

# Improving the information society skills: Is knowledge accessible for all?

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**Abstract** The emergence and popularization of information and communications technologies (ICT) is changing modern society and its educational landscape. ICT facilitates individuals' ability to learn anywhere and at any time. In fact, by using ICT, access to knowledge acquisition is not restricted to formal contexts, such as academic institutions. This position paper reviews the educational contexts in which new learning strategies using ICT have been adapted, by focusing on how users access information and improve their digital skills. Our initial hypothesis is that in technological environments, learners use very specific devices and applications to access information, because content accessibility depends on both the user's profiles and ICT. We demonstrate this through a case study applied in several Spanish university institutions.

**Keywords** Informational skills · Knowledge · Human-computer interaction · Technological ecosystems · Education · Data accessibility

## 1 Introduction

In teaching and learning processes, technology is ever present and allows for the incorporation and strengthening of new educational strategies, many of which have been defined in new teaching frameworks in the last two decades [1]. Educators' interest in using these technologies in the teaching process involves greater engagement and an increase in student motivation in understanding content [2, 3], thereby improving academic results [4]. In this context, it is necessary to analyze where and when the learning happens, how it happens, and what the learners' needs, aims, and abilities are. In order to do so, it is necessary to explore existing methodologies, frameworks, and tools used to access and manage knowledge and to consider whether they make it accessible for all.

People can also acquire skills during their everyday life in an intentional and structured way (known as non-formal learning), or informally, such as by talking with friends, playing games, using their mobile devices, searching for information on the Internet (also known as informal learning). This means that students are acquiring skills continuously, and in many cases, they are unaware that they are doing so. In this situation, there is a need to explore how skills are acquired and/or validated in each context. Beyond these formal, non-formal, and informal contexts of learning, it is necessary to explore how people acquire their skills. Because not all people learn in the same way, based on their basic education and experience using technologies, there is lot of research dealing with the idea of digital natives and digital immigrants [5–7].

However, even taking into account this differentiation, not all digital natives or 'immigrants' (those who were not born in the digital era) access new skills in the same way; moreover, there are other specific groups of learners that

should be considered, such as older people and people with disabilities [8–10]. For these groups, as well as for those living in disadvantaged environments or societies, where access to new technology and devices is more difficult, the use of ICT can be exclusive. Therefore, there is a need to facilitate knowledge and skills acquisition for all. The study of how to improve universal access to digital information and how to improve society skills to achieve this general objective is the starting point of the present paper.

Section 2 of this paper includes an overview of new learning strategies and best practices for ICT acceptance, outlines the educational contexts, and provides a brief approach to understanding special needs of students and older people. The main features of a quantitative research study developed by the authors in Spain are described in Sect. 3. Section 4 presents the research results, which are discussed and summarized in Sect. 5.

## 2 Literature review

This section explores existing literature, taking into account four main issues: new education strategies; best practices for ICT acceptance; places where educational activities are developed; and the special needs of some groups with regard to learning and information access.

### 2.1 New learning strategies: educational innovation

Innovation is essentially the creation and implementation of new processes, products, services, and methods of delivery, which result in significant improvements in the efficiency, effectiveness, or quality of outcomes [11]. Thus, there are three important elements of innovation [12]:

- It means the creation of something new;
- It is a process;
- It should provide some kind of quantitative or qualitative improvement in the outcomes.

If we focus on educational innovation, based on the ideas expressed in [13], it can be described as the process of changing teaching or learning activities that produce improvements in student performance. However, in order to consider this process educational innovation should respond to certain needs: It should be effective and efficient; it should be sustainable over time; and it should produce transferable outcomes beyond the particular context in which it arose [14]. In order to assess the needs identified, we can define other variables to be studied, namely the relationship between student motivation, degree of satisfaction, and the user experience; or student perceptions of their interaction with and teaching of applied collaboration [15, 16].

In the previous century, access to information required access to physical spaces, such as libraries or classrooms. Nowadays, however, information cannot only be found in educational environments, but is also accessible via several platforms and in various locations, particularly through the Internet. It is in this educational environment that most important changes have taken place, especially with regard to using the Internet to learn or access information. Simplifying the previous ideas, we would affirm that there are two primary frameworks: real and virtual. In the real field, any design goes through various phases: conceptual design, prototyping, usability study, and final production. This way, the developers aim to invent products that are adapted to the necessities of all kinds of users, improving the final product's accessibility. Similarly, in the virtual framework, innumerable resources have been dedicated over the last several decades to improving and generating new models and methods for accessing content (rules and recommendations), thereby adapting that content to all types of users and devices [17]. These efforts are dynamic and constantly changing, especially considering the ongoing technological revolution that is continuously transforming these devices and their capabilities.

Centered on new educational uses through ICT, we must define the moment and level at which the technology may be used. Strategies and necessities in kindergarten or primary school are different and must evolve in secondary education to adapt to more complex and diverse environments in university education, thereby developing formal or informal processes that last for a lifetime. Nevertheless, we can affirm that the current trend is the inclusion of systems that have a great influence on mobile work and allow for the search for and managing of information anywhere. This offshoring affects mainly access to content, in other words, information.

The evolution of mobile technologies, Wi-Fi networks, and the increased power and sophistication of mobile devices have inspired a new body of research on the use and optimization in ubiquitous training (referred to as mobile learning, or m-learning), which allows for both onsite and virtual collaborative work to occur between educators and students [18, 19]. The increasingly advanced and comprehensive, though easy-to-navigate, applications directly generate a greater utility perception from the user and a better attitude about using this technology [20]; these premises represent one starting point for a more consistent inclusion of these technologies in teaching. The m-learning concept has the following principal characteristics: interaction between the user and content, contribution of media to immersive environments, incorporation of communication technologies, the use of new contexts for education, and awareness of the possibility of sharing and recording the learning process.

Merging technology and access to data, a substantial effort is being made to adapt the educational, commercial, and in general, all types of content on mobile devices because their popularity and the progressive lowering of their cost have given them a significant presence in society. In particular, aspects such as security [21], and adaptation and communication with users of advanced age [22], or with disabilities [23], are perhaps the most developed work within design or multimedia studies. The idea to improve user content accessibility, with customizable and usable interaction adapted to the basic navigation rules, is nowadays a basic discipline with a lot of examples and efforts [17].

## 2.2 Best practices for ICT acceptance

Implementing new communication technologies in education and in society in general was a hot topic over the last 10–15 years [24]. Nowadays, nobody questions the need to use and adapt the content to the new technological systems in order to improve society's both generic and digital skills. However, technological innovation, which is intended to improve student learning processes and skills acquisition, must facilitate the provision of support to address the difficulties that could arise in the student's use of, interaction with and accessibility of technological elements. These elements must not obstruct the auto-learning process, which is altered by this technology, and the learners must be motivated by the new educational methodology. Carrying out new learning experiences using ICT is not an easy process, nor is it always successful. In fact, plenty of previous studies have documented the problems and failures in processes of implementing ICT in education [25].

One of the major deterrents to implementing ICT in teaching is the administrative environment. Not only must the students be trained, but also the teachers [26] must be capable of giving full-time support to students (thinking in a dislocated learning environment), the success of which is dependent on the professors' willingness and ability to devote the time required for the training, modification, and actualization of the related content, including a post-evaluation of all processes. These premises assume an economic investment that not all institutions will accept [27] and that many teachers will not make unselfishly [28]. Without a motivated teacher and a supportive environment, the success of the implementation will be lower and the student will have a negative perception of ICT usage in education, which could evolve into a lack of interest in the subject [29].

In order to include a new ICT-based methodology in a specific teaching environment, some recommendations for avoiding student rejection must be considered. The literature defines the so-called best educational practices that are

primarily focused on virtual rooms, distance education (or e-learning), and semi-present teaching [30]. From the specific characteristics that shape these practices, four principal objectives can be identified:

- Promotion of professor–student relationships for a more effective feedback process;
- Active learning promotion among students, which is made possible by applying collaborative techniques;
- Contribution to better task development by heterogeneous learning methods, meeting high expectations;
- Application of teaching/learning methods based on teaching innovation and new ICT technologies.

In accordance with [31], any methodology that promotes the inclusion of ICT in teaching must have the following objectives:

- Personal production support: applications that allow both the professors and students to carry out tasks faster and more efficiently;
- Content improvement: the use of tools that allow for the notification and modification of content rapidly and efficiently (e.g., e-mail, digital content, video, multimedia resources) without changing the basic teaching method;
- Paradigm shift: at this level, the teacher reconfigures the teaching activity and learning activities to utilize the newly incorporated technologies.

Examples of educational methodologies that have implemented the first two objectives are numerous, but examples that address the third objective are less common. In these cases, most of the solutions involve basic tools and derived applications of an Internet connection [32] and take for granted the presence of mobile devices and access to an Internet connection, though not for advanced options, such as analysis, interaction, or professional visualization.

In all of these processes, both the more traditional processes and those that look to implement ICT in classrooms efficiently, the main aim is focused on improving the intensity of learning [33, 34]. Consequently, neuro-educational experts agree that in order to acquire new knowledge we need to have an emotional response [35]. Studies related to learning difficulties in dyslexics or people with ADHD show that most problems are not related to the syndromes, but to the educational methodology used and the typology of the studies selected [36, 37]. As a result, neuro-didactics [38] propose a change in learning methodology, replacing master classes with visual supports such as conceptual maps, videos and interactive platforms, and collaborative work—ultimately, the use of ICT that motivate the students in their subjects. This paradigm shift is summarized in the new methodological order of how the brain learns: first comes motivation, then attention, and lastly, memory.

Starting from the premise that only 10% of the individuals enrolled in a massive open online course (MOOC) finish it [39] and that using a computer is not a technological innovation if the one speaking is the teacher, it is necessary to look for new teaching formats that incorporate technology. In the past, we always knew whose notes to borrow; however, now platforms such as Facebook and Twitter allow us to decide who to follow, what to debate, and what products to use. The teacher has a guiding role and contributes by outlining some criteria regarding which content is good, thereby functioning as a mentor of SCC (scenario centered curriculum) studies, where students learn by performing certain roles in real and/or professional formative situations [40].

Integrating social networks and their educational use was the first step in the process of introducing technology in the classroom, and now other technologies, such as augmented reality and virtual reality [41–43], are constantly being added. The capacity to add virtual information to interact with the real world, or the possibilities of recreating a scene in 360 degrees, allow students to feel the material/data and interact with them spatially to understand them, instead of only reading it or listening to it. These technologies are allowing students to concentrate more, be more motivated, and dedicate greater effort to learning specific material—all of which are aspects that translate into better results in less time [44].

However, as described at the beginning of this section, in order for ICT to be applied in the framework of best educational practices, it is necessary to evaluate the work tendencies [45] and overcome the following set of barriers:

- Resistance of teaching faculty and educational centers to the use of high-cost mobile technologies associated with leisure: Up to this point, the main barrier was found in the cost of Smartphones, tablets, and devices such as virtual reality glasses. Nevertheless, the current market offers economical solutions even at the level of visualization, with Google's Cardboard the most successful one, and its content available in Google Expeditions;
- Technological adequacy of educational environments for the use of mobile devices: adequate network and Wi-Fi speeds, charging and connection points, classical and 3D printing, etc.;
- Capacity to provide support to those students who do not have access to the required resources: One in three 10-year-olds currently has a Smartphone, compared to 78.4% of 13-year-olds and 90% of those aged 15 and over (according to data from *Instituto Nacional de Estadística* 2014);
- Faculty training: Every year, 10,000 professors are formed in Spain in digital competencies [46], being still

necessary to specify which systems and models are the most adequate for every level and knowledge area;

### 2.3 Educational contexts

The use of ICT in education presents the idea that individuals do not only learn in the context of a learning institution environment. People learn throughout the course of their entire lives, and in many cases do so without meaning to or being aware of it [47].

Depending on how training is provided, we could distinguish between three types of learning [48–50]: (1) formal learning, which is obtained from a regulated institution; (2) non-formal learning, which is structured learning that is not obtained in an institutional environment and is generally linked to the employment sphere; (3) informal learning, which is acquired by an individual throughout their life.

Apart from training modalities, we must consider the mobility of the individual who could, for example, be trained in one university today and in another tomorrow. This disparity of training modalities and contexts makes it necessary to propose environments and tools that can facilitate the unification of the user's portfolio. We understand portfolio evidenced as the guideline of achieved learning [51–54]. In other words, it must provide the tools that are able to reflect the competences achieved by the individual throughout his/her life (in what would be the process of *lifelong learning*), independently from the training modality used, or the context in which it is obtained. This is one of the fundamental objectives of the European Higher Education Area [55] and requires tools to facilitate it.

Learning management systems (LMSs) can be considered the most adequate learning environment for the context of both formal and non-formal training, normally related to an institution. LMSs, which appeared in the mid-nineties, supply tools that extend and give support to the traditional concept of a class, because they are mostly centered around helping the teachers, due to their emphasis on facilitating administrative and management work relative to learning (which includes tools for document managing, questionnaire correction automatization, discussion spaces, etc.) [56]. For students, LMSs constitute concrete spaces in which they can carry out their lecture activities or with which they can complement their classes. Demonstrated by the high implementation rate by education institutions [57–59], as well as by the realization of training activities within businesses [60], these learning platforms have been widely accepted. Nevertheless, these tools also generate problems [61, 62] due to the fact that (1) they are not centered on the user, but in the institution and

the course [63], (2) they do not offer lifelong learning support [51, 54], and (3) they do not support the incorporation of new technological trends (such as 2.0 tools or the use of contexts other than the Web) [64, 65], or the possibility to evolve [66].

For these reasons, students do not exclusively use these kinds of platforms. It is necessary to create environments that are better adapted to their needs, open to the inclusion of all kinds of innovative technologies and tools that they must use to learn, and have the capacity to adapt to the student's profile (technological, social, and physical). Furthermore, in these contexts, we must consider a change of focus—the tools will not be so much aimed at the specific course or institution, rather at the student's own specific preferences. It is necessary to customize learning, to give the student spaces and tools that he or she can configure according to his/her needs, not only within the institution, but at any given moment in everyday life [63]. That is to say, people need access to the tools that are related to informal learning.

Why attribute so much importance to this learning modality? Nowadays, informal learning is once again at the center of discussion for three fundamental reasons: (1) the recognition that the Bologna process [67] intends to give to this type of learning; (2) the pressing necessity of being able to show that learning is mostly acquired through observation and experience [63]; (3) last, but not least, the appearance of tools that facilitate these actions, such as 2.0 technologies [64, 65, 68]. It is necessary to incorporate tools that favor this learning type into educational environments, whether self-acquired learning or knowledge gained through interaction with other people. In this sense, we can consider personal learning environments (PLE) [69]. These spaces aim at facilitating the users' learning by allowing them to use the tools that they consider to be suitable (normally those with which they are familiar), without being related to any specific institutional environment or time [70]. With PLE, students are the ones responsible for their own learning due to their ability to determine the tools to be used, to make the shift from being a consumer to a provider of learning, and to their relationships with other people, according to their specific needs, etc. [70, 71].

However, the introduction of PLE does not aim to replace LMS [70]. As already mentioned, LMSs have had great success both for institutions and for students. They are sufficiently tested, students know how to use them, and institutions have made investments to ensure their correct functioning, etc. [72]. In addition, the fact that the student is responsible for his/her learning does not mean that educational entities should no longer have any control (especially in regulated training activities). Rather, this means that LMSs are used as formal training environments, while PLEs constitute informal training ecosystems.

In this context, it is necessary to focus on two main aspects: the integration between learning environments, and how to validate and consider what is happening in informal training contexts within formal environments.

With respect to integration, it is not an easy task [73, 74]. There may be different reasons for this, including the following [72, 74, 75]: (1) LMSs do not normally include interoperability standards; (2) the integration of training activities in the PLE is not satisfactory because they are designed for representation, classification, and tracking in other platforms; (3) problems derived from user activity traceability in the PLE and, therefore, in the formal environment as well; (4) single sign-on implementation problems; and (5) information security issues. Some examples of initiatives in this sense could be [74, 76–86].

With respect to the validation of informal learning, it is interesting to consider the context of employment. The recognition of informal learning is especially relevant here for a variety of different reasons. Among others [87, 88], it enhances employability and produces positive benefits for managers and companies; it can develop task skills and knowhow and communicates 'social' norms and preferred patterns of behavior; it gives employees the opportunity to learn and keep their skills up-to-date, while being part of the overall workplace culture rather than just its training regime. These factors create an interest in informal learning in the corporate world, driven by the desire to capitalize on the intellectual assets of the workforce, in order to manage organizational knowledge and in recognition that informal learning may prove a cost-effective way to develop competence [63].

Such factors have led to the definition of several initiatives related to informal learning recognition and validation. Examples include the CEDEFOP European Guidelines for validating informal and non-formal learning contain the experiences of more than 20 countries [89]; the ECOTEC inventory of validation of non-formal and informal learning provides a catalog of best practices in the area of validation for policy-makers [90]; the OECD recognition of informal learning [91] and the ILO international standard classification of occupations, ISCO-88 [92] and ISCO-08 [93], are clear examples demonstrating the importance of qualifications closely related to skills and competences. There are also several initiatives focused particularly on issues related to certification and qualification, such as the National Qualification Systems and European Qualification Framework, MyElvin social network for language practice [94], TENCompetence [95] [96], FREE (fostering return to employment through entrepreneurship, innovation and creativity) [97], IBAK (identification, assessment and recognition of informally acquired competences) [98], Open Badges [99], TRAILER Project [100].

In addition, it is necessary to take into account that educational information systems are continuously evolving, so other possibilities must be considered, such as educational ecosystems. Today, we can talk about technological ecosystems for providing support for the management of information and knowledge in heterogeneous environments [101]. A fundamental shift toward ecology and ecosystems as the basis of the discussions on innovation is presented [102–105]. These concepts are often used in European Commission official policy documents as tools for regional innovation policies that are aimed at achieving the Lisbon Agreement goals [106, 107].

In education, a technological ecosystem has an architecture based on open-source software components [108] that work together to evolve and gradually become smarter through inputting the ideas and components of the community to implement learning services [109, 110]. In fact, the metaphor of the technology ‘ecosystem’ comes from biology and was inspired by the business and biological ecosystem concepts of Moore [111] and Iansiti [112], which led to the definition of Software ECOsystems (SECO) [113].

Technological ecosystems are defined as complex processes with a wide range of requirements. Each technological ecosystem is unique. It is very difficult to find two different institutions or companies that share the exact same problems and goals regarding their own knowledge management.

Technological ecosystems should have the ability to recognize a complex network of independent interrelationships among the components that compose its architecture, while offering an analytical framework for understanding the specific evolution patterns of its technology infrastructure, taking into account that its components must be able to adapt to any changes suffered by the ecosystem and not collapse if they cannot accept the new conditions [114–116].

Technological ecosystems should connect and relate the different tools and services that arise and serve knowledge management, thereby building technological ecosystems and increasing internal complexity, from the semantic interoperability of their components to provide more functionality and simplicity to their users. In particular, the use of service-oriented architectures has increased in the development of learning systems, as these are not currently part of a single system or monolithic platform [117], but several services and tools that are used to create heterogeneous ecosystems.

When creating a framework for a technology ecosystem, we should take into account the integration, the interoperability, and the evolution of its components, and a proper definition of the architecture that supports it [77, 118]. The status and the technical and technological evolution of

technology ecosystems share a very evident parallelism with all the technology that develops around the Internet and cloud services. More specifically, the evolution in data collection, analysis procedures, and decision-making is based on certain types of emerging technologies, such as the Internet of Things [119], processes that extract concepts of business intelligence [120], or data mining processes applied to knowledge management [121].

Finally, in order to guarantee the acceptance of an educational technological ecosystem by its users, it is very important to create systems that allow the users to interact [122, 123], with the main goal being that the user will be an essential component of the ecosystem that will evolve and improve as a result of its users’ behaviors [124].

## 2.4 Education and special needs

Another important issue that should be addressed when accessing information is that not all people have the same capacities. Thus far in this paper, we have consistently mentioned students, though it is necessary to consider whether all students have similar characteristics, and whether technology will always facilitate access to information and training regardless of the type of student. This leads us to consider groups with special needs and older people [125].

People with disabilities and older people do not always see technology in the same way as other users do [126, 127]. In fact, this last group, which is continuously growing, uses ICT in a different way and pursues different aims [128, 129]. Older people were not raised in an ICT context; however, they have to use it because of its widespread popularity. In this case, ICT addressing the promotion of integration and enhancement of relationships between people does not have the expected effect. For older people, the use of technology can become something exclusive instead of inclusive [129]. The main problem is that technology has been developed, in many cases, without taking into account the special needs of older people, and that they have no previous training in this kind of technology [130].

What do we mean by older people, also known as the elderly or senior citizens? This depends on contextual issues such as life expectancy and quality of aging. This can include different stages of development and differences in the quality of health services available, etc. For instance, in Europe, an older person is not the same age as an older person in Africa. Most developed countries define an individual aged 65 and over as old. At the moment, there is no common United Nations (UN) standard numerical criterion for this; however, the UN agreed cutoff is 60 + years to refer to the older population [131]. For the purposes of this research, this will be the age used to define

an older person. However, it should be noted that older people form a very heterogeneous group, so the present work also takes into account the following categories within the group of older people [132]: (1) age more or less close to retirement (period of pre-retirement); (2) autonomous age as a pensioner (period of independent living); (3) age with increasing handicaps (start of period of dependent living); and (4) dependent pensioners' age (period of dependent living up to the end of life).

It should be noted that older people is a continuously growing group. For example, due to the dynamics in fertility, life expectancy, and migration, the age distribution of the population of the EU is expected to change dramatically in the coming decades. The overall size of the population is projected to be slightly larger by 2060, though much older than it is now [133].

Older people have special needs and use ICT differently from people who have grown up surrounded by ICT [128, 130, 134, 135]. This means that there is a significant generational knowledge gap [5, 136]. In order to bridge this gap between older and young people (also known as digital natives), different EU countries and institutions have developed several initiatives. For instance, the European Commission funds basic and applied research under the Seventh Research Framework Programme [137] and its successor, Horizon 2020 [138]. Within Member States, the European Commission participates in the Active and Assisted Living Joint Programme (with a grant of 700 million euros) [139]. In 2011, the Commission started the European Innovation Partnership on Active and Healthy Ageing that promotes several projects and initiatives.

Is a large investment needed to make ICT more accessible and useful for older people? The answer is obviously yes. ICT has a high potential to include older people; however, it can also be associated with exclusion. ICT can be inclusive because it promotes social interaction, gives elderly people access to apps that will be helpful in their daily lives, and provides them with new ways to maintain contact with family and friends, etc. [140, 141]. However, several hurdles are also present that make it difficult for older people to use ICT [128, 135, 142, 143] such as:

- Older people as a group is not homogeneous with respect to education, income, or even the different types of disabilities often associated with advanced age. Elderly people as a group are at the greatest risk of being excluded from reaping the rewards of the information society;
- Since they have not directly been involved in the evolution of ICT or the Internet, older people have to learn to use something that has been developed without taking into account their specific needs;

- Older people have problems using technology and learning how to use it because ICT does not always take into account age-related sensory, physical, and cognitive functions, or the possibility of older people having motor control and cognitive impairments;
- Older people on a limited income can struggle to use and access ICT; the availability of ICT services is also a problem because of geographical restrictions, as for instance in the case of people with limited access to the Internet in rural areas.
- Overcoming accessibility and usability issues is essential for the success of any ICT solution and is especially critical for older people who, as mentioned above, experience age-related impediments.

A clear example of how these issues influence older people can be demonstrated in the way they use mobile devices. This kind of ICT solution has high relevance and recognition in our society. By the end of 2015, there were more than seven billion mobile cellular subscriptions in the world and more than one mobile device per person in developed countries [144]. These devices provide access to a complete set of services that can be employed with different purposes. A high percentage of older people in developed countries own one of these devices; however, they only use mobile phones for very limited purposes, such as calling or texting in emergencies. This is mainly because the devices are neither designed nor adapted to meet their needs and because they need to learn how to use their devices [127, 128].

Given this context, it is clear that older people need special learning approaches to use ICT and to make ICT more inclusive. The European Commission, through the Lifelong Learning Programme, has set out different initiatives to help older people learn how to use ICT [145, 146], and several countries are also enhancing this kind of learning actions [128]. Older people are quite interested in participating in these learning activities. They value the role of ICT in helping them keep in touch with family and friends, using the Internet to find information, to support their hobbies and interests, and to make the mechanics of everyday life easier [134].

However, older people also encounter difficulties learning about ICT. Some common problems are a lack of confidence and fear of using ICT (worry about doing something wrong or breaking something); the absence of support after the learning activity; the high cost of training (although learning initiatives are addressing this problem); memory problems; and problems with understanding technical jargon, etc. Some of these barriers are reduced with growing familiarity with ICT, while others persist, and some are affected by age-related constraints (such as physical and cognitive changes, motor control problems,

reduced vision) [132, 134]. The elements of learning proposals for other special needs groups should adapt to address these hurdles; however, what is clear is that access to information should be available for everyone and promote the inclusion, not exclusion, of the people involved.

### 3 Access to information through ICT: a case study

Given the context described in the previous sections, it is clear that the use of ICT to access useful information for learning depends on different factors: the group that is accessing the information, the ‘technicality’ degree of the environment in which they are developed, the context in which the education is taking place (formal, non-formal, or informal), the devices or applications used, etc.

In a low-tech environment, the use of ICT for learning is interesting; however, the current reality is different. In ‘technified’ contexts, implementing a methodology supported by ICT does not depend on the educator, rather on the students’ needs with regard to their experience and the applications and devices they think are required to access information.

In this situation, the hypothesis would be that “in highly ‘technified’ environments, students use very specific applications and devices to access information.”

In order to validate this hypothesis, a descriptive evaluation of a survey about access to information was carried out. Some of the existing surveys regarding the impact and use of ICT in education or in the access to information [147–149] could have been used. However, this research aims at taking into account the already mentioned groups regarding the devices and applications used for both leisure and learning purposes. Therefore, we developed our own survey regarding these aspects.

The questionnaire carried out can be found at the following address: <https://goo.gl/forms/4OM5pwCucgXshnR63>. This survey consists of a series of control questions (age, gender, country, academic level, and professional activity), questions regarding the use of ICT devices to access information, the use of applications to access information, the use of ICT for learning, and finally, questions regarding the conformity of the user with ICT tools for learning and working.

### 4 Results

The survey was framed in the Spanish scope, and 183 valid responses (179 Spanish users and 4 foreign Spanish-speaking users) were gathered. Table 1 presents the age distribution.

**Table 1** Distribution by age

Age	Samples	Male	Female
<30	46	35	11
30 < x < 60	101	76	25
>60	36	19	17

Using this distribution, in Table 2 we can observe the average answers obtained from the survey. The following coding was used (only quantitative answers are shown, for example Q4D is a qualitative question, addressed in the next section):

- Q2A: What are the devices that you commonly use? (From 1: never, to 5: everyday): #1: Smartphone, #2: Tablet, #3: Smartwatch, #4: Fitband, #5: SmartTV, #6: Laptop, #7: Personal Computer (PC), #8: MP3/4 Player.
- Q3A: What are your favorite applications? Select how easily can you access information with the tools listed (From 1: very hard, to 5: very easy): #1: Facebook, #2: Instagram, #3: Twitter, #4: YouTube, #5: Dropbox, #6: Google Suite.
- Q4A: How often do you use ICTs to learn? (From 1: never, to 10: always).
- Q4B: Where do you learn? #1: I do not have any activity to learn, #2: Only in educational institutions and sites, #3: In educational institutions and in my workplace, #4: In educational institutions and in my home, #5: Anywhere at any time.
- Q4C: What are the devices that you commonly use to learn? (From 1: never, to 5: everyday): #1: Smartphone, #2: Tablet, #3: Smartwatch, #4: Fitband, #5: SmartTV, #6: Laptop, #7: Personal Computer (PC), #8: MP3/4 Player.
- Q4E: What applications do you use to learn? Select how easily you can access information using the tools listed (From 1: very hard, to 5: very easy): #1: Google Scholar, #2: Google Search, #3: Wikipedia, #4: Microsoft Suite, #5: Intranet.
- Q5A: Do you think that ICTs help you to learn? (From 1: not at all, to 5: completely agree).
- Q5B: Do you think that ICTs help you to work? (From 1: not at all, to 5: completely agree).
- Q5C: Are you happy with the devices you use to learn? (From 1: not at all, to 5: completely agree).
- Q5D: Are you happy with the applications you use to learn? (From 1: not at all, to 5: completely agree).
- Q5E: Are you motivated to use new ICTs to learn or work? (From 1: not at all, to 5: completely agree).

The analysis of the answers using the gender and age variables allows discarding the influence of the gender

**Table 2** Answers by age: average (standard deviation)

	<30			>30 and <60			≥60		
	Total	Female	Male	Total	Female	Male	Total	Female	Male
Q2A-1	3.73 (1.72)	3.72 (1.71)	3.74 (1.76)	4.91 (0.49)	4.76 (0.88)	4.96 (0.26)	3.53 (1.76)	3.65 (1.73)	3.42 (1.84)
Q2A-2	3.00 (1.66)	3.33 (1.64)	2.74 (1.66)	3.31 (1.48)	2.72 (1.49)	3.50 (1.44)	3.17 (1.65)	3.35 (1.69)	3.00 (1.63)
Q2A-3	1.20 (0.87)	1.22 (0.94)	1.17 (0.83)	1.53 (1.25)	1.16 (0.80)	1.66 (1.34)	1.22 (0.93)	1.24 (0.97)	1.21 (0.92)
Q2A-4	1.46 (1.27)	1.39 (1.14)	1.52 (1.38)	1.41 (1.06)	1.44 (1.16)	1.39 (1.03)	1.42 (1.20)	1.41 (1.18)	1.42 (1.26)
Q2A-5	2.27 (1.47)	2.44 (1.62)	2.13 (1.36)	2.73 (1.68)	2.04 (1.49)	2.96 (1.69)	2.36 (1.57)	2.53 (1.62)	2.21 (1.55)
Q2A-6	3.07 (1.71)	2.72 (1.74)	3.35 (1.67)	4.29 (1.21)	4.04 (1.43)	4.37 (1.13)	2.81 (1.65)	2.53 (1.66)	3.05 (1.65)
Q2A-7	2.85 (1.71)	2.89 (1.68)	2.83 (1.77)	4.50 (1.20)	4.16 (1.43)	4.61 (1.10)	3.06 (1.67)	3.06 (1.64)	3.05 (1.75)
Q2A-8	1.56 (0.95)	1.50 (0.79)	1.61 (1.08)	1.95 (1.33)	1.72 (1.31)	2.03 (1.34)	1.78 (1.27)	1.47 (0.80)	2.05 (1.54)
Q3A-1	3.10 (1.67)	3.00 (1.71)	3.17 (1.67)	3.31 (1.48)	3.36 (1.41)	3.29 (1.51)	3.25 (1.71)	3.06 (1.75)	3.42 (1.71)
Q3A-2	2.17 (1.34)	1.94 (1.35)	2.35 (1.34)	2.43 (1.53)	2.00 (1.44)	2.57 (1.54)	2.00 (1.35)	2.00 (1.37)	2.00 (1.37)
Q3A-3	2.27 (1.61)	1.72 (1.41)	2.70 (1.66)	2.77 (1.57)	2.20 (1.47)	2.96 (1.57)	2.11 (1.58)	1.76 (1.44)	2.42 (1.68)
Q3A-4	3.68 (1.65)	3.83 (1.65)	3.57 (1.67)	4.04 (1.18)	3.88 (1.24)	4.09 (1.17)	3.50 (1.76)	3.76 (1.68)	3.26 (1.85)
Q3A-5	2.29 (1.47)	2.33 (1.68)	2.26 (1.32)	4.22 (1.23)	3.92 (1.55)	4.32 (1.10)	2.50 (1.61)	2.41 (1.70)	2.58 (1.57)
Q3A-6	1.83 (1.26)	1.72 (1.32)	1.91 (1.24)	3.06 (1.59)	2.76 (1.71)	3.16 (1.55)	1.97 (1.46)	1.76 (1.35)	2.16 (1.57)
Q4A	5.78 (3.02)	5.39 (3.29)	6.09 (2.83)	7.91 (2.12)	8.16 (1.95)	7.83 (2.17)	5.33 (2.98)	5.18 (3.26)	5.47 (2.78)
Q4B	3.41 (1.41)	3.22 (1.59)	3.57 (1.27)	4.47 (0.87)	4.44 (0.77)	4.47 (0.90)	3.28 (1.47)	3.12 (1.58)	3.42 (1.39)
Q4C-1	2.51 (1.50)	2.06 (1.51)	2.87 (1.42)	3.11 (1.50)	3.56 (1.53)	2.96 (1.47)	2.28 (1.41)	1.88 (1.36)	2.63 (1.38)
Q4C-2	2.78 (1.59)	3.00 (1.64)	2.61 (1.56)	2.82 (1.45)	2.40 (1.44)	2.96 (1.44)	2.83 (1.48)	2.94 (1.68)	2.74 (1.33)
Q4C-3	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.10 (0.52)	1.04 (0.20)	1.12 (0.59)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
Q4C-4	1.05 (0.31)	1.00 (0.00)	1.09 (0.42)	1.11 (0.56)	1.24 (0.88)	1.07 (0.41)	1.06 (0.33)	1.00 (0.00)	1.11 (0.46)
Q4C-5	1.59 (1.00)	1.72 (1.23)	1.48 (0.79)	1.36 (0.82)	1.40 (1.12)	1.34 (0.70)	1.69 (1.14)	1.76 (1.25)	1.63 (1.07)
Q4C-6	2.85 (1.71)	2.56 (1.76)	3.09 (1.68)	3.97 (1.34)	3.76 (1.61)	4.04 (1.24)	2.61 (1.68)	2.47 (1.77)	2.74 (1.63)
Q4C-7	2.80 (1.74)	2.61 (1.69)	2.96 (1.80)	4.10 (1.30)	4.12 (1.09)	4.09 (1.37)	2.89 (1.80)	2.71 (1.83)	3.05 (1.81)
Q4C-8	1.15 (0.53)	1.11 (0.32)	1.17 (0.65)	1.23 (0.61)	1.20 (0.65)	1.24 (0.61)	1.22 (0.72)	1.06 (0.24)	1.37 (0.96)
Q4E-1	1.63 (1.07)	1.61 (1.24)	1.65 (0.93)	3.42 (1.51)	3.56 (1.56)	3.37 (1.46)	1.53 (1.00)	1.41 (0.94)	1.63 (1.07)
Q4E-2	2.39 (1.58)	2.17 (1.83)	2.57 (1.38)	4.20 (1.27)	4.48 (1.08)	4.11 (1.32)	2.36 (1.61)	2.18 (1.78)	2.53 (1.47)
Q4E-3	3.61 (1.48)	3.67 (1.50)	3.57 (1.50)	3.84 (1.32)	4.00 (1.12)	3.79 (1.39)	3.50 (1.48)	3.53 (1.46)	3.47 (1.54)
Q4E-4	1.85 (1.17)	1.72 (1.23)	1.96 (1.15)	2.40 (1.44)	2.16 (1.49)	2.47 (1.43)	1.78 (1.10)	1.53 (0.94)	2.00 (1.20)
Q4E-5	2.29 (1.49)	2.33 (1.71)	2.26 (1.32)	3.41 (1.52)	3.32 (1.77)	3.43 (1.44)	2.08 (1.36)	2.00 (1.46)	2.16 (1.30)
Q5A	4.00 (1.22)	3.78 (1.31)	4.17 (1.15)	4.55 (0.75)	4.84 (0.37)	4.46 (0.82)	3.94 (1.29)	3.71 (1.31)	4.16 (1.26)
Q5B	3.61 (1.45)	3.28 (1.49)	3.87 (1.39)	4.68 (0.66)	4.84 (0.47)	4.63 (0.71)	3.53 (1.52)	3.18 (1.47)	3.84 (1.54)
Q5C	3.93 (1.17)	3.61 (1.29)	4.17 (1.03)	4.42 (0.71)	4.72 (0.54)	4.32 (0.73)	3.92 (1.25)	3.53 (1.28)	4.26 (1.15)
Q5D	3.46 (1.31)	3.22 (1.35)	3.65 (1.27)	4.24 (0.79)	4.40 (0.71)	4.18 (0.81)	3.53 (1.40)	3.24 (1.39)	3.79 (1.40)
Q5E	3.71 (1.15)	3.72 (1.23)	3.70 (1.11)	4.29 (1.02)	4.20 (1.00)	4.32 (1.04)	3.78 (1.17)	3.76 (1.25)	3.79 (1.13)

variable, because the questions answered in every age group by people of different genders reveal the same range of significance toward the question asked. Therefore, we must show the gender variable in the results.

Nevertheless, the age variable does have an influence. In the question ‘What are the devices that you commonly use?’ (Q2A), the three age groups coincide in listing the Smartphone as their first option, with a significant difference with the 30–60 age group, whose average approaches daily use, with a typical deviation of 0.49. As the second most used device, the PC appears in the 30–60 age group,

although closely followed by the Laptop and the Tablet (despite the Tablet being the fourth most used device, it has a frequency of use that is superior to the second most used device according to the other age groups, with an average of 3.31). In the ‘under 30’ age group, the Laptop is the second most used device, while the ‘over 60’ group answered the Tablet. If we translate this question to the educational framework (Q4C), the first option for the 30–60 age group is the PC, followed by the Laptop and the Smartphone. The ‘under 30’ group chose the Laptop as the first device, the PC as the second, and the Tablet as the

third. The ‘over 60’ group also chose the PC as the most used device for learning, followed closely by the Tablet, and lastly, the Laptop.

Regarding the use of ICT, the 30–60 age group is the most technologically active in their learning, and this is seen in the frequency of use of their most used device, the Smartphone, with a frequency of 3.11, which is superior to the frequency of the device used for learning in the ‘under 30’ group (Laptop, 2.85) and also superior to the frequency of use for those over 60 (PC, 2.89). These results are also in line with the response of the 30–60 age group about whether they use ICT for educational purposes (Q4A), with an average of 7.91 over 10 and a tendency to use technology for this objective anywhere and at any time (Q4B), which brings them much closer to the concept of m-learning.

These responses are also coherent with the motivation and perception of help and satisfaction from the use of ICT (block 5), where the 30–60 age group is the most positive toward the use of technology, with averages above 4 in all responses. However, the youngest group is the most critical with regard to its satisfaction with the applications used and motivation to use technologies with learning or working aims. If we focus on applications from the point of view of access to information sources (Q3A), YouTube is the application used most often by both the under 30s and over 60s; however, for the 30–60 age group, YouTube is the second most used option after Dropbox, which indicates the work-oriented character of this group. When they asked about the educative use of applications (Q4E), both under 30s and over 60s rank Wikipedia as their main source of information and Google as their second, while the 30–60 age group flips these answers to choose Google as the first and Wikipedia as the second.

Likewise, we have studied the responses in terms of the participants’ levels of education. For that, we defined five levels (study level): SL1–2: without education or primary level, SL3–4: secondary and undergraduate level, SL5: professional studies, SL6: university studies (undergraduate degree and master’s), and finally SL7: doctorate. The distribution of the sample is shown in Table 3.

The results obtained based on education level are shown in Table 4.

**Table 3** Distribution by education level

Study levels	Samples	Male	Female
SL1–2	9	3	6
SL3–4	40	32	8
SL5	7	4	3
SL6	62	41	21
SL7	65	50	15

When we focus on the education levels in the analyzed results, we may argue that the higher the level of study, the more devices and applications are used, both in a general and in an educational way. Furthermore, the two groups with the highest levels of education are the most satisfied with and motivated to use technology.

In general, the most used device (Q2A) independent of education level is the Smartphone, although the frequency of use increases along with education level. As the second most used device, it is curious that at the lowest education level is the Fitband, though it has a very significant typical deviation for the average value. In other groups, the PC and the Laptop appear as the next option. When asked about the educational use of devices (Q4C), level SL1–2 again chooses the Smartphone as the most used device, followed by the SmartTV, although the typical deviation is again quite significant. In other levels, the most used device for learning is the computer, being either a Laptop or a PC, distinguishing between levels SL3–4 and SL5 (whose second most used device is the Smartphone) and levels SL6 and SL7 (whose second most used device is the computer, complementing the first device, so if the first one is the Laptop, then the second one is the PC, and vice versa).

Finally, we analyzed the information obtained according to the professions of the participants in the sample. For this, we distinguished between four professional levels: BP1, Housewife, Retired, Unemployed; BP2: Student (all levels); BP3: Professional (dependent and independent); and BP4: Teacher/Researcher. Table 5 shows the initial distribution.

The results obtained according to professional or personal activity expressed by the participants are shown in Table 6.

When we analyze the results obtained using the variable of profession, we see once again that the most used device (Q2A) is the Smartphone, with a frequency close to daily use in the Professional and Academic sectors, and also quite frequent in the Student group. In all groups, the second most used device is the computer, being a Laptop or a PC. When the general use is aimed toward learning (Q4C), group BP1 chose the Laptop in the first place and the PC as the second most used; groups BP3 and BP4 chose first the PC and secondly the Laptop, while group BP2, which represents Students, chose the Laptop as the first one and the Smartphone as the second device.

Regarding the applications related to information, YouTube is the most significant one, being the most used by all groups except for the Teacher/Researcher group, for which it is the second option, though with an average frequency of use that is superior to the rest of the professional groups. When asked about the educational

**Table 4** Answers by education level: average (standard deviation)

	SL1-2	SL3-4	SL5	SL6	SL7
Q2A-1	2.56 (1.88)	4.35 (1.03)	4.14 (1.46)	4.65 (1.01)	4.85 (0.64)
Q2A-2	1.00 (0.00)	2.68 (1.51)	2.57 (1.99)	3.11 (1.52)	3.54 (1.37)
Q2A-3	1.33 (1.00)	1.20 (0.88)	1.00 (0.00)	1.47 (1.24)	1.54 (1.20)
Q2A-4	2.00 (1.41)	1.58 (1.36)	1.00 (0.00)	1.56 (1.36)	1.32 (0.81)
Q2A-5	1.67 (1.41)	2.20 (1.40)	1.00 (0.00)	2.87 (1.63)	2.62 (1.67)
Q2A-6	1.33 (1.00)	3.53 (1.32)	2.57 (1.62)	4.00 (1.40)	4.45 (0.98)
Q2A-7	1.22 (0.67)	2.98 (1.51)	3.14 (1.68)	3.97 (1.56)	4.49 (1.19)
Q2A-8	1.78 (1.56)	1.80 (1.29)	1.14 (0.38)	1.94 (1.44)	2.02 (1.30)
Q3A-1	1.44 (0.73)	3.10 (1.48)	3.00 (1.53)	3.52 (1.51)	3.34 (1.48)
Q3A-2	1.22 (0.67)	3.05 (1.47)	1.86 (1.46)	2.66 (1.53)	2.49 (1.58)
Q3A-3	2.44 (1.81)	3.00 (1.38)	1.43 (0.79)	2.90 (1.60)	2.86 (1.57)
Q3A-4	1.22 (0.44)	3.95 (1.08)	3.43 (1.51)	4.08 (1.22)	4.11 (1.24)
Q3A-5	1.00 (0.00)	2.40 (1.13)	1.86 (1.46)	3.81 (1.50)	4.38 (0.93)
Q3A-6	2.89 (2.80)	1.95 (1.26)	1.43 (0.79)	2.90 (1.59)	3.12 (1.54)
Q4A	2.00 (1.50)	7.23 (1.85)	6.29 (3.25)	7.48 (2.30)	8.09 (1.88)
Q4B	1.44 (1.01)	3.95 (1.04)	3.86 (1.35)	4.18 (0.95)	4.49 (0.87)
Q4C-1	2.44 (1.81)	3.23 (1.37)	2.71 (1.80)	3.06 (1.45)	3.06 (1.49)
Q4C-2	1.00 (0.00)	2.43 (1.48)	2.43 (1.90)	2.85 (1.49)	2.92 (1.37)
Q4C-3	1.00 (0.00)	1.08 (0.47)	1.00 (0.00)	1.10 (0.53)	1.08 (0.41)
Q4C-4	1.22 (0.67)	1.10 (1.56)	1.00 (0.00)	1.15 (0.62)	1.06 (0.39)
Q4C-5	1.44 (1.33)	1.33 (0.41)	1.00 (0.00)	1.48 (0.99)	1.40 (0.86)
Q4C-6	1.00 (0.00)	3.58 (1.54)	2.57 (1.99)	3.87 (1.32)	4.06 (1.25)
Q4C-7	1.00 (0.00)	2.83 (0.99)	3.71 (1.50)	3.68 (1.58)	4.14 (1.30)
Q4C-8	1.00 (0.00)	1.18 (0.35)	1.29 (0.76)	1.18 (0.56)	1.26 (0.64)
Q4E-1	1.11 (0.33)	1.98 (0.67)	1.29 (0.76)	2.60 (1.56)	3.75 (1.31)
Q4E-2	2.00 (1.22)	3.18 (1.12)	2.71 (1.70)	3.66 (1.58)	4.26 (1.20)
Q4E-3	1.11 (0.33)	3.43 (1.26)	3.43 (1.81)	3.66 (1.39)	4.03 (1.16)
Q4E-4	1.33 (1.00)	2.15 (1.27)	1.57 (0.98)	2.23 (1.26)	2.46 (1.48)
Q4E-5	2.89 (1.69)	2.10 (1.17)	2.71 (1.89)	3.13 (1.44)	3.48 (1.56)
Q5A	2.00 (1.12)	4.33 (0.69)	3.71 (1.11)	4.53 (0.72)	4.60 (0.75)
Q5B	2.89 (1.05)	4.25 (0.84)	3.43 (1.40)	4.52 (0.88)	4.72 (0.63)
Q5C	2.00 (1.12)	4.25 (0.74)	3.71 (1.38)	4.50 (0.74)	4.31 (0.75)
Q5D	3.00 (1.41)	3.90 (0.84)	3.57 (1.40)	4.31 (0.74)	4.20 (0.81)
Q5E	2.56 (1.88)	4.08 (0.86)	3.86 (1.46)	4.26 (0.87)	4.34 (1.06)

**Table 5** Distribution by professional activities

Professional level	Samples	Male	Female
BP1	41	23	18
BP2	30	22	8
BP3	36	16	10
BP4	76	49	17

framework, Wikipedia and Google are the most used in all groups, alternating between the first and second most used; Google is the most used for Professionals and Academics.

Regarding the perception of usefulness, satisfaction, and motivation, although generally high in all groups, it reaches maximum values in the Professional and Academic groups;

Academics value technology the most as an aid to work and learning; while the Professional group is more satisfied with technology and more motivated to use it.

Additionally, it is necessary to remark that for every section with multiple options, and with the aim of completing the answers, users had the option to add more devices, applications, and comments in an open question. Breaking down the results obtained in each main section, we can summarize the following findings:

- Q2 ('What are the devices that you commonly use?'): We obtained 26 additional answers. The most cited options are the use of conventional TV (5 times), gaming consoles (3), e-books (3), and virtual reality headsets (3);

**Table 6** Answers by professional activities: average (standard deviation)

	BP1	BP2	BP3	BP4
Q2A-1	3.73 (1.72)	4.30 (0.95)	4.86 (0.49)	4.89 (0.56)
Q2A-2	3.00 (1.66)	2.47 (1.41)	2.81 (1.56)	3.59 (1.36)
Q2A-3	1.20 (0.87)	1.27 (1.01)	1.50 (1.28)	1.50 (1.16)
Q2A-4	1.46 (1.27)	1.43 (1.10)	1.81 (1.60)	1.28 (0.76)
Q2A-5	2.27 (1.47)	1.93 (1.26)	2.69 (1.64)	2.80 (1.71)
Q2A-6	3.07 (1.71)	3.53 (1.20)	3.78 (1.49)	4.51 (0.95)
Q2A-7	2.85 (1.71)	2.80 (1.52)	4.03 (1.48)	4.54 (1.15)
Q2A-8	1.56 (0.95)	1.97 (1.50)	1.86 (1.50)	2.00 (1.31)
Q3A-1	3.10 (1.67)	3.10 (1.56)	3.44 (1.48)	3.32 (1.47)
Q3A-2	2.17 (1.34)	3.50 (1.41)	2.53 (1.54)	2.50 (1.56)
Q3A-3	2.27 (1.61)	3.13 (1.25)	2.75 (1.57)	2.91 (1.55)
Q3A-4	3.68 (1.65)	4.03 (1.00)	3.92 (1.20)	4.09 (1.19)
Q3A-5	2.29 (1.47)	2.77 (1.28)	3.44 (1.63)	4.47 (0.84)
Q3A-6	1.83 (1.26)	1.97 (1.19)	2.64 (1.62)	3.30 (1.51)
Q4A	5.78 (3.02)	7.73 (1.60)	7.14 (2.34)	8.20 (1.79)
Q4B	3.41 (1.41)	3.97 (1.00)	4.25 (0.94)	4.50 (0.84)
Q4C-1	2.51 (1.50)	3.23 (1.28)	3.19 (1.55)	3.09 (1.46)
Q4C-2	2.78 (1.59)	2.30 (1.49)	2.58 (1.50)	2.99 (1.38)
Q4C-3	1.00 (0.00)	1.13 (0.57)	1.17 (0.70)	1.05 (0.36)
Q4C-4	1.05 (0.31)	1.10 (0.31)	1.25 (0.81)	1.04 (0.34)
Q4C-5	1.59 (1.00)	1.17 (0.38)	1.28 (0.61)	1.42 (0.93)
Q4C-6	2.85 (1.71)	3.90 (1.06)	3.64 (1.48)	4.12 (1.19)
Q4C-7	2.80 (1.74)	2.60 (1.61)	3.72 (1.47)	4.18 (1.25)
Q4C-8	1.15 (0.53)	1.17 (0.46)	1.17 (0.61)	1.26 (0.66)
Q4E-1	1.63 (1.07)	2.13 (1.28)	2.14 (1.57)	3.87 (1.20)
Q4E-2	2.39 (1.58)	3.13 (1.31)	3.83 (1.50)	4.34 (1.09)
Q4E-3	3.61 (1.48)	3.17 (1.29)	3.39 (1.38)	3.99 (1.23)
Q4E-4	1.85 (1.17)	1.87 (1.07)	2.19 (1.33)	2.55 (1.45)
Q4E-5	2.29 (1.49)	2.17 (1.34)	3.03 (1.44)	3.51 (1.48)
Q5A	4.00 (1.22)	4.30 (0.70)	4.53 (0.74)	4.59 (0.73)
Q5B	3.61 (1.45)	4.17 (0.87)	4.58 (0.73)	4.75 (0.59)
Q5C	3.93 (1.17)	4.17 (0.79)	4.58 (0.60)	4.34 (0.72)
Q5D	3.46 (1.31)	4.03 (0.81)	4.31 (0.71)	4.22 (0.79)
Q5E	3.71 (1.15)	4.17 (0.91)	4.42 (0.81)	4.30 (1.03)

- Q3 ('What are your favorite applications?'): We obtained 62 additional answers. The most cited options are the use of WhatsApp (16 times), Internet navigators (3), and Google Maps (3);
- Q4D ('What are the devices that you commonly use to learn?'): We obtained 9 additional answers. The most cited option is the use of TV (3 times), without any other repetition;
- Q4F ('What applications do you use to learn?'): We obtained 25 additional answers. The most cited option was YouTube (7 times), and Moodle systems (3). No more repetitions have been found;

- Q4G ('If you learn in places other than educational institutions, what tools and devices do you use?'): On this occasion, we obtained 76 complementary answers. The most cited devices are PC (18 citations), Smartphone (12), Laptop (8), and Tablet (7). Focusing on applications, we find that Google suite is the most cited application (5 times), YouTube for online tutorials (4), and books, journals, and magazines in general (8).

To summarize, users that answered the survey consider ICT to be part of the future of education because ICT is able to help students by improving their access to information. Nevertheless, a number of divergent opinions are also presented, such as the view that the role of these technologies in the field of education is overvalued, and the rapid and constant evolution that they experience causes users who are less familiar with technology to be easily marginalized. Users such as Retirees and Housewives end up incorporating technologies into their lives sharing experiences more than through necessity, although they appear to be satisfied with the uses they give them, and according to them 'they improve quality of life and the day-to-day.'

Another finding relates to the educational challenge that supposes ICT is incorporated in current methodologies. In this vein, the interoperability, and the allowance, of several formats and ways of communication and the aperture to the use of mobile devices in a natural way at every educational level and in professional activities [150–152] are key factors to address.

## 5 Conclusions

We live in a highly digitalized society, with continuous access to direct and indirect technology regardless of age, education, or profession. In order to evolve and create a real information society, people must have basic ICT competences that allow them to access sources of knowledge and permit them to benefit from those sources by recognizing their quality and reliability.

Modern society's technological bias makes learning necessary for all groups to get a job, learn an activity, or simply communicate with other people and be informed. This implies a need to access technological devices and possess a set of basic abilities to interact with technological elements and their applications.

New conceptions regarding information systems, such as technological ecosystems, consider this and include users as another part of the ecosystem that must integrate and inter-operate with the rest of their components in order to achieve the desired goal.

An important characteristic of these ecosystems is that they evolve, moving toward a flexible and transparent format for users which requires them to interact with it from any device and in any location; that is to say, we are approaching a ubiquitous and mobile environment. Smartphones are the most used devices for all user types, and although they are not the most used for every purpose, as seen in the educational context, their presence is gaining strength.

Another important detail to consider is the functional complexity of these technological ecosystems. More advanced users, a group that usually corresponds with those with more education and working in professional or academic employment, demand more services and greater flexibility of access, thus creating a new potential gap in technology for those users with a reduced number of digital competences. The barrier to development is not only seen between those who have these abilities and those who do not; it is also seen between those who are able to reach their full potential within the ecosystems that shape our social and professional activities and those who are just getting by, and perhaps unable to keep pace with the rapid evolution of the technology that surrounds us.

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