 20th century, digital inequality – first, among countries and communities, and then among people – had become a topic of major political and academic concern (Norris, 2000; Compaine, 2001; Castells, 2010). At the beginning of the 21st century, a difference was noted between citizens who were, or were not, connected to the internet (Morales Martín & Rodríguez Rodríguez, 2008) with those who did, or did not, have access to it referred to as 'haves' and 'have nots' (Selwyn, 2004; Morales Martín & Rodríguez Rodríguez, 2008; Van Deursen & Van Dijk, 2013; Haight, Quan-Haase & Corbett, 2014).

Currently, it is more usual to speak of multiple divides or gaps (Morales Martín & Rodríguez Rodríguez, 2008; Van Deursen & Van Dijk, 2015), related to differing social conditions. On the one hand, inequalities are linked to the material access to technology, which also considers the quality of internet access (Robinson 2009), the types of devices used (Van Deursen & Van Dijk, 2015), difficulties in staying connected over time (Gonzales 2016), and the space-time, sociocultural and economic barriers conditioning access to the technology (Robinson, 2012). On the other hand, interest has recently moved towards diversity in the uses of the internet and the digital skills required for such uses – leading to the concept of a 'second level of the digital divide' (Correa, 2016: 2) or 'second digital divide' (Castaño, 2008). In this regard, several authors have constructed typologies of internet users (Gire & Granjon, 2012; Dutton & Blank, 2015), connecting

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digital practices with particular forms of technological appropriation. One such distinction has been established between groups that make a more intensive and immersive use of the internet, and those that male a more practical use (Robinson, 2009; White & Le Cornu, 2011). Other authors specifically link the second level of the digital divide to the acquisition of new digital skills by users (DiMaggio & Hargittai, 2001; Hargittai, 2002; Van Deursen & Van Dijk, 2014a), which also relates to digital literacy processes acquired over the life course (Livingstone, 2008; Erstad, 2011).

A variety of integrated models of digital stratification have been developed from other perspectives with the purpose of relating the social position of individuals and their cultural and economic resources to the different dimensions of the digital divide (Robinson, 2012; Eynon & Geniets, 2016; Ragnedda, 2017). The most developed of these is the 'model of the four gaps' by Van Deursen and Van Dijk (2015), which, based on research in the studies of digital inequality in the 21st century, states that the most important dimensions of the digital divide are motivation, material access, digital skills and the type of use of the internet.

Finally, the most recent trend (Helsper, Van Deursen & Eynon, 2015; Ragnedda, 2017) focuses on the concept of the 'third digital divide' – the offline benefits or results individuals obtain from the use of digital technologies, especially the internet. In this approach, attention is drawn to the study of how the differential use individuals make of digital devices may serve to reproduce or even strengthen social inequalities, based on the argument that most members of initially privileged groups (economically, culturally and socially) will have greater possibilities to make a better use of ICT to improve their life opportunities.

The study of the digital practices of individuals has immensely diversified the concept of the digital divide, which can now be applied to a number of different social areas, since it makes it possible to relate people's social, cultural and economic conditions to their specific patterns of 'domestication' of digital technologies (Mariën & Prodnik, 2014: 41). Given the social importance of work, this is a field where it is particularly important to investigate the characteristics of the digital divide – especially since almost all studies carried out so far have taken a general perspective that does not allow detailed analysis of the digitalisation processes in any specific social field. Taking this sort of differentiated approach towards the digital divide in the context of work implies an adaptation of the meaning of the concept.

In recent decades, many studies have analysed the transformation of the labour market related to the introduction of digitalisation and the emergence of an information society (Kirchner, 2015; Fernández-De-Álava, Quesada-Pallarès & García-Carmona, 2017; Murdoch & Fichter, 2017). But very little research has been carried out on the digital divide in the workplace: most studies have focused on the digital skills and competencies needed to better adapt to the increasingly digitalised job market (Cooke & Greenwood, 2008; Van Deursen & Van Dijk, 2014b; Van Laar et al., 2020).

Several studies – including the most recent – consider access to the internet as an individual decision, although conditioned by social and cultural elements. That is to say, in the view of these scholars, it is the individual who, using his or her particular skills and motivation, decides whether or not to use the internet, how and for what purposes, leading to different personal outcomes. This does not take account of the way

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that the use of the internet at work for labour-related purposes depends on the way that work is organised in general and how jobs are defined in particular: workers who use the internet at work may not use it in their private lives, or vice versa. Likewise, even if the internet is used both inside and outside the workplace, the type of use might differ substantially. Even though the study of psychological and motivational determinants of digital skills is much more developed than that of its socio-economic and cultural determinants (Van Laar et al., 2020), digital literacy still appears as an individualised biographical process even if it is conditioned by the structured social spaces – including work position – in which subjects interact (Clayton & Macdonald, 2013).

In line with the thesis of the polarisation of the labour force (Antunes 1999; Alonso 2000); there is a trend in which, while there is an increasing demand for training for job-specific skills for highly qualified positions in so-called 'creative' jobs (for instance, in programming, systems engineering, media content creation, community managers), there is less demand for training for lower skilled jobs, requiring more general knowledge, but also involving the use of digital applications or programmes. The first type of knowledge is often provided through vocational or higher training, while the second type may be provided by means of official, unofficial or even informal training. The latter is much more commonly found and may be treated differently in the recruitment processes by which workers are selected.

In most cases, the literature about the labour digital divide refers to the digitalisation of work processes (Van Deursen & Van Dijk, 2012, 2014b; Kirchner, 2015; Murdoch & Fichter, 2017) and the particular digital skills needed in a flexible labour market (Cooke & Greenwood, 2008; Van Laar et al., 2020). Contrasting with this approach, in our research we wanted to provide an analysis of digital work activities and digitalisation at work as instances of the reproduction of social stratification processes. With this aim, the main objective of this paper is to characterise the digitalisation processes in the work activities of the Spanish population as they are related to the different labour digital divides. This aim can be expressed by means of three research questions (RQ) relating to:

RQ1. Penetration of digital technologies at work, in comparison to other activities of private life.

RQ2. Degree and intensity of use of ICT at work, delving into the profiles of those who do not use the internet at the workplace.

RQ3. Building a typology of internet use at work which connects the first-level (accessibility) and second-level (practices) digital divide.

Methodology

Our methodological approach is quantitative, based on a survey as the main tool. All charts and figures included in this article were created from the data collected in this survey, the fieldwork for which was carried out from 14 to 30 November 2016, through an online 15-minute survey. The respondents to the survey were a representative sample of Spanish internet users, stratified according to prior quotas (gender, age, habitat,[1] civil status). Overall, there were 2,800 participants

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Table 1: Age intervals of the sample

Age intervals	Total (%)	Base (N)
16–24	15	426
25–34	21	580
35–44	28	779
45–55	24	658
55–64	14	396
65–74	6	161
Total	100	3000

Source: Own elaboration. RDI survey: 'The uses of time related to virtualisation'.

(total number of questionnaires completed and validated) from throughout mainland Spain (sampling error 95% with a level of trust of 1.9%). Of the total number of internet users participating, 51% were men and 49% were women, both groups aged between 16 and 74. The age groups in the study were grouped as shown in Table 1.

An important concept in this study, reflected in the design of the survey, was that of the repercussions of virtualisation in the uses of time, with the aim of identifying those activities that have been transferred to the virtual space (interpersonal relationships, leisure, consumption, sport, culture). This article specifically addresses the impact of virtualisation in the working lives of the respondents.

A total of 53% of all respondents claimed to have performed activities related to paid jobs or their professional life (for instance, seeking work, work activities with managers or workmates) in the last seven days. Additionally, 34% of these people had used the internet to perform such activities, of whom 53% were men and 47% women.

An analysis was carried out to identify and understand the social uses of ICT in work activities (N=952), taking into account gender, age, education level, habitat and subjective economic situation.

In order to respond to the research questions, three main dimensions of analysis were considered: (D1) penetration of ICT at work, (D2) degree of use of ICT at work and (D3) typology of internet uses at work.

(D1) Penetration of ICT at work. This addressed RQ1, analysing the relation between the use of digital technologies at work and other social contexts in which digital technologies were incorporated. Both univariate and bivariate statistical analysis were used.

1 The 'habitat' variable used in this study refers to the number of inhabitants in the municipality where the respondent resides. It is, in other words, an indicator of urbanisation.

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(D2) Degree of use of ICT at work. This addressed RQ2, studying the intensity and frequency of use of digital technologies at the workplace as well as the main reasons for (non-)use of the internet. The statistical analysis techniques used here were univariate and bivariate analysis, as well as a hierarchical CHAID model.

(D3) Typology of internet use at work. This addressed RQ3, building a typology of forms of internet use at work in which forms of accessibility (first-level digital divide) and digitalised working activities (second-level digital divide) were considered. Here, a principal component analysis and a k-means cluster analysis were used.

The main statistical forms of analysis used were as follows:.

Univariate analysis: relative frequencies of the variables referred to daily activities in which the internet is used were calculated to compare the levels of digitalisation of work activities with those of study, housework and care-related tasks. Furthermore, the variable describing the internet activity to which more time was devoted was used to analyse the importance of work activities on the internet in relation to all daily digital practices. Lastly, two quantitative variables were built: the number of work activities related to the internet; and the number of technological devices used at work, which were used in the subsequent k-means analysis.

Bivariate analysis: cross tables were made on the variables relating to digitalised work activities on the basis of the abovementioned control variables. A Z-significance test was used for percentage differences to a trust level of 95.5% (excluding the subjective economic situation variable of the tables since the results did not provide significant differences). This analysis made it possible to analyse the level of digitalisation of work activities according to gender, age, level of education and habitat, which is a good indicator of the first level of the labour digital divide.

***Analysis of hierarchical CHAID*:** a CHAID classification tree was elaborated from the dependent variable of labour digitalisation and the control variables, with the goal of defining the most influential variables for predicting access to the internet (or its absence) within the labour environment. Although the results of the classification tree are shown in the results section, Table 2 shows the model's suitability from the correct classification percentages.

Principal Components Analysis: a Principal Component Factor Analysis was carried out with Varimax rotation from the variables of the types of labour uses of the internet, online services and technological devices used in the labour environment, with a result of 0.652 in the KMO test, a determinant of 0.392 and a significant result of Barlett's sphericity test of 99.73%. Table 3 shows the main punctuations of the variables associated with each one of the two components from the factorial model, which explain 40.44% of variance as follows:

- *F1. Mobile-phone-oriented use* (24.3% of variance). This component includes the activities and uses mainly linked to the mobile phone.
- *F2. Computer-oriented use* (16.1% of variance). This component includes the activities and uses mainly linked to the computer.

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Table 2: Summary of the CHAID statistical model

Observed	Predicted		
	0	1	Percentage correct (%)
0	1385	427	76.4
1	83	569	91.3
Overall percentage (%)	53.1	46.9	81.5

Dependent variable: use of the internet at work

Source: Own elaboration. RDI survey: 'The uses of time related to virtualisation'.

Table 3: Principal Components Analysis: Rotated matrix

Variables	F1. Mobile-phone-oriented use	F2. Computer-oriented use
Mobile phone or smartphone	0.77	–0.13
Messaging services (Whatsapp, Hangouts, etc.)	0.71	0.23
Social media (Facebook, Twitter, Linkedin, etc.)	0.50	–0.26
Videoconference apps (Skype or similar)	0.44	0.19
SMS	0.41	0.06
Carry out professional tasks	0.14	0.71
E-mail	0.10	0.66
Personal computer (desktop, laptop)	–0.15	0.58
Communication with colleagues for working purposes	0.46	0.47

Data: component punctuations

Source: Own elaboration. RDI survey: 'The uses of time related to virtualisation'.

K-means Cluster Analysis: A K-means Cluster Analysis was performed based on the two factors relating to type of use of the internet and the two number variables relating to activities and technological devices used at work. All the variables introduced were significant in the ANOVA table up to 99.73% (see Table 4). The following are the resulting groups:

- *C1. Communication and mobile use (16.4% of cases).*
- *C2. Productive and office use (42.9%).*
- *C3. Multiple functions and uses (40.7%).*

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Table 4: K-means analysis: Final cluster centers

Variables †	C1. Communication and mobile use	C2. Productive and office use	C3. Multiple functions and uses
F1. Mobile-phone-oriented use	–0.04	–0.86	0.93
F2. Computer-oriented use	–1.79	0.34	0.36
Number of digitalized working activities	0.36	0.23	1.50
Number of technological devices	0.75	0.28	1.37
Percentage (%) of cases in each cluster ‡	16.4	42.9	40.7

Data: † final cluster centers; ‡ % of cases in each cluster

Source: Own elaboration. RDI survey: 'The uses of time related to virtualisation'.

Results

The results of our analysis are presented according the three main dimensions of the research (penetration of ICTs, degree of use and typology of use), introducing statistical comparisons by the control variables considered (gender, age, education level, habitat and subjective economic situation).

D1. Penetration of ICT at work

Regarding the penetration of ICT in the work environment, shown in Table 5, our results show that 64.1% of workers perform some work activity linked to the internet. This proportion is lower than for internet use for study and training (79.3%), but much higher than that for daily activities, such as housework (14.9%) or care provision (6.9%). On the one hand, this shows that a relatively large number of jobs are structured around tasks and activities linked to the internet and digital technologies, implying that the acquisition of digital skills would be a basic training requirement for these individuals. On the other hand, even in those positions that are not necessarily linked to the internet, online communication is becoming an increasingly important basic mediator or facilitator of people's work activities – for instance, in the use of instant messaging applications or social networks to communicate with workmates to organise work, even in offline tasks.

While the penetration of digital technologies is greater in the case of study than in employment, when it comes to the time devoted to these activities, those related to employment are more important. Thus, in the case of workers, 47.5% report that their digital labour practice is the most important use of the internet in their lives, while in the case of students, just one-third confirm that the use of the internet for their studies

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Table 5: Labour digitalisation regarding studies and private life

Activities with internet connection	Carry out an activity †	Activity in which they spend more time †	Total †	% Carry out an activity ‡	% Activity in which they spend more time ‡
Employment, professional life	952	452	1486	64.1	47.5
Study and training	721	250	909	79.3	34.7
Housework	348	27	2340	14.9	7.8
Care provision	49	2	712	6.9	4.1

Data: † absolute frequencies; ‡ relative frequencies (%)

Source: Own elaboration. RDI survey: 'The uses of time related to virtualisation'.

is the digital activity to which they devote most time, with the range of digital practices outside the studies environment (e.g., linked to leisure) taking up more of their time.

Regarding sociodemographic characteristics (shown in Table 6), no significant differences were found relating to gender, age or size of habitat; internet use at work was only two points higher for men than women and slightly higher among people under 44 compared with older workers. However, in terms of educational level, we found wider differences, with three-quarters of workers with higher studies using the internet at work, while the proportion among workers with primary and secondary studies barely exceeded 50%.

D2. Degree of use of ICT at work

Regarding the intensity of internet use, it is more frequent among men that work is the internet activity to which they devote more time (51.6% as opposed to 42.8% of women). By age, the percentage of respondents who devote more time to the internet at work increases with the age of the worker, indicating that, in case of younger workers – between 16 and 34 specifically – there is a greater variety of practices linked to the internet outside work. By contrast the use of the internet at work is the most frequent digital activity, particularly for those between 55 and 64 years old. Regarding the educational level, the degree of internet use at work is especially low among workers with a primary-level education, although the low sample percentage makes this difference less significant. No significant differences were reported in relation to the variable related to the size of the habitat. Digitalisation in the field of work, according to these findings, is not distributed evenly across the population, with the level of education constituting the most significant sociodemographic variable.

Figure 1 shows a CHAID segmentation analysis developed from the labour digitalisation variable, which enables us to define a profile of users and non-users of the internet at work according to their sociodemographic characteristics. In the first level,

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Table 6: Labour digitalisation by sociodemographic variables

Labour activities with internet connection		Total †	% Carry out an activity ‡	% Activity in which they spend more time ‡	Sig. Carry out an activity §	Sig. Activity in which they spend more time §
Total		1486	64.1	47.5		
Gender	*Men (A)*	778	65.0	51.6		B
	Women (B)	708	63.0	42.8		A
Age	*16–24 (A)*	185	65.9	35.2		E
	25–34 (B)	336	65.5	40.0		E
	35–44 (C)	442	64.7	51.0		
	45–54 (D)	370	62.7	48.7		E
	55–64 (E)	143	61.5	67.0		ABD
Educational Level	*Primary Studies / No Studies (A)*	94	50.0	34.0	CD	
	Obligatory Secondary Studies (B)	491	53.4	45.4	CD	
	Post-obligatory Secondary Studies (C)	258	65.9	45.3	AB	
	Superior (D)	643	73.6	50.7	AB	
Size of Habitat	*<10,001 (A)*	154	55.8	48.8		
	10,001–50,000 (B)	247	64.4	43.4		
	50,001–100,000 (C)	155	59.4	48.9		
	100,001–400,000 (D)	471	62.4	46.3		
	400,001–1,000,000 (E)	176	67.0	43.2		
	>=1,000,001 (F)	283	71.7	53.7		

Data: † Absolut frequencies; ‡ relative frequencies (%); § variable categories in which there is a statistically significant difference (Z test: 95.5%)

Source: Own elaboration. RDI survey: 'The uses of time related to virtualisation'.

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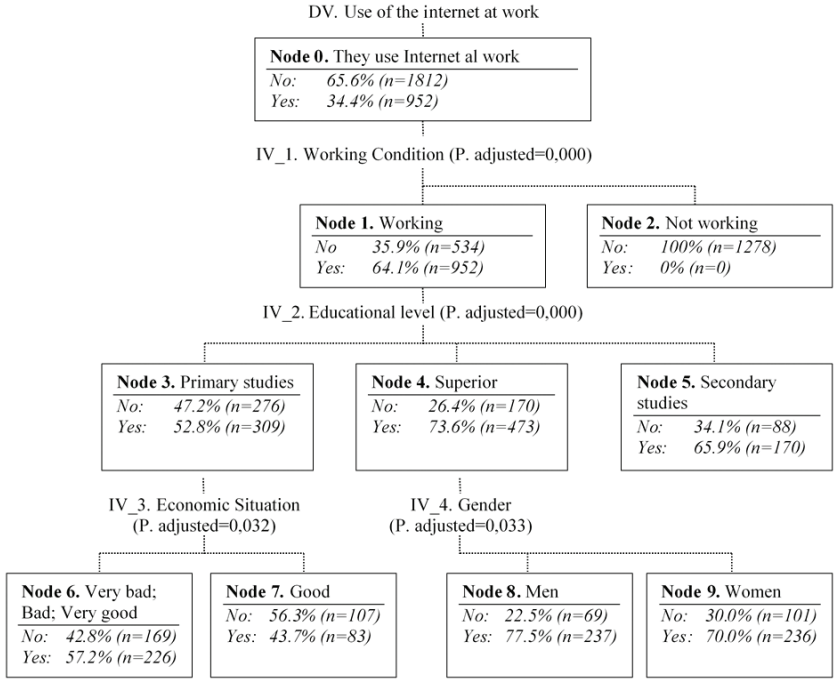

Figure 1: Cluster of (non-)users of the internet at work

Source: Own elaboration. RDI survey: 'The uses of time related to virtualisation'.

the sample is divided between those who have performed some work activity (64.1%) and those who have not – which is a precondition for considering the sociodemographic variables. In the second level, in line with what was stated above, the most relevant variable is the educational level, which divides respondents into three groups: first, those with secondary or primary studies, among whom only 52.8% claim to perform any work activity linked to the internet; second, those with post-compulsory secondary studies, among whom the penetration of the internet at work rises to 65.9%; and third, those with higher studies, among whom 73.6% engage with digitalisation at work.

In the third level, workers with secondary and primary studies are further divided according to their economic situation. Here, workers with a good situation show lower levels of exposure to digitalisation at work. This may be due to the fact that many of these workers with a favourable economic situation occupy stable jobs that have not experienced the digitalisation process – most probably, permanent positions likely to disappear as these workers reach retirement. Lastly, our results show a certain digital divide in terms of gender among workers with higher educational levels. Among those holding a university degree, 77.5% of men compared with 70.0% of women use the internet at work, demonstrating that differences by gender are present among workers with higher studies. In our research the differences are due – as we will see – to the type of internet use that individuals make at work, which prompts us to consider the second level of the digital divide.

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D3. Typology of internet use at work

To analyse the type of internet use, a k-means clusters analysis was carried out on the main uses of the internet at work and the devices used in the work environment to connect to it. As stated earlier, to carry out this analysis two factors of the type of use of the internet drawn from the main components analysis were used, as well as two standardised variables on the number of work activities related to the internet and the number of technological devices used at work. From these four variables, three main clusters were drawn, which summarise the type of use workers make of the internet at work.

> ***C1. Communication and mobile use*** (16.4% of respondents). This group includes workers who use the internet in activities specifically linked to mobile devices and tasks requiring mobility. Communicative activities scored higher than productive activities.
>
> ***C2. Productive and office use*** (42.9%). This group includes workers who use the internet almost exclusively on the PC at work – consequently, this group is the one using the least number of devices. Productive practices are emphasised over communicative activities.
>
> ***C3. Multiple functions and uses*** (40.7%). This group includes workers that use both mobile and fixed devices. On average, this group is the one that uses most devices. Likewise, they make a more varied use of the internet at work compared to the other two groups, as they score positively both in communicative and productive activities.

Table 7 presents a comparison of these three clusters according to the sociodemographic and socio-economic characteristics of the individuals present in each group. Starting with gender, there is a greater relative presence of women in group C1 (people who make a work use of the internet linked to the mobile phone and to communicative activities). By contrast, men have a greater presence in group C2 (PC-oriented productive activities). In group C3 (those who make multiple use of the internet) the inequality between men and women is even greater, with men constituting 65% of workers in this cluster. This demonstrates that, while gender differences in the first level of the digital divide at work are barely significant, inequalities are evident in the second level of the digital divide, with men more likely to be making a productive use of the internet at work and using a greater range of devices, while women are more likely to be using mobile devices and making communicative uses of digital technologies. This specific conclusion on gender differences in the work environment is entirely consistent with the results of other research on the gender digital divide in Spain and Europe (Castaño, Martín & Martínez, 2011).

Turning to age, our data show that the presence of people under 34 is significantly greater in group C1 than the other groups, which may be related to a labour market in which young people are more likely to work in precarious and low-skilled positions, where the use of the internet is related to the management and communication of workers rather than to a more productive or advanced use. In line with this, the group of workers over 55 is more present in group C2, whose use of the internet is limited to productive tasks carried out from the PC, while the groups aged 34–55 are more

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Table 7: Typology of internet use clusters by sociodemographic variables

Sociodemographic Variables		C1. Communication and mobile use	C2. Productive and office use	C3. Multiple functions and uses
Gender	*Men (A)*	45.1	54.2	65.0
	Women (B)	54.9	45.8	35.0
Age	*16–34*	41.5	27.1	27.1
	35–54	51.2	54.2	63.1
	55–64	7.3	18.7	9.9
Educational Level	*Primary Studies/ No Studies*	15.9	6.1	1.0
	Compulsory Secondary Studies	39.0	26.6	22.2
	Post-Compulsory Secondary Studies	12.2	19.6	15.8
	Higher	32.9	47.7	61.1
Size of Habitat	*<10,001*	4.9	5.4	4.2
	10,001–50,000	14.6	15.0	16.7
	50,001–100,000	15.9	9.8	7.9
	100,001–400,000	35.4	26.2	32.5
	400,001–1,000,000	9.8	12.6	10.3
	>=1,000,001	14.6	25.7	24.1
Economic Situation	*Very Good & Good*	23.2	40.7	58.1
	Regular	47.6	45.3	36.0
	Very Bad & Bad	29.3	14.0	5.9

Data: column percentages (%)

Source: Own elaboration. RDI survey: 'The uses of time related to virtualisation'.

predominant in cluster C3, which is more linked to multiple use and shows greater diversification of ICT.

An analysis by educational level shows a direct relationship between the level of qualification and the type of labour use of the internet, with mobile communicative uses (C1) most likely to be performed by low-skilled people, while individuals with

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post-compulsory studies are more prominent in productive uses linked to the PC (C2) and workers with higher studies in multiple uses (C3). This demonstrates that educational level is a very important variable in the second level of the digital divide, as we also saw in relation to access to the internet at work more generally.

When we look at the size of the habitat, differences are not so clear, though workers residing in municipalities with more than one million inhabitants were more likely to be involved in the productive and multiple uses of the internet. Lastly, bearing in mind the economic situation of people – a variable barely relevant when access to the internet at work was examined at a more general level – a greater proportion of people defining their situation as regular, bad or very bad were found among workers who made a more communicative and mobile use of the net (C1), while in the other two groups – especially among workers in C3 (who make a more diversified use of the internet at work) – the percentage of people stating that their economic situation was good or very good was much higher (at 58.1%). This demonstrates that the digital divide at work is also closely linked to people's economic condition. This is unsurprising given that it is mainly related to the type of work the individuals perform – more precarious in the case of workers in C1, and better skilled and paid in the case of C2 and, especially, C3.

Discussion and conclusions

In a socioeconomic context marked by the symbiotic dynamics established between the development of new technologies and the implementation of new forms of work organisation and management, the concept of digitalisation becomes increasingly interesting as a structuring phenomenon of the labour market. The rapid spread of ICTs, which constitutes the defining main feature of our contemporary society, facilitates the breakdown of previously fixed boundaries and the creation of a new scenario for the organisation of productive processes in which 'digitalisation has become the new social standard' (Mariën & Prodnik, 2014:37). Workers in this globalised world must adapt to the new working contexts arising from technological transformations. From this point of view, the job skills required from workers must be increasingly related to the efficient management of all kinds of ICT devices (Sparks, 2013:29), with the corollary that these skills need to be kept permanently updated, just as the technological means are updated. The chances of achieving this adjustment to meet the demands of the changing labour market must be related to the starting position of individuals, which requires revisiting the debates on the 'digital divide' concept. This enables us to analyse not only the implementation of the internet as an omnipresent tool within the work field, but also – and mainly– the inequalities in the uses workers make of such a tool.

In this sense, our analysis of labour digitalisation shows some similar and distinctive results with respect to the empirical research developed on the digital divide more generally. We agree that access to the internet is not equally distributed among the population. Furthermore, we have established that the level of education is the most significant variable for explaining differences in the access to and type of use of the internet, as shown by the findings of recent studies both in Spain (Calderón Gómez, 2019) and other developed countries (Haight, Quan-Haase & Corbett, 2014; Mariën &

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Prodnik 2014; Dutton & Blank 2015). In fact, according to Van Deursen and Van Dijk (2015:382), 'the educational level is probably the most critical factor in the research on the digital divide'.

In our case, it has been shown that age and gender are also significant variables for explaining the the use of the internet inside and outside work, since men and older people are the groups showing the greatest use (in number of hours) that is specifically linked to work. The creation of internet user typologies has been a recurrent strategy in studies on the digital divide (Gire and Granjon, 2012; Robinson, 2012; Dutton and Blank, 2015). Our project has added to this by relating the type of device used by individuals at work to the working activities that are digitally mediated by such devices. This approach is uncommon in quantitative studies, which usually focus on such aspects as individual dimensions or indicators of the digital divide, as shown in Van Deursen and Van Dijk's (2015) four-gap model. Our research demonstrates that men – specifically middle-aged men – make a wider use of digitalised technologies at work, both in the range of devices and in the types of use. This may represent an informational advantage (Robinson, 2012) with respect to the rest of the workforce, who experience more limited conditions to access and use. In particular, older men are more linked to a PC-based use of these technologies, but many of these are in the types of jobs facing extinction. In the meanwhile, younger men, women and workers with the lowest educational levels are in jobs entailing a mobile-oriented use, representing a use of new technologies in low-skilled positions. Indeed, Pearce and Rice (2013:73) go so far as to say that users who access the internet exclusively via their mobile phones may be 'strengthening their lower social status and increasing their divide in use and knowledge as opposed to PC users'.

Thus, our analysis confirms the existence of a gender gap, but specifies where it can be found and points to some of the reasons for this. The gender gap is not to be found in the access to the internet at work, but in the intensity of its use. Furthermore, women are most strongly represented in group (C1) where only the more general-purpose digital skills are necessary. This is occurring in spite of the strong influence of workers' educational levels on the labour market. As Castellano, Rocca & Read (2019:1) confirm, 'the gender gap endures even in countries where women have surpassed men in education'. In our view this is a confirmation of a, now more subtle, pattern of discrimination against women in the labour market, as their worse job situation is not due to their lack of digital skills, but to the characteristics of the jobs they are hired to perform. Furthermore, this is also a confirmation that hopes that the digitalisation process may contribute to the reduction of gender gaps on the labour market, by lowering cultural barriers and providing equal opportunities between men and women (Kergroach, 2017), are failing to materialise, as other recent research on the third digital divide confirms (Ragnedda, 2017).

In relation to the Spanish labour market, these analyses give us an interesting overview that points to a more complex picture than the polarisation thesis suggests. Around 36% of Spanish workers do not use the internet at work at all. It is difficult to say whether this percentage is higher or lower in other countries, due to the novelty of our methodological approach. Based on our results, we believe that this part of the labour market can be divided into at least two groups: the 'analogical precariat'

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(around 10–11%) and the 'traditional analogical labour' (around 24–5%). This distinction is made on the basis of the very low ratings that most analogical workers with a low skill level give to their economic situation, leading us to categorise them as precarious. The remainder of the analogical workers either have a better economic situation and/or a higher educational level which excludes them from this 'analogical precariat', placing them in a different category which we have called 'traditional analogical labour'.

The 64% of workers who, as already noted, are working with digital tools at work, are split into three groups, according to the cluster analysis. The C1 group (around 10% of the total workforce) could represent an emerging digital precariat, as they also tend to report not being in a good economic position and lower educational levels, and have jobs that are especially linked to uses involving mobility and digital communication. Young people and women are overrepresented in this group. The C2 group (around 27%) can be regarded as 'traditional digital labour', since its members, as well as being older, perform mainly technical or productive tasks on the internet, which means their work organisation is more traditional and less subject to new organisational trends, such as team work or client-orientation. Finally, the C3 group (around 26%) could be called the 'innovative class'. In contrast with the previous group, this incorporates both digital communications tasks and productive ones, indicative of the presence of these new trends in work organisation.

The picture thus revealed is considerably more complex than the simple binary division suggested by the polarisation thesis. Since our data are not longitudinal, it is hard to say whether our conclusions contradict the assumption of polarisation or simply render it more complex. We do, however, propose that our analysis provides a more nuanced framework to put it to the test.

In short, these results should help us to make the notion of 'digital divides' more multifaceted (Villanueva-Mansilla, Nakano & Evaristo, 2015), and problematise any kind of uniform categorisation of the impact of digitalisation on working activities on the basis of division, hierarchy and stratification vectors of all kinds. Differences in the level of digitalisation of different positions and tasks reflect social inequalities based on the differences of access and use of the internet inside and outside work, as well as differences regarding the possibilities to acquire the necessary skills to achieve higher working status in the information society. Several issues remain unresolved to be addressed in future research on the third digital divide (Ragnedda, 2017). These include the specific social benefits individuals get from their working digital practices, which will require a qualitative approach that looks deeply into the biographical processes by which individuals integrate ICTs into their daily lives, as developed by Robinson (2012) or Eynon and Geniets (2016). Likewise, there is a need for further qualitative investigation of the access conditions and the forms of use of the internet at work that have been operationalised in this article, making it possible to study the individuals' motivations and digital skills – the other two main dimensions of the digital divide according to the integral model created by Van Deursen and Van Dijk (2015).

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AUTHORS' CONTRIBUTIONS

Daniel Calderon (Results of the study); Belén Casas-Mas (Methodology); Mariano Urraco (State of the Art); Juan Carlos Revilla (Discussion).

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