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Different paths and same destinations? An analysis of the convergence in Internet usage patterns between different age groups

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Abstract

The present article delves into the understanding of the digital gap that divides the younger age groups from those who are older, specifically the young (17-30), adults (31-45), mature adults (46-60), and older adults (61-75). The analysis carried out in three capital cities of Latin America (Buenos Aires, Lima, and Guatemala City) finds that there is a pattern of convergence in the trajectory of Internet appropriation of users belonging to different age groups. However, the gap between the younger groups and the older group does not close completely, even after several years of experience using the Internet. Likewise, it is observed that the adoption of more sophisticated activities on the Internet is conditioned by characteristics specific to each age group.

KEYWORDS

digital convergence, generational digital inequality, internet appropriation, Latin America

JEL CLASSIFICATION

O31; O32; O33; D63

1 | INTRODUCTION

Today the Internet generates benefits that allow people to carry out diverse activities that would be impossible without it, thus, improving their well-being (Castells, 2010; Kleine, 2013; Smith & Reilly, 2014). However, the intensity of taking advantage of the Internet varies widely among individuals (Mendonça, Crespo, & Simões, 2015; Robinson et al., 2015) and some groups even facing barriers (Barrantes & Vargas, 2016; Robinson et al., 2015). Among these, older adults are usually relegated in digital spaces, and many times, these barriers are reinforced by prejudices rendering this group as technophobes (Neves & Amaro, 2012).

Nevertheless, several studies have shown that older adults adopt technologies and improve their perceptions regarding the involved risks and benefits of using the Internet (Barrantes & Cozzubo, 2015; Neves & Amaro, 2012; Vilte, Saldaño, & Martín, 2013; White, et al., 2002; Zickuhr & Madden, 2012). Research has focused on developed countries or on identifying the access gap, also called the first level digital divide, and much less on the appropriation processes that happen once this first gap has been solved for, or about Latin American countries, despite studies by Barrantes and Cozzubo (2015), Vilte et al. (2013), or Caballero de Luis (2016).

1.1 | Research objectives

One of the main pending challenges in the research agenda of Internet appropriation is to better understand younger and older generations' appropriation processes and the gaps that remain. Our aim is to analyze, once the access barriers have been overcome, whether there is a

convergence pattern between the Internet appropriation processes of younger and older users in three Latin American metropolitan cities and how appropriation patterns differ among those groups.

Given the growing Internet penetration in Latin America—according to the International Telecommunication Union (ITU), in 2015, 62.2% of individuals used the Internet; in 2018, 69.6% did use the Internet—it is relevant to analyze whether, once access to the network is guaranteed, a convergence process in Internet usage patterns between users of different ages does in fact occur. If a convergence process does exist, it should be expected that digital inclusion policies for the elders will be effective. If, however, the gap maintains or deepens as time goes by, interventions focused on achieving the realization of a minimal set of activities would be a more effective digital inclusion strategy. This set could be defined as basic in as much as are activities already performed by younger cohorts.

The plan of the text is as follows: in the following section, the literature about ICT appropriation and inequality, emphasizing younger and older users, is discussed. In the second section, we conduct an empirical analysis of the patterns of activities carried out on the Internet according to age groups and the convergence of these patterns as the user's experience increases in three metropolitan cities of Latin America. The paper closes with conclusions.

2 | UNDERSTANDING GENERATIONAL DIFFERENCES IN INTERNET APPROPRIATION

It has been almost 3 decades since ICT started bursting into social, political, and economical structures, renewing and transforming the way we live our lives and relate with each other (Castells, 2010; Smith & Reilly, 2014). All these changes have created a set of opportunities that have allowed users to expand their liberty to choose a way of living that they consider valuable (Barrantes & Vargas, 2016; Kleine, 2013; Sen, 2001; Smith & Reilly, 2014). This is possible either because of the increasing improvements in production and consumption technologies (Castells, 2010) or because of digital environment participation that allows users to belong and take advantage of new and larger communities (Strahilevitz & Benkler, 2007). Social groups take advantage of this in different manners and extents.

2.1 | The digital gap: Beyond access

Different views of the so-called digital gap have been incorporated into the debate throughout the years, transcending the binary view of internet access vs no access. The literature points out three levels, or gaps, that limit a meaningful usage of the Internet: (a) access to devices and the physical connection itself, described in the literature as the first-order digital gap; (b) the set of skills necessary to use technological devices, related to cultural and educational capital and the appropriation capacity of digital spaces, described as the second-order gaps; (c) the set of skills that allows users to build relationships with other users within digital environments and to carry out activities that increase each user's *stock* of assets, thus making it possible for them to fully develop in those spaces (Camacho, 2006; Mendonça et al., 2015).

In other words, differences in Internet usage go beyond the mere use of the Internet and can be explained by the difficulty to overcome certain barriers (Barrantes & Vargas, 2016; Mendonça et al., 2015). As Mendonça et al. (2015) mention, making meaningful use of the Internet does not consist of only taking the individual to the door (access) or making sure he or she can open it (usage skills), but it also implies that this person can cross the door, relate, and fully develop in the environment that is behind the door (capacities).

2.2 | The generational gap

Digital gaps create inequality in the access to opportunities no matter which groups are involved. However, the nature of the gap and the characteristics of the social groups involved shape the appropriation and divergence processes, thus requiring a context specific analysis. This is the case of the digital gap between younger generations and older adults.

A key element that substantially influences Internet use and appropriation level is age. While Prensky (2001) argues that there is a digital gap generated by the existence of "digital natives" and "digital immigrants," distinguished by whether they were born before or after ICT irruption; Tapscott (1998) suggests that the "digital native" condition is not determined solely by age but by the exposure and experience of users using ICT. In both scenarios, the existence of this gap correlates with the users' age and could mean disadvantages and exclusion for the elderly. Moreover, Prensky's view has been challenged by different studies because of its simplification of the relation between age and ICT appropriation (Helsper and Eynon (2010), R. González, Ramírez, and Viadel (2015), Jones, Shao, and Keynes (2011).

The challenge notwithstanding, the evidence illustrates a divide, as shown in Figure 1. With Cepal (2016) data, in the year 2010, there was a substantial gap between the percentage of 60+ adults that used the Internet and the percentage of users in younger groups. The percentage of Internet users in some groups increases over the following 4 years. However, the distance between the group of 60+ adults that used the Internet and the younger groups seems to stay constant.

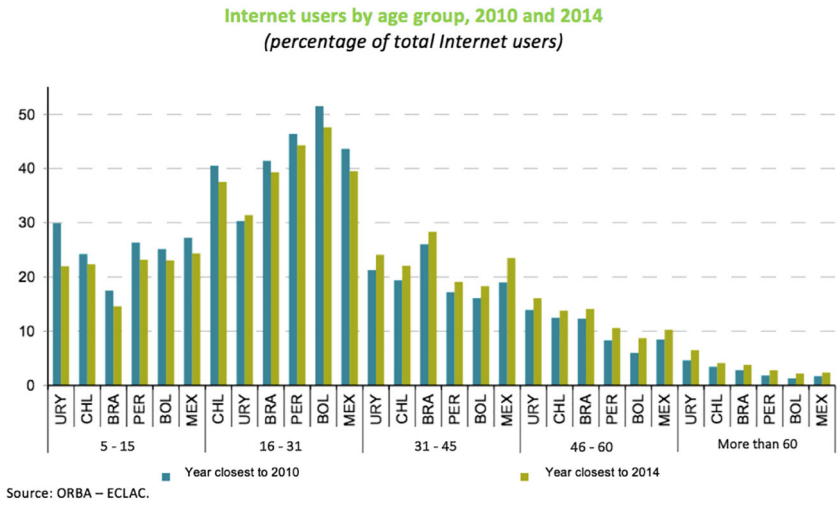

FIGURE 1 Percentage of people using Internet in Latin American countries, per age group
Source: Cepal (2016)

Several studies have analyzed and identified the existence of a generational digital gap at one point in time; both in developed countries (Colombo, Aroldi, & Carlo, 2015; Neves & Amaro, 2012) and in Latin America (Castellón & Jaramillo, 2002). For example, Barrantes and Vargas (2016) found significant gaps in the appropriation level between older adults and younger users in urban areas of Buenos Aires, Lima, and Guatemala City.

2.2.1 | Factors that explain the generational digital gap

The differences found in the access and appropriation levels between different age groups are explained by both users' personal and contextual characteristics. In their literature review, Blaschke, Freddolino, and Mullen (2009) propose that the appropriation process of older adults is mainly affected by these five factors:

1. Age related issues: such as people's impaired cognitive and motor ability. However, different studies show that these may be overcome with constant training (Au et al., 2015).
2. Characteristics of the available technologies: difficulties that may arise from the design of the devices (keyboard and small screens) or of the platforms (sophisticated language or unintuitive functions) that limit their use by older adults.
3. Attitudes toward ICT: prejudices or beliefs about the potential Internet dangers or the perception that the expected benefits from appropriation are minimal.
4. Factors related to training and support: limitations known as second-order barriers or lack of digital abilities (Camacho, 2006); lack of friendly learning spaces, especially considering the existence of stereotypes regarding the limited capacities of older adults (Neves & Amaro, 2012).
5. Service cost that plays an important deterrent role, both because of high costs in Latin America and of limited income perceived by older adults.

When exacerbated, these issues may turn into barriers for older adults, while younger users do not face them. However, given that the Internet has surpassed most of daily life's spheres, replicating and mounting on existing structures (Robinson et al., 2015), the use of the Internet is also strongly linked to the appropriation trajectories and the meanings that individuals themselves give to it. These, in turn, differ substantially between age groups and could explain a potential convergence in usage patterns between users of different age groups. It is for this reason that a deeper understanding of each age group's appropriation process is key for designing interventions and policies that effectively focus on the inclusion of older populations.

2.2.2 | Internet appropriation trajectories

The Internet appropriation process is driven by the traits of the user's contexts. These include user's age group and socioeconomic level (Barrantes & Benítez, 2016; Barrantes, Ugarte, & Vargas, 2016; Goldfarb & Prince, 2008), and the meaning they give to the Internet (Muñiz, 2011). Thus, the way in which a school student starts to relate to the Internet can be completely different than the way an older retired adult interacts with the Internet. Likewise, users who give more sophisticated usages to the Internet are usually the ones that have been more exposed to ICTs (Fernández-Ardèvol, 2013).

The literature shows a difference in the appropriation process for younger and adult users. Younger users initiate contact with the Internet from a very young age, mainly during middle and high school years especially for doing schoolwork (Barrantes & Benítez, 2016; Barrantes

et al., 2016). Also, social networks play a substantially important role in the socialization process (Gross, 2004). Adult users begin their appropriation process as job requirements, older adults even starting after being 50 years old. Older adults may even face physical limitations, such as sight and coordination problems, that limit their use of devices. Thus, stereotypes regarding older adults' cognitive capacity are reinforced (Czaja & Lee, 2007). For this reason, family and informal learning spaces play a critical role in older adults' decision to use the Internet, especially with small children, since they can play the role of "warm experts" (Bakardjieva, 2005; Barrantes & Benítez, 2016; Barrantes & Cozzubo, 2015; Comunello, Belotti, Mulargia, & Fernández-Ardèvol, 2014; Eynon & Helsper, 2010).

In summary, appropriation trajectories vary not only according to the user's age but also according to their main occupation and the family context. Evidence in the United States shows that the access gap has kept constant for a decade (Zickuhr & Madden, 2012). However, other studies show that older adults manage to become mature users once they have crossed the access barrier (Colombo et al., 2015; White et al., 2002).

3 | CONVERGENCE IN INTERNET USAGE PATTERNS

This section analyzes the evolution of the Internet usage patterns among different users and the different appropriation trajectories between different age groups. The aim is to identify if there is, as Colombo et al. (2015) point out, some sort of convergence in the usage patterns between younger and older generations.

3.1 | Data

This study uses the "Internet Usage Survey: Platforms and Free Access Data – 2014," collected by the Regional Dialogue of the Society of Information (DIRSI). The data set is particularly useful because it has individual level information regarding access to technological devices and Internet usage in 2014 in three major cities: Buenos Aires, capital of a high income country with an Internet penetration of 64.7%, at the country level; Lima, capital of a middle income country with an Internet penetration of 39.5% at the household level in urban areas; and Guatemala City, capital of a low income country with an Internet penetration of 23.4% at the country level (Telecommunication Services Residential Survey-ERESTEL- for Peru; ITU 2016 for Buenos Aires and Guatemala City). Having information from metropolitan cities in three different stages of economic development (high income, middle income, and low-income countries) allows us to have a better understanding of ICT appropriation in the Latin American setting (Barrantes, Aguero, & Vargas, 2015a, 2015b, 2015c).

3.1.1 | Age group definition

The analysis is carried out from a subsample of (a) individuals who access the internet through a PC, notebook, Tablet, or XO computer (sub-portable computers for educational purposes) and (b) whose age is between 17 and 75 years, leaving out younger school children. Inspired by Martin Ruiz (2005), age groups are defined along two dimensions: possible participation in the labor force and the combination of biological and physical characteristics. So we group "young" people who are between 17 and 30; "adults" who are between 31 and 45; "mature adults" who are between 46 and 60; and lastly, "older adults" who are between 61 and 75.

We also define five occupation categories: (a) people dedicated to household care, retired, and disabled or physically challenged are classified as inactive, (b) students, (c) working people who declared to be employed or be employers are classified as stable income workers, (d) working people who declared to be independent workers, commission workers, household workers, or farmers are classified as unstable income workers, and (e) people who declared not to work nor studying are classified as unemployed.

Table 1 shows the combination of age group and occupational category.

TABLE 1 Main occupation and attendance to educational centers according to age group

	Distribution of the Sample according to the Main Occupation						Percentage Enrolled in An Educational Center
Age Group	Inactive, %	Students, %	Regular employment, %	Irregular employment, %	Unemployed, %	Total, %	
Young (17-25)	18.2	27.0	39.4	13.2	2.3	100	50
Adults (26-40)	21.6	0.5	50.6	26.6	0.6	100	12
Mature adults (41, 65)	22.4	0.2	41.7	35.1	0.5	100	7
Older adults (66, 75)	47.0	0.0	21.4	31.6	0.0	100	4

Note. Source: Internet Usage Survey: Platforms and Free Access Data – 2014.

3.1.2 | Sample selection

As shown in Table 2, the chosen sample consists of 2099 observations, 33% less than the total sample. Most of the sample's reduction occurs in older age groups, leaving out almost 65% of older adults, 41% of mature adults, 31% of adults, and 18% of the young. This reveals that access (to devices and to the Internet) tends to diminish as older people are sampled (Barrantes & Cozzubo, 2015; Barrantes & Vargas, 2016). Lastly, the individuals in the sample are distributed among three capital cities of Latin America in the following way: 32% are from Buenos Aires, 40% from Lima, and 28% in Guatemala City.

Descriptive statistics for the indicators by city are shown here. First, age distribution in the three cities differs. Unlike Lima and Buenos Aires, in Guatemala City, almost half of the sample is in the young group (17-30 years).

It is found that the percentage of users that carry out each activity is usually larger in Guatemala City, as shown in Figure 2. This trait can be explained by the larger presence of the young population in this city's sample. Buenos Aires stands out as the city where users engage more with government entities.

The analysis considers differences in Internet usage patterns among the different age groups, taking into account the number of years of experience using the Internet, as shown in Table 3.

3.1.3 | Empirical definition of Internet appropriation

The Internet appropriation paths will be studied through the change in the number of activities that each individual performs on the Internet, according to their digital experience or their time using the Internet. While there are many activities that can be studied, the available data only allow us to analyze the realization of the following 13 activities, which could be grouped into five categories, as Table 4 shows.

3.2 | Descriptive analysis of the digital gap once access is achieved

Firstly, we analyze which are the most important activities within each age group. Figure 3 shows that the younger age groups take the lead in almost all the activities, except for the use of social networks for professional or work purposes and the use of online bank operations and the completion of online procedures for government interaction, as expected. Activities that could be considered basic, inasmuch as they either

TABLE 2 Sample selected for the analysis of convergence

	Young (17-30)	Adults (31,-45)	Mature Adults (46, 60)	Older Adults (61-75)	Total
Number of observations	1193	906	702	350	3151
Sample size	942	616	424	117	2099
Percentage belongs to the sample	79%	68%	60%	33%	67%
Average number of activities carried out in the Internet*	6.98	5.37	4.18	1.89	5.33

Note. Source: Survey on Internet Use: Platforms and Free Access Data – 2014.

*Significant at 1% between groups.

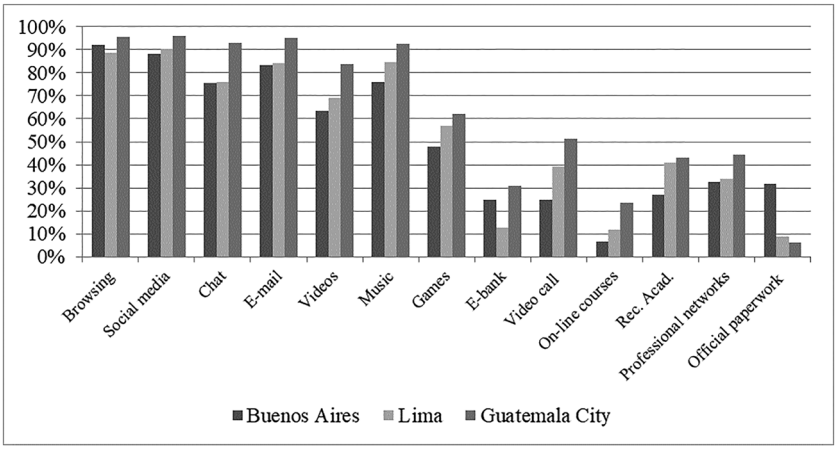

FIGURE 2 Average number of activities on Internet, per age group and city
Source: Internet Usage Survey: Platforms and Free Access Data – 2014

TABLE 3 Number of observations according to experience and age groups

Age Group/Experience	Up to 1 y	1 to 2 y	2 to 3 y	3 to 4 y	4 to 5 y	5 to 6 y	6 to 7 y	7 to 8 y	8 to 10 y	Over 10 y	Total
Young (17-30)	74	91	94	98	151	96	66	59	155	58	942
Adults (31-45)	73	61	67	48	81	43	33	36	98	76	616
Mature adults (46-60)	31	55	42	37	63	22	17	25	66	66	424
Older adults (61-75)	9	9	16	13	19	6	2	8	14	21	117
Total	187	216	219	196	314	167	118	128	333	221	2099

Note. Source: Internet Usage Survey: Platforms and Free Access Data – 2014.

TABLE 4 List of activities carried out on Internet considered in the analysis

Type of Activity	Activity	Description
Information	Browsing	Using search engines and browsing the net.
Social network	Social networks	Using social network like Facebook, Twitter, Instagram, and so on.
Communication	Chat	Communicating via instant messaging.
	E-mail	Communicating via email.
	Video call	Communicating via video calls (eg, Skype).
Entertainment	Music	Downloading and listening to music.
	Videos	Downloading and watching videos (eg, YouTube).
	Online games	Playing on line.
Asset expansion	Academic resources	Looking at digital libraries and using free access databases.
	On-line courses	On-line courses (free or paid).
	Professional networks	Looking at job centers, putting CV on line, having a profile on a professional social network (eg, LinkedIn) and taking part in Facebook groups related to work or job search.
	E-bank	Bank transactions over Internet.
	Official paperwork	Paperwork, queries, payments, complaints and making appointments at government offices.

Note. Source: Survey on Internet Use: Platforms and Free Access Data – 2014.

require a somewhat passive attitude by the user (as browsing the Internet) or communicate with means similar to an SMS (chat) or e-mail that is totally imported from an non-Internet world, are the most frequent activities for all age groups. The most important differences between age groups are found in activities such as the use of chats, access to music, videos, games, and academic resources, in favor of the younger group.

Figure 4 shows the average number of activities on the Internet for beginner and mature users, per age group, showing differences in favor of the younger groups. When observing only those with at most 1 year of experience, the size of the gap is greater than the one observed in the whole sample. This trait relates, amongst other things, to the previously mentioned five factors that Blaschke et al. (2009) propose. However,

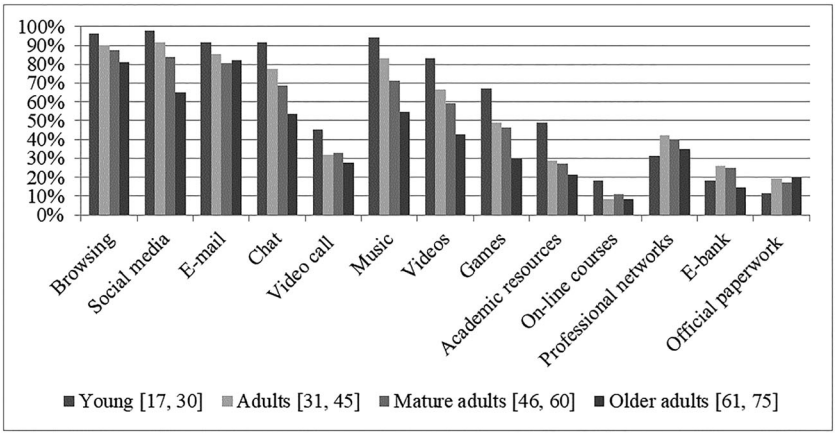

FIGURE 3 Percentage of people who carry out activities on Internet, according to age group
Source: Internet Usage Survey: Platforms and Free Access Data – 2014

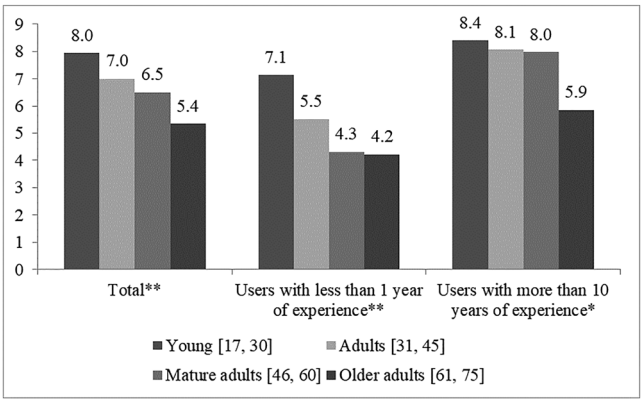

FIGURE 4 Average number of activities on Internet in beginners and mature users, per age group. **Significant at 1%, *The difference between older adults and the other two groups is significant at 5%.
Source: Internet Usage Survey: Platforms and Free Access Data – 2014

when we only take into account users with over 10 years of experience, the difference among the different age groups practically disappear except for the gap with older adults, although smaller, persists. This is a first indication that there seems to be a convergence in the number of activities users carry out as time goes by, at least for the first three age groups, while older adults seem to lag behind.

3.2.1 | Convergence in Internet usage patterns

Each group's processes and the motivation that leads them to incorporate new Internet activities into their daily lives are different (Barrantes et al., 2016; Barrantes & Benitez, 2016). To analyze this aspect, we divide the sample according to the number of activities they carried out in the Internet. We define three brackets to reflect different sets of activities. The first includes the activities related to absorbing information (such as browsing the Internet) or communicating through SMS-like (such as chat) or one of the first activities almost totally imported from a nondigital world (e-mail) and goes from one to five. The second one goes from six to nine, including the three activities related to entertainment. Lastly, the third one includes the four more sophisticated activities reported in the data set, the ones that potentially would expand the assets of the users, and goes from 10 to 13.

Table 5 shows that the basic activities in the first bracket are the most common amongst users that perform five activities at the most. Users that carry out between six and nine activities perform those related to accessing information and communication (basic activities), regardless of

TABLE 5 Most common activities in each age group, according to number of activities carried out

		Between 1 and 5 Activities				Between 6 and 9 Activities				Between 10 and 13 Activities			
Type of Activity	Activity	Young (17-30)	Adults (31-45)	Mature adults (46-60)	Older adults (61-75)	Young (17-30)	Adults (31-45)	Mature adults (46-60)	Older adults (61-75)	Young (17-30)	Adults (31-45)	Mature adults (46-60)	Older adults (61-75)
Information	Browsing the net	**72%**	**72%**	**69%**	**64%**	98%	95%	97%	98%	100%	100%	100%	100%
Social network	Social network	**81%**	**72%**	**64%**	**37%**	99%	98%	95%	92%	100%	100%	98%	100%
Comm.	Chat	53%	38%	31%	19%	**95%**	**90%**	**89%**	**88%**	99%	100%	95%	100%
	E-mail	48%	57%	58%	69%	**95%**	**95%**	**92%**	**94%**	100%	100%	100%	100%
	Skype	10%	4%	8%	8%	39%	32%	36%	38%	85%	74%	84%	100%
Entertainment	Videos	20%	22%	20%	19%	**87%**	**80%**	**78%**	**62%**	99%	95%	98%	100%
	Games	58%	51%	37%	29%	**97%**	**94%**	**90%**	**80%**	100%	99%	98%	88%
	Music	21%	18%	20%	15%	66%	54%	55%	44%	93%	80%	84%	50%
Asset expansion	Professional networks	0%	4%	6%	8%	10%	20%	27%	18%	**55%**	**77%**	**68%**	38%
	On-line courses	1%	1%	2%	5%	9%	5%	9%	8%	**59%**	31%	41%	38%
	Academic resources	20%	13%	8%	3%	42%	26%	30%	30%	**88%**	**63%**	**65%**	**100%**
	E-bank	6%	12%	22%	22%	28%	43%	42%	40%	56%	**87%**	**75%**	**100%**
	Official paperwork	3%	7%	8%	15%	9%	15%	19%	20%	24%	50%	38%	50%
	Total	89	167	156	59	665	339	205	50	188	110	63	8

Note. Age groups: young (17-30); adults (31-45); mature adults (46-60); older adults (6-75). Source: Internet Usage Survey: Platforms and Free Access Data – 2014.

age group. The next set of activities undertaken are related to entertainment (access to music, videos, and games), again regardless of age group, but more frequently by the younger one. When increasing activities, the younger move into academic related ones, while the other three groups move into labor related ones. Finally, looking at the heavy users, those that carry out between 10 and 13 activities, almost all prefer those related to accessing information, communication, and entertainment and work and professional purposes, regardless of age group. In other words, as it is highlighted in the next table, it seems to be a pattern when the number of activities carried on increases: the adoption process looks similar between different age groups for the most basic activities, as communication and entertainment. However, once they are incorporated inside user activities, the most advanced activities to be added depend on the age group of the users; the same that also depends on the preferences and main activities at those particular ages.

The data show a divergence between age groups regarding the most sophisticated activities. An important percentage of teenagers start to take online courses and to access academic resources, while in the next two age groups network use for government or financial procedures becomes more usual; a larger percentage of older adults carry out procedures in public entities and use online academic resources.

These results suggest that the Internet appropriation process follows a progressive path and reinforces the hypothesis that there is an Internet use convergence pattern that happens when individuals increase their experience using it. In a first stage access to information, communication, or other basic activities is incorporated. Then, once these tools are assimilated, more intensive use of the Internet begins, incorporating recreational purposes. Finally, users incorporate more sophisticated activities, usually related with education or work (Barrantes et al., 2016; Barrantes & Benítez, 2016; Navarro, 2010; Witte & Mannon, 2010). Even though older adults keep a constant difference with the younger group, more sophisticated uses also become more frequent with more experience.

3.2.2 | Convergence in the number of activities

The relationship between the average number of activities and the user's Internet experience is positive but occurs at a different pace for each age group, as can be seen in Figure 5. The data show that as the user's experience increases, the difference between the average number of activities that each age group carries out decreases, almost closing the gap among the young, adults, and mature adults and slightly between the young and the older adults, although maintaining a considerable distance.

3.3 | Econometric analysis: The effects of experience and age group over the number of activities

3.3.1 | Methodology

The analysis will be carried out in two stages. The first stage consists of an econometric estimation that uses interactions between user's experience and belonging to an age group (Cameron & Trivedi, 2009) to estimate the differentiated effect of Internet experience over the number of activities each age group performs.

Since the dependent variable is the number of online activities performed by the user, which goes from 0 to 13, a truncated regression model is chosen over the traditional least square model or ANOVA analysis (Cameron & Trivedi, 2009). Particularly, by including dummy variables indicating age group (young, adults, mature adults, and older adults), the estimated coefficients will show the existing gap between the people that belong to each age group. Moreover, interactions of the user's Internet experience and these dummy variables will be included to explore if there is a

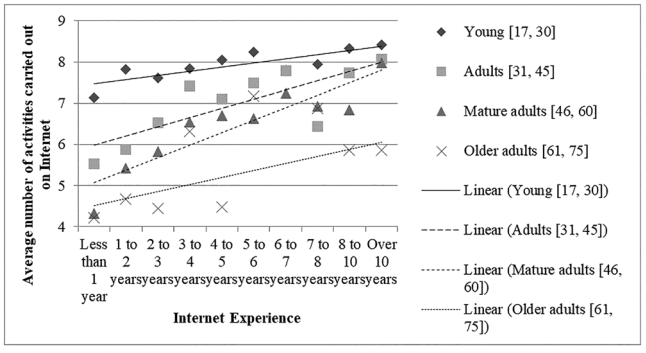

FIGURE 5 Relationship between the number of activities carried out on Internet and the experience ofthe users, per age group
Source: Internet Usage Survey: Platforms and Free Access Data – 2014

TABLE 6 Estimation of the differentiated effect of digital experience per age group on the number of activities carried out on Internet

	Variables	Number of Activities Carried out on the Internet Coefficients	*SD*
Internet experience	Number of months using Internet	0.000783	(0.00140)
Age group (base = Young [17, 30])	Adults (31-45)	−0.541***	(0.195)
	Mature adults (46-60)	−1.190***	(0.228)
	Older adults (61-75)	−1.286***	(0.385)
Interactions	Adults (31-45)* Internet experience	0.00248	(0.00213)
	Mature adults (46-60)* Internet experience	0.00720***	(0.00218)
	Older adults (61-75)* Internet experience	0.000992	(0.00339)
Characteristics about human capital	Years of education	0.0891***	(0.0216)
	Enrolled in a school?	0.616***	(0.120)
Subjective valuation of the internet	Considers that Internet is important to be integrated?	0.336***	(0.0738)
Sex	Woman	−0.0834	(0.0908)
Main occupation (base = inactive)	Students	−0.0913	(0.167)
	Regular employment	−0.0137	(0.144)
	Irregular employment	−0.0480	(0.153)
	Unemployed	0.0395	(0.286)
Household characteristics	HH head years of education	0.0214	(0.0169)
	Log of HH expenditures	0.0955	(0.0737)
	Dependency rate	0.778***	(0.190)
	HH head is woman	0.137	(0.100)
	Landline telephone service in the home	0.402***	(0.101)
City (base = Buenos Aires)	Lima	0.604***	(0.122)
	Ciudad de Guatemala	0.525***	(0.132)
Type of access	Access by Mobile or Smartphone	1.664***	(0.119)
	Access by tablet	0.376***	(0.0996)
	Access by Notebook	0.255**	(0.109)
	Access by XO	0.535***	(0.189)
	Access by Desktop Computer	0.378***	(0.143)
	Access by SmartTV	0.203	(0.170)
Internet access availability	Access from home or family or friend's house	0.917***	(0.169)
	Access from work or place of study	0.475***	(0.103)
	Access from cybercafe	0.488***	(0.108)
	Access from community center or public place	0.376***	(0.104)
	Constant	−0.157	(0.617)
	Sigma	1.882***	(0.0320)
Model adjustment	Observations	2099	
	Wald test	0.00	

Note. Robust standard errors in parentheses. Source: Internet Usage Survey: Platforms and Free Access Data – 2014.

***$P < .01$. **$P < .05$. *$P < .1$.

differentiated effect of each additional month of experience over the number of Internet performed activities by each age group. If the coefficient of the interaction of an older age group is statistically significant and bigger, this will mean that extra years of experience have a stronger effect in this group and that the increase in experience will mean the gap will reduce, as the last figure shows.

The econometric model is specified below:

$$N\,Act_i = \alpha + \beta_1 Exp_i + \beta_2 DAd_i + \beta_3 DAdm_i + \beta_4 DAdM_i + \beta_5 (DAd_i{}^{*}Exp_i) + \beta_6 (DAdm_i{}^{*}Exp_i) + \beta_7 (DAdM_i{}^{*}Exp_i) X_i B + u_i,$$

in which:

$N\,Act_i$ = Number of activities carried out on Internet.

Exp_i = Number of months using Internet.

DAd_i = Dichotomous variable that identifies adults (aged 27-49).

$DAdm_i$	=	Dichotomous variable that identifies mature adults (aged 50-59).
$DAdM_i$	=	Dichotomous variable that identifies older adults (aged 60-75).
X_i	=	Set of control variables.
u_i	=	Residue or nonobservable factors.

The second stage aims to estimate the effect of each additional month of experience for each age group by calculating the impulse response functions of the months of experience on the number of activities performed on the Internet. For that, we will implement a generalized matching strategy used for continuous treatment variables—years of Internet use—proposed by Hirano, Imbens, and Berkeley (2004). This methodology makes it possible to model the effect of each additional treatment unit over a result variable; yet it does not aim to identify the causal effect of an additional unit of treatment. The details can be found in Appendix 1.

3.3.2 | Heterogeneous effects of experience on number of activities by age group

While the descriptive results show a correlation between two variables—number of Internet activities performed and the experience using the Internet—we use econometric analysis to study the convergence process. Table 6 shows a positive, yet not significant, relationship between the number of months a person has been using the Internet and the number of activities he or she performs online.

The coefficients that identify the individuals as belonging to adults' or older adults' age group are negative and significantly different from zero, indicating a gap in the number of activities that each group's members perform online. Particularly, adults carry out an average of 0.5 fewer activities than the young, while mature adults perform an average of 1.2 fewer than the young, and the older adults perform an average of 1.3 fewer activities.

The results from the interaction between the user's Internet experience and the dummy variable that identifies the age groups only show one statistically significant result: the positive coefficient for mature adults. This suggests that each month of additional experience has a greater effect on the number of performed activities than in groups of younger ages (0.000783 + 0.00720 = 0.007983). Therefore, there is a convergence

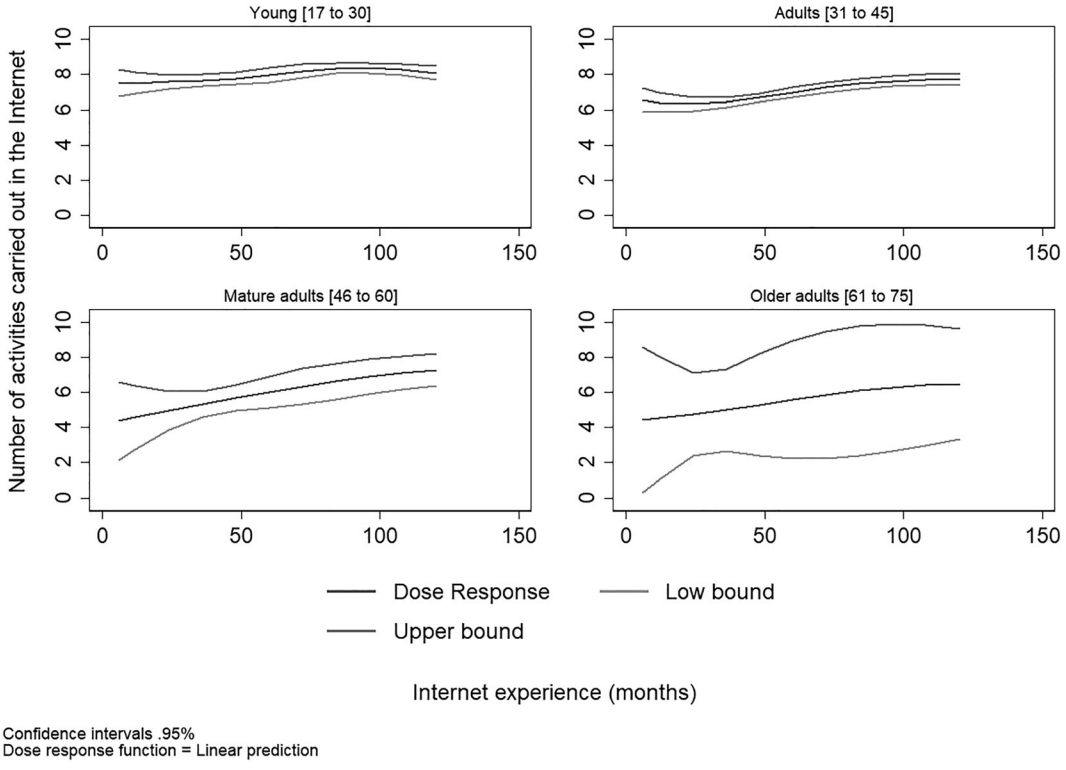

FIGURE 6 Estimated impulse response functions, by age group
Source: Internet Usage Survey: Platforms and Free Access Data – 2014

process in the number of activities carried out on the Internet between this group and the younger one. Furthermore, this result is robust to different definitions of age groups, as it can be seen in Appendix 2.

Notably, context variables also play a significant role on the number of activities users perform online. Being enrolled in an education center has a positive and significant effect, which is coherent with the interaction dynamics that occur in learning spaces and that reinforce the appropriation process (Strahilevitz & Benkler, 2007). Similarly, improvements in the user's Internet appreciation has a significant effect on the number of activities carried out on the Internet, as indicated by technology adoption models (Venkatesh, Morris, Davis, & Davis, 2003).

Other interesting findings are related to the factors that change the experience of Internet use. The devices used for accessing the Internet are of critical importance: users that access through mobile or smartphones on average carry out on average 1.6 more activities on the Internet that those who do not use them. Similarly, the place where users connect to the Internet is also important to understand their use patterns. The analysis shows that users that access from home or family or a friend's house carry out on average almost one more activity (0.9) on the Internet than those who do not access from any of those places. Moreover, accessing the Internet from a study or workplace has almost the same effect than accessing from a cybercafé (about 0.5 additional activities).

3.3.3 | Speed of the Internet appropriation process

The existence of diminishing returns of time in people's learning suggest that the effect of each additional month of experience is not constant (Fredrick & Walberg, 1980); hence, the changes in cognitive processes that occur with aging should also play an important role in this dynamic.

Following the methodology proposed by Hirano et al. (2004), we estimated the impulse-response functions for each age group that are presented in Figure 6. As can be observed, the difference in the average number of activities that a user from each age group performs when they just start using the Internet is substantial. While the youngest groups start carrying out between seven and 8 activities on the Internet, mature adults begin performing between four and six. Although the confidence intervals are not delimited enough to be certain, older adults start roughly at around four activities. As the number of months using the Internet increases, the number of activities performed also grows. This result is coherent with the findings presented in the previous sections.

Moreover, the estimated velocity (slope of the curve) with which the number of activities rise in mature adults is significantly greater than for the other age groups. Although we cannot see the gap closing completely as was shown in Figure 5, a convergence pattern in this usage level is indeed confirmed. These findings show that the appropriation process in these groups goes through different paths (Barrantes et al., 2016; Barrantes & Benítez, 2016), older adults depending on the experience they gain through usage.

4 | CONCLUSIONS

Internet penetration generates opportunities that can improve people's well-being (Castells, 2010; Smith & Reilly, 2014). However, the existence of digital gaps can lead to a scenario where only a few benefits from these opportunities (Camacho, 2006; Robinson et al., 2015). The generational gap, understood as the differences in access and use of technologies between the older and the younger generations, is one of the most important ones. Despite the existence of this gap, very little is known about the Internet appropriation process and the evolution of the usage patterns of older users. This paper delves into the convergence of this appropriation patterns once users have already accessed the Internet, emphasizing the effects of these two channels.

Using quantitative data from three Latin American cities (Buenos Aires, Lima, and Guatemala City), our analysis finds a difference in favor of the younger age groups (young and adults) in most activities, except for the use of social networks for work or professional purposes, the use of online banking, and the use of online government procedures, which are much more common amongst mature and older adults. Also, there is a significant difference in favor of the younger group in the number of activities that the members of each age group perform. Particularly, there is an average difference of 0.5 activities between the youth and the adults, an average difference of 1.2 activities between the youth and the mature adults, and an average difference of 1.3 activities between the youth and the older adults.

We also find that the Internet appropriation process follows a progressive path that sustains the hypothesis that there is an Internet use convergence pattern that happens when individuals increase their experience using it. In a first stage access to information, communication, or other basic activities are incorporated. Then, once these tools are assimilated, a more intensive use of the Internet begins, incorporating recreational purposes. Finally, users incorporate more sophisticated activities, usually related with educational, work, or government-related purposes (Barrantes & Benítez, 2016; Barrantes Ugarte & Vargas, 2016; Navarro, 2010; Witte & Mannon, 2010). Even though older adults keep a constant difference with the younger group, more sophisticated uses also become more frequent with more experience.

Moreover, the velocity in which these processes happen differs by age group. Data show that younger users quickly incorporate several activities as soon as they start using the Internet (around 8 of the 13 activities considered), while users who are older than 60 start performing an average of four activities. Then, with the increase of Internet experience, older users begin incorporating activities that the younger users already

performed; this way, the initial gap starts to close. However, this process is much less intense for older adults who adopt additional activities with more experience on the Internet but fail to reach the level of the younger users.

This paper shows older adults adopting the Internet and being capable of seizing the opportunities that the Internet gives them but at a different pace than younger users do. This is why efforts or policies designed to include older adults should take into account their particular appropriation processes. Although most of our analysis shows a convergence pattern in Internet usage, it is also true that the gap between the youth and the older adults persists yet in a smaller magnitude. This opens the door to interventions that could give support to older adults' learning and Internet appropriation processes, getting them started on the web. Estimations show that participation in educational centers, as well as better appreciation of the Internet, have strong effects on the incorporation of new activities. Also, relationships inside the household (Barrantes & Cozzubo, 2015), as well as informal learning spaces (Eynon & Helsper, 2010), have proven to be very effective to include this population. Incorporating these insights in the design of public policies is crucial to improve older adults' experience with the Internet.

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APPENDIX 1 A.

The Propensity Score with continuous treatments

The empirical strategy proposed by Hirano & Imbens (2004), and operationalized by Bia & Mattel (2008) is a generalization of the matching methodology, known as Propensity Score Matching (PSM) for cases in which the treatment variable does not correspond to a binary category (treated and not treated) but to a continuum of options or continuous treatments. This methodology makes it possible to model the effect of each additional treatment unit over a result variable: in this case, the effect of each month of experience over the number of activities the user performs on the Internet. However, although similar to quasi-experimental evaluation techniques, this method does not aim to identify the causal effect of an additional unit of treatment, but it aims to examine the dynamic relationship between the two variables (Bia & Mattel, 2008; Hirano et al., 2004)

In that sense, as well as the PSM methodology, this strategy relies on the assumption of conditional independence. Once that all observable characteristics that affect both the treatment and result variable are controlled for – through a function – then it is possible to clean all estimation biases, assuming there are no non-observables variables that affect both variables.

On the other hand, in order to estimate the effects of the different levels of treatment, the treatment variable distribution is divided in a certain number of levels, where the effect is sought to be analyzed. In each relevant treatment level, or strata, the estimate of the result variable is averaged and then plotted, as shown in the impulse-response graph.

The methodology of Hirano and Imbens (2004) postulates the existence of a series of potential results $Y_i(t)$, for $t \in \mathcal{T}$, referring to the unit of the impulse response function level and $\mathcal{T}\epsilon\{t_0, t_1\}$ to the continuum of possible treatments, where the result of interest is the average impulse response function $\mu(t) = E[Y_i(t)]$. We also observe the vector of co-variables X_i (the same control variables that were included in the estimations presented in the regression table), the treatment level $T_i\epsilon\{t_0, t_1\}$ and the potential result corresponding to the treatment level $Y_i = Y_i(T_i)$. Hereafter we shall stop using the sub-index *i* to simplify the notation:

Weak conditional independence supposition

The methodology's main supposition is a generalization of the "weak conditional independence supposition" used for binary treatments, which supposes that once all the relevant variables are checked, the result variable is independent from the treatment variable.

$$Y(t) \perp T \mid X \text{ para todo } t \in \mathcal{T}$$

Generalized Propensity Score (GPS)

The generalized propensity score or GPS as a function of the treatment level T_i and the set of variables $X_i$as follows:

$$\mathrm{GPS} = \mathrm{R} = \mathrm{r}(\mathrm{T}, \mathrm{X})$$

Where the GPS property balance, as in the binary case, is that within a stratum those individuals with the same$r(T,X)$, the probability that $T = t$ does not depend on the value of any of the co-variables in$X$:

$$\mathrm{X} \perp 1\{\mathrm{T} = \mathrm{t}\} \mid \mathrm{r}(\mathrm{T}, \mathrm{X})$$

Bias elimination using GPS

The process of elimination of the bias by observable variables has two steps: first, an estimate is made of the conditional expectation of two variables, the treatment level (T) and the GPS R, $\beta(t,r) = E[Y \mid T = t, R = r]$; second, to estimate the impulse response functions at a particular treatment level, this conditional expectation is averaged over the GPS at a particular treatment level:

$$\mu(\mathrm{t}) = \mathrm{E}[\beta(\mathrm{t}, \mathrm{r}(\mathrm{t}, \mathrm{X}))]$$

It is important to note that the average is not calculated over GPS$R = r(T,X)$, but over the score evaluated at the treatment level of interest$r(t,X)$. In this case, the intervals of experience with Internet use are chosen that correspond to the length of use in years, from 1 month to 10 years (1 month to 120 months divided by 10 intervals).

Implementation algorhythm (Bia & Mattel, 2008)

The generalized propensity score proposed by Hirano and Imbens (2004) for estimating the effect of a treatment when this is continuous is made operational by Bia and Mattel (2008) in the following steps:

1. Modeling the conditional distribution of the treatment given a set of co-variables.

Starting from the supposition that the treatment (or its transformation) is distributed normally given a set of co-variables, we present the following relationship, in which $g(T_i)$ is a transformation of the treatment variable and $h(\gamma, X_i)$ is a function of the co-variables X and a parameter vectorγ.

$$\mathrm{g}(\mathrm{T_i}) \mid \mathrm{X_i} \tilde{} \mathrm{N}\{\mathrm{h}(\gamma, \mathrm{X_i}), \sigma^2\} \tag{1}$$

   a. From the previous equation (1), we estimate the parameters for maximum likelihood γ,$\sigma^2$of the distribution of treatment, given the co-variables.

b. Using the parameters estimated in (a), we calculate the conditional density of the treatment given the co-variables or, as Hirano and Imbens call it (2004), a Generalized Propensity Score (GPS) for each individual ($r(T_i, X_i)$), as follows:

$$\widehat{GPS_i} = \widehat{R_i} = \frac{1}{\sqrt{2\pi\widehat{\sigma}^2}} \exp\left[-\frac{1}{2\widehat{\sigma}^2}\{g(T_i) - h(\widehat{\gamma}, X_i)\}\right]$$

   c. We check that the GPS complies with the balance property.

d. Estimate the conditional expectation of the result variable given the treatment and the GPS
   a. Model the conditional expectation of the result variable (Y_i), given T_i y GPS_i, as a flexible function of the two arguments for obtaining a parameter vector $\widehat{\alpha}$:

$$\varphi\left\{E\left(Y_i | T_i, \widehat{R}_i\right)\right\} = \psi\left(T_i, \widehat{R}_i; \alpha_i\right) = \alpha_0 + \alpha_1.T_i + \alpha_2.{T_i}^2 + \alpha_3.{T_i}^3 + \alpha_4.\widehat{R}_i + \alpha_5.\widehat{R}_i^{\,2} + \alpha_6.\widehat{R}_i^{\,3} + \alpha_7.\widehat{R}_i.T_i$$

   b. Estimate the impulse response function
      a. The last step is to average the estimate of the result variable $E\left\{\widehat{Y(t)}\right\}$, evaluated at the desired treatment level. Specifically, in order to obtain an estimation of the total of the impulse response function, we estimate the possible average result for each treatment level that interests us, as possible:

$$E\left\{\widehat{Y(t)}\right\} = \frac{1}{N}\sum_{i=1}^{N} \varphi^{-1}\left[\widehat{\psi}\{t, \widehat{r}(t, X_i); \widehat{\alpha}\}\right]$$

Where $\widehat{\alpha}$ is obtained in step (2) and t is the level of treatment of interest.

b. We estimate standard errors of the impulse response function by bootstrapping.

c. Lastly, we trace the impulse response function and the confidence intervals.

APPENDIX 2 B.

Robustness analysis

One critical aspect of the analysis performed in this document relies on the definition of the age groups used in all the previous sections. Although the arguments behind the election of the age groups used in the study are explain in a former section, this appendix presents the results of the econometric analysis using alternatives definitions for the age groups. As it can be seen in the following table, the main results are robust to different groups definitions and suggests that people between 50 and 60 years old are the ones in which a convergence process with the younger can be found. Simultaneously, we found that there is not a significant difference in the effect of an additional month of experience for the older people and the youngest group. Finally, no matter what age group is selected, the place and devices used for accessing the network are statistically relevant.

Robustness analysis

	Variables	Age groups 1 [17, 26] [27, 49] [50, 59] [60, 75]	Age groups 2 [17, 25] [26, 50] [50, 65] [66+]	Age groups 3 [17, 30] [31, 45] [46, 60] [61, 75]	Age groups 4 [17, 25] [25, 40] [40, 65] [66+]	Age groups 5 [17, 30] [31, 40] [40, 50] [50, 65] [66+]
Internet experience	Number of months using Internet	0.000867	0.00130	0.000783	0.00130	0.000740
		(0.00161)	(0.00170)	(0.00140)	(0.00170)	(0.00140)
Age group	Adults	-0.354*	-0.315*	-0.541***	-0.149	-0.442**
		(0.185)	(0.186)	(0.195)	(0.198)	(0.204)
	Mature adults	-1.438***	-1.328***	-1.190***	-0.986***	-0.824***
		(0.295)	(0.292)	(0.228)	(0.218)	(0.236)
	Older adults	-1.099***	-1.363**	-1.286***	-1.373**	-1.469***
		(0.356)	(0.550)	(0.385)	(0.550)	(0.283)
	Older adults 2					-1.492***
						(0.545)
Interactions	Adults * Internet experience	0.00175	0.00133	0.00248	0.000729	0.00226
		(0.00205)	(0.00205)	(0.00213)	(0.00219)	(0.00222)
	Mature adults * Internet experience	0.00984***	0.00737***	0.00720***	0.00468**	0.00313
		(0.00272)	(0.00274)	(0.00218)	(0.00225)	(0.00252)
	Older adults * Internet experience	0.00142	0.00295	0.000992	0.00298	0.00801***
		(0.00321)	(0.00495)	(0.00339)	(0.00495)	(0.00258)
	Older adults 2 * Internet experience					0.00350
						(0.00487)
Type of access	Access by Mobile or Smartphone	1.678***	1.689***	1.664***	1.690***	1.651***
		(0.119)	(0.120)	(0.119)	(0.120)	(0.120)
	Access by tablet	0.379***	0.374***	0.376***	0.375***	0.369***
		(0.0992)	(0.0991)	(0.0996)	(0.100)	(0.0993)
	Access by Notebook	0.264**	0.278**	0.255**	0.271**	0.267**
		(0.109)	(0.109)	(0.109)	(0.109)	(0.109)
	Access by XO	0.524***	0.523***	0.535***	0.539***	0.536***
		(0.190)	(0.191)	(0.189)	(0.189)	(0.190)
	Access by Desktop Computer	0.382***	0.389***	0.378***	0.395***	0.392***
		(0.144)	(0.145)	(0.143)	(0.145)	(0.145)
	Access by SmartTV	0.192	0.213	0.203	0.210	0.220
		(0.169)	(0.170)	(0.170)	(0.169)	(0.170)
Access availability	Access from home or family or friend's house	0.893***	0.898***	0.917***	0.928***	0.933***
		(0.168)	(0.168)	(0.169)	(0.169)	(0.168)

(Continued)

	Variables	Age groups 1 [17, 26] [27, 49] [50, 59] [60, 75]	Age groups 2 [17, 25] [26, 50] [50, 65] [66+]	Age groups 3 [17, 30] [31, 45] [46, 60] [61, 75]	Age groups 4 [17, 25] [25, 40] [40, 65] [66+]	Age groups 5 [17, 30] [31, 40] [40, 50] [50, 65] [66+]
	Access from work or place of study	0.477***	0.477***	0.475***	0.476***	0.475***
		(0.103)	(0.103)	(0.103)	(0.103)	(0.103)
	Access from cybercafe	0.499***	0.500***	0.488***	0.495***	0.484***
		(0.108)	(0.107)	(0.108)	(0.108)	(0.107)
	Access from community center or public place	0.381***	0.381***	0.376***	0.373***	0.373***
		(0.104)	(0.104)	(0.104)	(0.104)	(0.105)
Controls	Controls and constant	Yes	Yes	Yes	Yes	Yes
	Sigma	1.887***	1.891***	1.883***	1.887***	1.882***
		(0. 033)	(0.032)	(0.032)	(0.032)	(0.032)
Model adjustment	Observations	2,099	2,099	2,099	2,099	2,099
	Wald test	0.00	0.00	0.00	0.00	0.00

Robust standard errors in parentheses:

***p<0,01,

**p<0,05,

*p<0,1

Elaborated by the authors.Source: Internet Usage Survey: Platforms and Free Access Data – 2014