Check for updates

How "basic" is basic digital literacy for older adults? Insights from digital skills instructors

Anina Vercruyssen[1]*, Werner Schirmer[2], Nelly Geerts[2] and Dimitri Mortelmans[1]

[1]Center for Population, Family and Health, Faculty of Social Sciences, University of Antwerp, Antwerp, Belgium, [2]Department of Sociology, TOR Research group, Vrije Universiteit Brussel, Brussels, Belgium

Introduction: With the continuing advancement of digitalization of everyday life, digital literacy becomes more and more a necessity. As a consequence, those who are digitally illiterate experience digital exclusion, which increasingly equals social exclusion. Older adults are typically less digitally active and also less skilled in digital technologies than younger cohorts. Digital inclusion frameworks by governmental and supra-national organizations, on the one hand, and academic definitions of "digital literacy" or "digital skills", on the other hand, tend to include a broad set of competencies next to technical understanding, such as cognitive and social-emotional skills. However, we argue the problem that expectations of what digital literacy commonly entails are too high level for older adults with no pre-existing digital experience with computers, internet, smartphones, or tablets. Even what is considered as entry-level, basic digital skills, or foundational skills, can be very demanding for older adults with limited or no prior knowledge of and practice with digital technologies.

Methods: To make our point, we draw on own data from interviews with 26 digital skills instructors who give training to older adults in Belgium (collected between December 2020 and February 2021).

Results: We provide empirical evidence for the circumstances that even seemingly basic digital skills, such as getting a device started or downloading apps, can be very demanding and anything but trivial for older adults without prior experience. We demonstrate evidence along three interrelated domains: (1) ICT-jargon and terminology; (2) Hardware; (3) Software and Internet. Each of these domains entail hurdles of knowledge and understanding that need to be overcome for these older adults before we can start addressing the higher goals of digital literacy frameworks.

Discussion: The main implication from this article is that even the most basic tenets of digital technology are neither trivial nor simple to grasp for older adults with no or limited prior experience — a point not sufficiently addressed by current frameworks of digital skills/literacy/competence.

KEYWORDS

digital literacy, older adults, digital skills instructors, digital inclusion and exclusion, digital skills acquisition

Introduction

Digitalization of everyday life of older adults

Digital technology has an empowering potential for older adults because it allows overcoming physical barriers and, thereby, facilitates contact with geographically remote family and friends, and enables cultural participation, access to information, shopping, banking, and health services from home. Having the necessary digital literacy can increase independence, promote the physical and

mental well-being of older adults (Choi and DiNitto, 2013), prevent cognitive decline (Tun and Lachman, 2010), and is helpful to maintain identity (Martin, 2009). As such, increasing digitalization has advantages for those older adults who are sufficiently skilled. The growing uptake of digital services gradually crowds out non-digital alternatives and compels individuals to integrate digital technologies as an essential component into their everyday lives. This is observable in the shift to online-banking and e-services, accompanied by shutting down manned counters and reduced office hours, in-person contact is replaced by video-calls, text messages or chatbots. Even tickets to public transport or museums are sold through apps. Hence, digital skills become more and more a necessity for social inclusion and participation.

Digital exclusion—the lack of access and skills to use digital technology—increasingly equals social exclusion, and this threatens people of all ages, not just older people (Robinson et al., 2015; Helsper, 2021). The frequently noted 'digital divide' does not differentiate older from young or middle aged people, but cuts across the older population along dimensions of access, skills, and attitudes (Peral-Peral et al., 2015; Friemel, 2016; Schreurs et al., 2017). Lack of access to devices and internet is only a first barrier, while differences in skills forms a "second level divide" (Hargittai, 2002). Of course, not all older adults automatically experience digital exclusion. Like any age group, the older population is highly diverse. With regard to digital literacy and skills, there are differences in gender, social status, education, personal biographies, health, and levels of self-efficacy (Barnard et al., 2013; Peine and Neven, 2021). Accordingly, the stereotypical view that all older adults are technologically incompetent needs to be rejected (Broady et al., 2010; Peral-Peral et al., 2015; Neves et al., 2018; Quan-Haase et al., 2018).

Age, generation, and digital technology

While old age alone in absence of other variables is not the greatest predicator of digital technology adoption, there is evidence that older adults, in a Belgian context usually defined as 65+, are typically less digitally active as well as less comfortable and less skilled in digital technologies than younger cohorts (Broady et al., 2010; Blažič and Blažič, 2018, 2020; Castilla et al., 2018). Also within the older population, the "young-old" (65–74 as compared to 75–84 and 85+) are more likely to have higher education levels and also better internet skills (Hargittai and Dobransky, 2017; Hunsaker and Hargittai, 2018; Campens et al., 2022). Hence, both generation and age-related factors need to be considered. Generation-related factors are typical for a certain era of socio-cultural evolution. With regard to technology adoption, it makes a difference whether one grows up in the non-digital 1950s, the 1980s when home computers became popular, or today when mobile internet, smartphones, and social media are ubiquitous (Schirmer et al., 2022). People of older generations had less opportunities to interact with digital technologies (Bhattacharjee et al., 2020) and often feel to be outsiders of digital culture (Blažič and Blažič, 2020). Age-related factors also tend to hit people of a certain age regardless of the specific era and refer to changes in cognitive and perceptual abilities (Czaja and Lee, 2007), for example learning, memory, attention, hearing and vision, but also physical, motoric and sensual changes. All of these changes affect autonomy and, as a consequence, can lead to psychosocial changes such as loss of self-esteem or identity crises (Martin, 2009; Gatti et al., 2017). In times in which ageing in place (i.e., at home) is strongly encouraged, such hindrances should be taken into account.

When it comes to learning how to use digital technologies in a way that fosters independence and participation in digital society for older adults, both generation and age need to be taken into account because they happen to intersect in the contemporary older population. Generation and age-related factors can add up and mutually aggravate the attainment of digital literacy when individuals experience the effects of physical or cognitive ageing while they cannot relate to the latest digital fads. As a result, older adults may believe they are too old and lose confidence in their ability to learn. Even those older adults with prior ICT experience from work often do not keep up with later evolution of digital technology after retirement (Selwyn, 2004). They may feel too old to understand it while they actually find a given technology uninteresting and hence lack motivation to learn it (Geerts et al, 2023a). They may also feel overwhelmed by the amount of information they need to learn. Against this background of advancing digitalization of everyday life, as well as generational and age-related barriers to digital technologies, digital literacy is deemed essential to digital inclusion of older adults, and even a right compared to classical literacy (Martin, 2009). As a key to becoming digitally literate at older age, research stresses the importance of a supportive social network of "warm experts" (such as family members and friends who provide informal support, see Bakardjieva, 2005; Olsson and Viscovi, 2020; Geerts et al, 2023b) as well as formal trainings specifically targeting older people (Delello and McWhorter, 2017; Ferreira et al., 2017; Blažič and Blažič, 2018; Chiu et al., 2019; Pachis and Zonneveld, 2019; Flauzino et al., 2020; Pihlainen et al., 2021).

Digital literacy, digital skills and digital competence

With the advancing digitalization of everyday life, we have to consider what "becoming digital literate" actually means, and what its central components are that older adults should master. As some authors (Ilomäki et al., 2011; Iordache et al., 2017; van Laar et al., 2017; Audrin and Audrin, 2022) note, the academic literature uses terms such as digital literacy, digital skills, digital competences, internet skills, ICT literacy, or 21st century skills interchangeably, despite some differences regarding scope and specificities. Originally coined by Gilster (1997, p. 1) in the 1990s, digital literacy referred to "the ability to understand and use information in multiple formats from a wide variety of sources when it is presented via computers." Today, there is no final consensus about the definition of digital literacy. It appears to be multifaceted with different interpretations responding to the interests and scope of different disciplines (Martínez-Bravo et al., 2020; Audrin and Audrin, 2022). A recent literature review by van Laar et al. (2017) reveals that digital skills depict more narrowly the technical abilities to use the digital devices and services, whereas digital literacy is usually defined as a broader set of competencies that goes beyond technical skills but includes cognitive and social–emotional skills. Next to operating the machines, literacy is also about accessing, evaluating and handling information (Oh et al., 2021) which brings digital literacy closer to critical media literacy (Kellner and Share, 2005). Eshet (2012) even adds socio-emotional literacy as an element of digital literacy, which refers to understanding and following of behavioral rules that prevail in internet spaces. Despite some disagreements on the detail level, there seems to be consensus that

digital literacy must mean much more than mere technical skills of operating the devices (van Laar et al., 2017). Gilster (1997, pp. 1–2) already said that "digital literacy is about mastering ideas, not keystrokes".

The problem that we address in this article is that these expectations of what digital literacy entails are way too high for many digitally excluded older adults with no pre-existing digital experience. In order to master the non-technical aspects, i.e., the cognitive and socio-emotional aspects of digital literacy, one does need basic technical skills to begin with. Critical evaluation of information is a skill that applies when reading a printed newspaper or pamphlet with questionable reputation, but if you do not know how to operate a web-browser, not to mention the computer running the browser, these skills do not help much. Hence, keystrokes could refer to writing code, but when applied to digital illiterate older adults without prior ICT knowledge, it could also mean the ability to use a keyboard in the first place.

If we look at definitions of narrower concepts such as digital skills or digital competence, the problem remains the same. Digital skills include technical elements but also content creation and communication (Van Deursen and Van Dijk, 2010; Iordache et al., 2017; Audrin and Audrin, 2022). Ilomäki et al. (2011) conceptualize digital competences in a similar way as others define digital skills, also stressing the technical aspects but including the ability to use the technologies meaningfully in (professional and) everyday life, to critically evaluate the technologies and to participate in digital culture. For Picatoste et al. (2018), digital competences are "a set of different skills for achieving a good performance on digital society and which is a multi-faceted moving target, covering many areas and literacies and rapidly evolving as new technologies appear." Martin (2009) explicitly distinguishes digital literacy from the more basic digital competence, suggesting the latter to include, among others, finding information, word processing, creation and manipulation of digital images, use of spreadsheets, creation of presentations. The step from competence toward literacy means the ability to apply these competences successfully in the right situations and in the right environments.

What all these academic definitions of digital literacy, skills, and competences have in common is that they are relatively high-level in a double sense. On the one hand, the components are very abstract as to comprising as many applications and situations as possible. On the other hand, they are aimed on level of abilities that presupposes a lot of pre-knowledge and experience. If digital literacies, skills, and competencies are defined like this, they seem out of reach for older adults with no prior exposure to computers, internet and smartphones. Digital inclusion frameworks by government and supra-national organizations, such as the DigComp framework by the European Commission (Ferrari and Punie, 2013; Vuorikari et al., 2022) are formulated at equally high levels when they outline digital competence as including information management, communication, content creation, safety, and problem-solving. The policy brief "Ageing in the Digital Era" of the United Nations Economic Commission for Europe UNECE (2021) follows the academic definition of digital literacy and gives examples such as using email applications, e-government, e-banking, e-commerce and social media profiles. For regular internet users of all ages, these skills pose no problem, and form the core of their digitalized everyday life.

Aims of this study

The stance of this article is of descriptive nature. We put forward an argument that we substantiate with empirical evidence from own data from interviews with digital skills instructors who give training to older adults. Our central claim in this article is that the prevailing academic and political frameworks of digital literacy, skills, and competences miss the mark for digitally illiterate older adults. Even what is considered as entry-level, basic digital skills (Zimba et al., 2021), or foundational skills to use digital devices and applications rudimentarily (such as operating devices, connecting to the internet, and setting up accounts) can be too demanding and presumptuous for older adults with limited or no prior knowledge and practical experience with digital technologies. To make our point, we provide empirical evidence for the circumstance that even seemingly basic digital skills are anything but trivial for novices. We demonstrate this along three domains: (1) ICT-jargon and terminology; (2) Hardware; (3) Software and Internet.

Methodological background and empirical data

The argument of this article is supported by empirical evidence collected through one particular sub-study within the context of a larger multidisciplinary research project on the digital inclusion of older adults in Flanders, the Dutch-speaking region of Belgium. The overarching project investigates several aspects of digital inclusion of older adults (digital inequalities among older adults, digital skills acquisition and support, social life with digital means, and digital ageism) and makes use of qualitative interviews with older internet users/non-users and digital skills instructors, focus groups with older adults and warm experts, as well as large-scale quantitative data sets and participant observations in other sub-studies.

The evidence for the argument put forward in the present article is taken from 26 individual in-depth interviews with people who teach digital skills to older adults. The respondents were recruited through an open call spread through the official overarching advisory body for the Flemish interest organizations for older adults, as well as through the channels of Flemish digital inclusion initiatives, resulting in 8 female and 18 male respondents (age 26–79, mean age 62). Six of them are in employment for different organizations (teaching ICT classes as one of their tasks), and 20 are retired and give trainings to older adults on a voluntary basis (see Table 1). The main inclusion criterion for participating in the study was being active as a digital skills instructor for older adults. There was no requirement of any formal degree or minimal amount of years of experience. Among the retired volunteers, 11 have a background in education (for instance high school teachers). The respondents teach in variety of forms ranging from courses for smaller (5–7 participants) and bigger groups (up to 15 participants), open walk-in sessions, to series of home visits in one-on-one sessions. Most of these trainings are free of charge and organized through municipalities or retirees' organizations.

The interviews were conducted by trained researchers employed in the overarching research project, and took place between December 2020 and February 2021. Due to the Covid-19 restrictions (lockdowns), we had to conduct the interviews via digital platforms (Teams, Zoom, Skype, Facetime). Before participation, the

TABLE 1 Overview of respondents.

Pseudonym	Age	Gender	Occupation	Type organisation
Anne	66	F	Retired, volunteer	Digital inclusion initiative
Carolien	63	F	Retired, volunteer	Various
David	65	M	Retired, volunteer	Municipality
Fred	78	M	Retired, volunteer	Municipality
Gilles	67	M	Retired, volunteer	Pensioners' organisation
Hubert	68	M	Retired, volunteer	Digital inclusion initiative
Inge	70	F	Retired, volunteer	Digital inclusion initiative
Jacob	67	M	Retired, volunteer	Pensioners' organisation
Johan	70	M	Retired, volunteer	Pensioners' organisation
Joris	37	M	Social worker	Digital inclusion initiative
Kathleen	40	F	Social worker	Digital inclusion initiative
Laurent	68	M	Retired, volunteer	Pensioners' organisation
Nathaël	74	M	Retired, volunteer	Digital inclusion initiative
Peter	74	M	Retired, volunteer	Adult education
Pieter	66	M	Retired, volunteer	Municipality
Robert	72	M	Retired, volunteer	Pensioners' organisation
Roos	66	F	Retired, volunteer	Pensioners' organisation
Seppe	30	M	Social worker	Governmental training center
Walter	70	M	Retired, volunteer	Municipality
Willem	65	M	Retired, volunteer	Digital inclusion initiative
William	67	M	Retired, volunteer	Pensioners' organisation
Wout	40	M	Computer specialist	Adult education
Wouter	66	M	Retired, volunteer	Digital inclusion initiative
Zala	26	F	Social worker	Pensioners' organisation
Véronique	69	F	Retired, volunteer	Social welfare organization
Viviane	51	F	Social worker	Digital inclusion initiative

respondents were briefed about the procedure and signed an informed consent form. The interview lengths ranged from 49 up to 97 min (average 74 min) and followed a semi-structured guideline, but left sufficient narrative freedom in order to elicit a large variety of accounts. An array of topics was covered such as the challenges of teaching digital skills to older adults (depending on the organization they work for, "older" usually starts at 55, 60 or 65 years of age), their experiences with and observation of older participants and their specific needs, and the instructors' overall views about the digitalization for the everyday lives of older adults. The interviews were transcribed verbatim, coded and analyzed with the software package MAXQDA. For the purposes of the research aims of the overarching project, the coding of the data was guided by grounded theory (Corbin and Strauss, 1990; Gibson and Hartman, 2013; Charmaz, 2014). The coding was done by two researchers individually and, in order to increase reliability, throughout a number of joint coding sessions to discuss potential ambiguities. The coding took place in three iterative steps (from more open inductive to more deductive axial and selective coding phases) with research goals for the other sub-studies in mind. Apart from the coding procedure, we did not further follow grounded theory for the present study because we did not intend to build any explanatory theory. For the

purposes of the present paper, we used the coded data material as a repository to provide illustrative evidence for our case.

With regard to the specific aims of the present article, we organized a peer debriefing. We listed initial findings and presented these to a group of respondents and other experts on digital inclusion in a workshop specifically set up for mutual feedback in order to verify and add nuance to our findings.

All interviews and transcripts were originally in Dutch; the excerpts reported in this study have been translated to English by the authors. The transcripts were stripped of any personal information that could identify the respondents, their names have been pseudonymized for the excerpts in the next section. The overarching project and its subprojects have been approved by the ethical commission of the host university of the principal investigator of this overarching project.

Three domains of essential problems with digital skills acquisition at older age

In this section, we present evidence to substantiate our claim that that there is a most foundational layer of digital skills that poses major

difficulties for absolute beginners to overcome before we can start thinking about higher goals such as media literacy or content creation. Digital inclusion initiatives aimed at older adults need to take this into account. This section is not a typical results/analysis section. Instead, the excerpts from our empirical data that we present serve as firsthand accounts of those at the frontline of teaching digital skills to older adults.

Teaching digital literacy is about teaching to master the everyday life with the help of digital means. The instructors in our study teach digital skills to a variety of audiences of older adults who have varying degrees of previous experience. While this is less of a problem in one-on-one sessions at home, it can be a challenge in a classroom with 10 participants. Even if the course topic is thematically demarcated as introduction to smartphones, to internet, or to windows computers, courses usually attract an audience with differential prerequisites with regard to motivation, knowledge, or practical experience. Some people have no device and never owned one, some people bought a device or got it gifted by their family but know nothing about how to use it, some people had used computers in their professional lives in the pre-internet era but have not followed the digital evolution since then, and may know about MS-DOS but not about Android, and all of them take the same beginner's lesson. Under these circumstances, it can be challenging to find a good starting point that does not alienate participants from the outset.

The complexity of digital technology can be overwhelming and its various dimensions (vocabulary, hardware, software, internet, safety) are difficult to navigate for beginners. There is no strict sequence to teach foundational digital skills because its basic components are multi-referential and aptitude in one domain presupposes grasping the others. In order to appreciate the functionality of software, one needs a comprehension of hardware; in order to understand the functionality of hardware, one needs to know the vocabulary, which in turn requires to understand the functionality of the hardware and software.

As we will show in this section, foundational digital skills, too, require tactile dexterity, cognitive processing of information, problem-solving, memory, and knowledge—just on a much more basic level than high level frameworks and definitions of digital literacy aim for. It is important to recognize that even the most basic activities are not trivial for novices. ICT instructors and policy-makers should avoid the mistake of looking down at these people. The key for grasping this thought is to put oneself in the position of somebody who is completely lacking digital skills, does not see the utility of a particular technology, does not speak the language, does not know the social codes on internet platforms. How does the world look like if you are not familiar with devices, software, operative systems, or the vocabulary? From that viewpoint, the thresholds experienced by many older adults to learn digital skills surely look less trivial.

In this section, we illustrate each of the three domains of stumbling blocks for older adults with excerpts from our data. These domains became apparent in the axial coding phase. In these excerpts, the instructors describe typical problems they encounter in their practice with teaching to older participants. We begin with ICT-language and jargon, then proceed with hardware, followed by software, which is nowadays intertwined with internet use (downloading apps, updates, etc.).

ICT-language and jargon

Our research project focuses on the Flanders Region of Belgium, in which the official language spoken by the majority of the population is Dutch. As is the case in many non-Anglo Saxon countries, most ICT-related terms—for instance computer, tablet, smartphone, swipe, download, update, app, cursor, Wi-Fi—are simply imported from English without any particular established equivalents in Dutch vernacular. In few cases there are translations, such as the word "verkenner" which happens to confuse novices because it can either refer to the explorer when it is about file management, or to the browser when it is about surfing the internet.

The fact that many ICT-terms come from English forms a first hurdle toward digital literacy because many of the older participants do not have sufficient proficiency of English. When the oldest old went to school English was yet not part of the curriculum. Those who did once learn English may not have practiced for many years. Aggravating is the fact that most ICT-related terms are technical and remote from the vocabular needed in everyday conversations. All these trainings take place in Dutch and need to address this issue adequately or they will lose their audience before the start. Here are some accounts:

> *The English terminology, they have a lot of problems with that… We have to teach that slowly. I usually translate it or I give a description of the English word… yes, that takes time of course. It's not fast if you're teaching retirees, huh?* (Robert, 62)

> *The language that is frequently used is English. And those seniors often did not learn English at school [back in the day].* (Willem, 75)

> *When I started working at [organization for older adults], it was mainly like "Does it really all have to be in English?" (laughs) Oh boy… So yes, I've already started working on a translation dictionary … because we really do see that there is a huge need for it.* (Kathleen, 40)

The English words make comprehension difficult, but switching to Dutch does not solve the problem entirely because many technical terms that are evident to experienced users are like an obscure jargon for many older adults. Even if you offered a translation in their mother tongue, the terms sound meaningless if they are unfamiliar with the underlying hardware- or software-related concept the terms refer to. Whether English or Dutch, instructor Zala emphasizes that it is still a new language:

> *It's a completely new language, actually. During the lessons, … you notice that for some, all those terms, that is a new language, so it is very intense for them to try to understand it. Some terms that we find normal, they do not know those at all so … we are up-to-date, but for them it is not always fun.* (Zala, 26)

Learning to use digital technology requires adopting the new language. The jargon is everywhere and hard to evade when dealing with devices, interfaces, applications and internet platforms. Translating the terms into the mother tongue may make the introduction smoother, but it will not be helpful in the long term. That

is why some instructors expose their participants intentionally to the terminology:

> *If we don't use the terminology, the jargon, they will encounter it in the next situation. Thus, we are eager to use the jargon, but we always build up the language very carefully. We always try to explain "we're going to download this. Okay, but what does that mean: 'downloading'?" So we explain the process that's happening. "Today we talk about apps. What is an 'app'?" … We find it is very important that we use the jargon because the next day they will hear it anyway and then they don't know what it means.* (Joris, 37)

Understanding and operating hardware

Buttons, connections and interface

When digitally inexperienced older adults get started with digital devices—be it one they purchased themselves, one that was gifted by family or one on loan during class—the instructors often see they come unprepared and clueless of what to do.

> *It regularly happens that people come to us with the device in the box and ask "tell me what I need to know". … The problem is quite widespread, we speak of about 25 % of the 65-plus population.* (Peter, 74)

It starts with turning on the device. Many older adults have difficulties finding the on/off button of their devices. The instructors in our study regularly make the same observation and devote considerable time to demonstrate. The fact that different brands or types of devices have different buttons is a problem, too.

> *After two months, they take it out of the box. Because they did not know anymore which button they had to press to start it up. They did not know anymore what to do before they get to the (virtual) keyboard. Like these dozy problems. And "my children have explained me and I asked this two times how I have to use it but it all goes so fast." And the people really say things like "okay, how do I start up my smartphone? What is my start screen?" Really, these kind of things. "And how do I start my tablet and which buttons? What's doing what?" It's really the basics of the device.* (Laurent, 68)

> *We proceed step by step to let the people discover their own device, well, in a playful way… By asking them "And where is the on/off button on your device? There, look, your neighbor has a different device, there it's at another spot." That's how we try to teach this.* (Kathleen, 40)

Another issue is the connectivity of cables and adapters. Instructors have to explain that the devices need to be plugged to a charger, that devices of different brands need different chargers and adapters, and they try to use analogies to the non-digital world whenever suitable.

> *… for example, with a Mercedes you do not go to a Ford garage. Those parts do not always fit. With an iPhone you have problems with [connecting to] a Windows laptop. And they understand that, when you say, 'a Mercedes'.* (Wouter, 66)

A complicating factor for digitally inexperienced older adults is the fact that there are different kinds of devices that have different purposes, functionalities, and interfaces. The buttons on smartphones and tablets are much smaller and harder to find then those of laptops. Laptops have a keyboard and a trackpad, sometimes an external mouse, that require a different dexterity than touchscreens of smartphones and tablets. Many participants of the digital skills trainings have never in their work-life used computers, and are thus not familiar with keyboards and mouse.

> *It's a problem that many people do not know how to type. Sure, they can read and write and stuff, but using a keyboard is often a problem that is missed in classroom trainings.* (Laurent, 68)

> *People who sat behind a computer for their work, for example at counters, are used to keyboards, they can work with a mouse. They do not need any explanation. But people who stood at the assembly line, they know nothing about keyboards and using a mouse. For them you have to explain it first.* (Gilles, 67)

On the other hand, people who had to use desktop computers in their work are familiar with keyboards and mouse, but may have not made the transition to using touchscreens. So pinching and swiping does not come intuitively to them. A frequent point of frustration is the realization that touchscreens often do not offer the functionalities of mouse and keyboard.

> *On a touchscreen, that's not so easy either. You have to press but do not press too long, you have to tap but… Some people find it handy to use a stylus pen but for others this does not work at all. So you have to check what works for whom.* (David, 65)

Performance properties (storage, CPU)

Next, to problems with the interface-related aspects of the devices, there is also lack of understanding about what is under the hood of devices. Although it is debatable how much knowledge about computer components (such as CPU and memory) is really necessary for the most basic foundations of digital literacy, proper independent use of digital technology demands some understanding of working memory, data storage, and storage capacity.

> *There is always a bit of theory given first, a very rudimentary explanation of how a computer works. What memory is… that is [like] your cupboard where all your binders are and where all your papers are in. And that is the memory of the computer, that's where everything is stored. Because that's also something: you cannot see that, huh? And that's something that some people do not really understand either. "Where is that memory of that computer?" and then they start looking [for it in the device].* (Veronique, 69)

The physical invisibility and intangibility of stored data makes it hard to grasp the notion of digital storage, such as how big files are, how much space a download requires. Users have to

simultaneously comprehend the hardware side of storage and the terminology of RAM, ROM, gigabytes, clouds, USB-sticks and smart cards. While instructors often use analogies to physical storage such as cupboards, drawers, and boxes, these metaphors only go so far because the basic abstractness and non-material nature of digital storage cannot be properly represented. Instructors repeatedly have to explain their audience that some free storage space is necessary for any activity and that space can fill up fast without their owners noticing. Regularly, instructors who run walk-in-sessions encounter users who lost overview and do not find their files anymore.

> *Those folders and the explorer, that is a big problem. Again and again. Recently, someone had 4,000 e-mails in his inbox and three thousand something files on his PC, and he had problems finding files…* (Walter, 70)

Savvy sales people at the consumer electronics store dare to use this lack of knowledge against digitally inexperienced older adults and sell them outdated devices that underperform or overpowered devices that go way beyond their needs. Because they cannot judge the specifications on their own, instructors have to warn them.

> *There are many who say "I'm going to buy something to see how it works." Then they buy a tablet for 100 euros or 50 euros, with a memory of 120 megabytes. Not one app fits on it and then they say: "Yes, but that's rubbish, you cannot do anything with that, huh." That's why we always say "If you buy something, buy something decent, or it will be disappointing".* (Fred, 78)

> *The stores, they really sometimes sell way too expensive devices to those people. Then I think "sorry, but you really do not need that." And I think they are kind of pushing this on these people in the store, but for what they are doing with that, that's really not necessary.* (Zala, 26)

Grasping software concepts and the internet

ICT-concepts often lack a reference to the non-digital world, and thus are not easily understood without simultaneous knowledge about the hardware and software. When a digitally inexperienced older person buys a device that happens to fit to their projected needs, they face the problem that the hardware does not do anything without the right software on it. The fact that devices run with operating systems (such as Windows, Android, IOS) and that programs or apps run on top of these operating systems, is something the instructors regularly struggle with getting across to their participants. To make matters worse for beginners, each of these systems has their own app-store, and some applications only work on a specific operating system. We showed that digitally illiterate people struggle with the terminology of software such as apps, stores, downloads, installations. Beyond the sheer meaning of the words, they also struggle with the concomitant conceptual

referent: What is an application? How do you find anything in a store? What does download and installation mean? Why all these updates all the time?

Downloads and installation

Given that the instructors have plenty of experience of teaching digital skills to digitally illiterate older adults, we can take their examples and pedagogic strategies as a good indicator that notions of apps and downloads are difficult to grasp otherwise. Again, it would be a mistake to dismiss the competence to handle downloads and install apps as trivial because without proper guidance, they can be overwhelming for novices.

> *And then installing this WhatsApp. You do not have to pay for that, you have to go into the PlayStore, the shop of the computer, that's where you must fetch it and must download it, right? Yes, this terminology… "Downloading, what's that?" Then they already begin to ask questions, and mostly the question is: "Couldn't you just do that for me?" (laughs).* (Veronique, 69)

> *I explain them: you have to download and install the program, and I use a household kitchen tip. I say: "go to the shop, you buy the thing and bring it home packaged, that's downloading. You fetch the software from the internet." I say "you first have to unpack the device. Unpack, get it ready for use, that's what we call 'install'." Then they get the difference between downloading and install. "Think about it." I say "when you go to the PlayStore, you see an hourglass turning. What's happening? Downloading." Then there's the installation. Then they get what the steps are: unpacking, getting it ready for use, turn it on. That is: "you must get the current on and then press the on/off button."* (Wout, 40)

The internet

The structure and logic of the internet is another challenge. The app stores are no physical stores with a specific geographical location. Navigating on the internet works in a different way than in the analog "real life" older adults have been socialized into a few decades ago. Hence efforts are needed to explain the basics of the internet.

> *On day 2, we teach them about the internet, because nobody really knows how, what. Everyone has heard of the internet but nobody knows what to find there. How do you have to search there, what you can do there. I let them search their own name, and sometimes they find something there they did not know yet.* (Fred, 78)

> *How do you go onto the internet? It's often already hard to get the difference between Google as a search engine and Google Chrome as a browser… for these people Google is Google.* (Walter, 70)

Combining the abstract understanding of overarching logic of software as the little tools running the device, and the overarching logic of the internet as a large amount of computers connected to each other, people can focus on opening websites as well as on finding and retrieving information with search engines. Only once they master this basic internet navigation, they can engage critically with the

content they are reading and seeing. Again, full-fledged digital literacy is beyond reach if the foundations are not taken care of.

Accounts, profiles and passwords

A general element of navigating the internet, participating in online spaces, and doing administrative errands online is the notion of accounts and profiles. While this is more obvious for any social media application, it is more and more required for running the devices in the first place. Without Apple-ID people cannot get their iPhone or iPad running; operating any Android tablet requires a Google Account. In order to access the stores to download anything, people are required to have an account to login into the store-platforms. In order to make accounts, users need active email addresses, which also include their own accounts, each of them requires user names and passwords. They also need a basic competence of opening and reading emails to verify their accounts. Many older adults have their accounts set up by a family member or even by teachers in the class because they do not know how to do it themselves.

For example, making a Google-account, well you have to do this individually – not in a class, such as Android for beginners. Those who do not have a Google account, we invite them for help and do the first steps with them individually, because that's really necessary… Of course, when it comes to emailing, it goes a bit further because if they do not have an email account, they have to create one first. (Viviane, 51)

Then we need to make an account [for them], then we have to choose a password, and then we must [overcome] these hurdles for some people like "that's too much fuss, [imitates dismissive hand gesture], then I just watch TV at home, let it be." (Inge, 70)

Passwords is another such an issue. Remembering it, coming up with one, phew, that's hopeless sometimes. (Anne, 66)

Just last week I got a call from someone "I cannot access my mailbox any longer" "How's that?" "Well, I have to enter a password but I do not remember." (Nathaël, 74)

Software updates

So far we have addressed the hurdles that need to be overcome to get a device running, get the software installed, and have accounts setup with email and password. In principle, people are now ready to do their banking errands, e-government services or social interaction with the family. After intensive training and plenty of practice, they know which buttons to click, where to enter their passwords, and what the functions do that they need. Everything could be fine if there were not these frequent updates that change the interface or functionality of apps and platforms. For older adults this can be troubling even if they are routinized in using digital technologies, but it is worse for the motivation of older adults who undergo a hard time learning something they expect to be outdated in a few weeks. The constant stream of updates is also a problem for the instructors because

software updates necessitate updates of the course material or else what they teach is obsolete.

What I hear a lot from older people, is that with the apps they know there is an update, and then it looks different and then they no longer know how it works. That should not be allowed, actually. That is not even being considered. The older people have [learned] a routine and once they know that routine, it goes well. But if you deviate from that pattern, then they are stuck. (Fred, 78)

She was so used to that one button always being on the left, and at some point it had shifted to the right after an update of the whole technology. And total panic! (Kathleen, 40)

It happens that the styling of those icons is adjusted a bit and that people with a tablet no longer find their gallery because the 'flower' that used to be there has now become an 'asterisk' or something. [Those are] also things that make it more difficult for the older people. (Walter, 70)

When it is about constant learning, age becomes a factor. It is harder to memorize new things, particularly if this means unlearning things that were new just a few months ago. The flexibility of making new habits decline. Many of the volunteering instructors in our study are of higher age themselves and report similar troubles. At the same time, they are forced to explain repeatedly that software and apps are not fixed products that, once installed, can continue to function as they did from the start. As some older adults do not understand the logic of updates, it helps explaining them that operators do not bring updates in order to mess with people but do this for security reasons, bug fixing, functional adjustments or adding features to remain competitive in the software markets. However, the instructors notice that automatically downloaded yet uninstalled updates are often enough ignored or even deleted by their participants, who fail to understand that this can create all kinds of problems for the device and its usability.

"Well sir, if I get an update, I always click it away.", "No, you have to [update]!","Why?","Why? Because there are always changes to your program, security changes especially. And if you don't do updates, then your computer or smartphone is vulnerable for [cyber] criminals." I have to say that a hundred times… I always say that, if there is an update, then install it. That's for your own safety. … If an update comes up during class, which frequently happens, I say "we're going to install it now, immediately, then you'll see what happens [and know it] for the next time." (Nathaël, 74)

"But it worked well, I do not need these updates." If you do not know where the dangers lie… (Anne, 66)

I see that a lot of people do not do updates on their computer. Some time ago, I was with someone who was stuck with their computer. … But when I wanted to start fixing it, I saw a whole list of updates there. I said to her: "you have to leave your computer on for three

days now, so first all those updates can be done." Yes, she had not done one single update. (Robert, 62)

Discussion

The digitalization of everyday life can be hard for older adults, and even harder for those without much pre-knowledge about computers, smartphones and internet. As we can see in the accounts by the digital skills instructors, the problems with trying to get acquainted with ICT already begins with the vocabulary that is needed to understand what digital devices and services are about. The fact that older ICT novices tend to struggle with the jargon and technical terms had also already been noted in other studies (Aula, 2005; Gatti et al., 2017; Schreurs et al., 2017), but the problem clearly still persists today. Furthermore, the command of English terminology and ICT-related jargon cannot simply be presupposed among the older populations in non-English speaking countries such as Belgium.

Next to the language issues, many facts and features of how hardware and software work need to be explained at the most basic level according to the instructors. Previous research has also pointed out difficulties learning to using a keyboard and/or a mouse (Aula, 2005; Morris et al., 2007; Hanson, 2011) and issues with on–off buttons (Neves and Mead, 2021), but those same problems emerge among these contemporary instructors for older adults in Belgium. Poor understanding of internet and internet browsers had been addressed as well (Aula, 2005) and almost two decades later, similar confusions are still found among older adults. Although browser interfaces and input forms have changed (from computers with keyboard to tablets/smartphones with touchscreen), the generic problems for understanding the logical structures of websites and browsers persist. The list of issues the instructors in our study encounter with older adults who are trying to learn basic digital skills is yet longer. While some of these issues are reported in the literature on digital skills acquisition of older adults, there is no comprehensive account and emphasis of their salience—which we consider one contribution of the present article.

From the viewpoints of digitally active people who have integrated technology into their everyday lives like a second nature, all these issues encountered in the digital skills trainings may look trivial. Moreover, the portrait of digitally inexperienced older adults presented through the excerpts from our study may look like the stereotypes of the technologically incompetent elderly that the literature has tried so hard to overcome (Neves et al., 2018; Quan-Haase et al., 2018). Obviously, this portrait does not fit to all older adults, who as a group are as diverse as any other age group. And yet, the accounts given by the digital skills instructors give us a realistic window into how *some* (and not just a few) older adults experience the advancing digitalization of everyday life and into how they struggle to make sense of digital devices and services. For these people it can be a source of stress and gives them feeling of dis-empowerment (Hill et al., 2015), incapability and dependence on others. The instructors encounter the troubles digitally inexperienced older adults face on a regular basis.

The main implication from this article is that even the most basic tenets of digital technology are neither trivial nor simple to grasp for older adults, especially for those who have never used computers in their professional lives—a point not sufficiently addressed by frameworks of digital skills/literacy/competence. Whether teaching to small groups, big groups, doing one-on-one help sessions at home for the older adults, the observations made by the instructors in our study provide evidence that older adults struggle with the ICT-jargon, and specific components and concepts of hardware and software on the most basic levels, far below the aims of widespread academic and policy definitions of 'digital literacy', 'digital skills' or 'digital competence'.

What does this mean for future definitions of basic digital literacy, skills, or competences? Based on the presented evidence, we argue that these definitions are most often too high-level when it comes to certain segments of the older population. Before we can even think of reaching the subcomponents of common definitions of digital literacy, such as accessing, evaluating and handling information—not to mention critical media literacy (Kellner and Share, 2005) and socio-emotional literacy (Eshet, 2012)—the most basic competences on the entry level of function skills need to be established (Zimba et al., 2021). These skills involve operating devices, connecting to the internet, setting up accounts and profiles, finding and retrieving information. As we have shown, even those competences require comprehension, memory, and dexterity, all of which can become difficult due to (the side-effects of) physical ageing. Before we can speak of online banking and e-health, there needs to be a basis for devices, apps, accounts and email, safe passwords, as well as the terminology and the underlying ICT-related concepts. For digitally illiterate older adults nothing is trivial, even if it might seem like that to routine technology users.

If we take seriously the firsthand accounts of the digital skills trainers who are working at the frontline, it becomes apparent that academic definitions and political frameworks of digital literacy need to start at a very basic level for older adults who have not been exposed to digital technology. Gilster (1997, pp. 1–2) said that "digital literacy is about mastering ideas, not keystrokes", but without the abilities that enable the keystrokes no ideas can be actualized. While we agree that full-fledged digital literacy, skills, and competences include much more than the mere technical abilities of operating the devices and platforms (Iordache et al., 2017), it is not helpful to relegate the latter to some "technicality" or sub-aspect underlying the more advanced goals of digital inclusion. Just like a final consensus on the definition of digital literacy is absent, it will be equally challenging to define the most fundamental elements, but, based on our findings, these should at least include turning devices on and off (including charging their batteries), operating the hardware and software interfaces, understanding how to access and install applications, how to set up accounts with secure passwords, as well as understanding how to operate search machines to retrieve useful information. As demonstrated, none of these are trivial for older adults, and, hence, these issues should receive attention in digital skills frameworks.

This study has some limitations. Due to the focus of the overarching project on Flanders, we can only refer to experiences in the Dutch speaking region of Belgium. We also cannot extrapolate these findings to other countries, but it would be recommendable for future research to investigate the prevalence of similar problems elsewhere. The qualitative nature of the data used for this study does not allow insights into how widespread the observed problems are

among the older populations, given the presented evidence of the multidimensional heterogeneity of this age segment.

As mentioned, the data was collected for an overarching research project with multiple research questions. For these research questions, which are beyond the scope of the present article, the material was coded in several iterations, in phases akin to the three steps by grounded theory (open coding, axial coding, and selective coding) but no full-fledged grounded theory was applied. For the descriptive and argumentative intention of the present article, we used the data as a repository to provide illustrative evidence for building our case. As a possible limitation, we did not intend to explain the phenomena (the fundamental problems older adults face with digital literacy requirements) we described, and as such, do not engage in any of the other steps necessary to build any explanatory grounded theory.

Furthermore, the focus of this study was on the perspective of instructors, and accordingly this article only shows their point of view and experiences but not of the older course participants themselves. Future research could study systematically how digital inclusion frameworks can guide training programs so that participants can overcome their initial hurdles in learning and retaining basic digital skills in order to handle their everyday lives autonomously in an increasingly digitalizing society.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by the Human Science Ethics Committee of the VUB. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

Funding

Acknowledgments

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

Ageing in the Digital Era. (2021). UNECE Policy Brief on Ageing No. 26.

Audrin, C., and Audrin, B. (2022). Key factors in digital literacy in learning and education: a systematic literature review using text mining. *Educ. Inf. Technol.* 27, 7395–7419. doi: 10.1007/s10639-021-10832-5

Aula, A. (2005). User study on older adults' use of the web and search engines. *Univ. Access Inf. Soc.* 4, 67–81. doi: 10.1007/s10209-004-0097-7

Bakardjieva, M. (2005). *Internet society: the internet in everyday life*. Thousand Oaks, CA: Sage.

Barnard, Y., Bradley, M. D., Hodgson, F., and Lloyd, A. D. (2013). Learning to use new technologies by older adults: perceived difficulties, experimentation behaviour and usability. *Comput. Hum. Behav.* 29, 1715–1724. doi: 10.1016/j.chb.2013.02.006

Bhattacharjee, P., Baker, S., and Waycott, J. (2020). Older adults and their acquisition of digital skills: a review of current research evidence. In *32nd Australian Conference on Human-Computer Interaction*, pp. 437–443.

Blažič, A., and Blažič, B. (2018). Digital skills for elderly people: a learning experiment in four European countries. *Rev. Eur. Stud.* 10:74. doi: 10.5539/res.v10n4p74

Blažič, B., and Blažič, A. (2020). Overcoming the digital divide with a modern approach to learning digital skills for the elderly adults. *Educ. Inf. Technol.* 25, 259–279. doi: 10.1007/s10639-019-09961-9

Broady, T., Chan, A., and Caputi, P. (2010). Comparison of older and younger adults' attitudes towards and abilities with computers: implications for training and learning. *Br. J. Educ. Technol.* 41, 473–485. doi: 10.1111/j.1467-8535.2008.00914.x

Campens, J., Schirmer, W., Vercruyssen, A., Verté, E., and De Witte, N. (2022). Identifying subgroups of non-internet-users among community dwelling older people. *J. Aging Innov.* 11, 112–130. doi: 10.1080/0144929X.2023.2235028

Castilla, D., Botella, C., Miralles, I., Bretón-López, J., Dragomir-Davis, A. M., Zaragoza, I., et al. (2018). Teaching digital literacy skills to the elderly using a social network with linear navigation: a case study in a rural area. *Int. J. Hum. Comput. Stud.* 118, 24–37. doi: 10.1016/j.ijhcs.2018.05.009

Charmaz, K. (2014). *Constructing grounded theory. A practical guide through qualitative analysis*. London: Sage.

Chiu, C.-J., Tasi, W. C., Yang, W. L., and Guo, J. L. (2019). How to help older adults learn new technology? Results from a multiple case research interviewing the internet technology instructors at the senior learning center. *Comput. Educ.* 129, 61–70. doi: 10.1016/j.compedu.2018.10.020

Choi, N., and Dinitto, D. (2013). Internet use among older adults: association with health needs, psychological capital, and social capital. *J. Med. Internet Res.* 15:e2333. doi: 10.2196/jmir.2333

Corbin, J., and Strauss, A. (1990). Grounded theory research: procedures, canons, and evaluative criteria. *Qual. Sociol.* 13, 3–21. doi: 10.1007/BF00988593

Czaja, S., and Lee, C. C. (2007). The impact of aging on access to technology. *Univ. Access Inf. Soc.* 5:341. doi: 10.1007/s10209-006-0060-x

Delello, J., and Mcwhorter, R. (2017). Reducing the digital divide: connecting older adults to iPad technology. *J. Appl. Gerontol.* 36, 3–28. doi: 10.1177/0733464815589985

Eshet, Y. (2012). Thinking in the digital era: a revised model for digital literacy. *Issues Inform. Sci. Inf. Technol.* 9, 267–276.

Ferrari, A., and Punie, Y. (2013). *DIGCOMP: a framework for developing and understanding digital competence in Europe.* Publications Office of the European Union Luxembourg.

Ferreira, S., Sayago, S., and Blat, J. (2017). "Learning in later life while engaging in cross-generational digital content creation and playful educational activities" in *Game-based learning across the lifespan.* eds. M. Romero, K. Sawchuk, J. Blat, S. Sayago and H. Ouellet (Cham: Springer), 115–129.

Flauzino, K., Pimentel, M. D., Batiston, S. S., Zaine, I., Vieira, L. O., Rodrigues, K. R., et al. (2020). Digital literacy for older adults: perceptions about teaching-learning. *Educ. Real.* 45:e104913. doi: 10.1590/2175-6236104913

Friemel, T. (2016). The digital divide has grown old: determinants of a digital divide among seniors. *New Media Soc.* 18, 313–331. doi: 10.1177/1461444814538648

Gatti, F. M., Brivio, E., and Galimberti, C. (2017). "The future is ours too": a training process to enable the learning perception and increase self-efficacy in the use of tablets in the elderly. *Educ. Gerontol.* 43, 209–224. doi: 10.1080/03601277.2017.1279952

Geerts, N., Schirmer, W., Vercruyssen, A., and Glorieux, I. (2023a). Exploring older adults' ICT support: a mismatch between needs and provision. *New media soc.* doi: 10.1177/14614448231166

Geerts, N., Schirmer, W., Vercruyssen, A., and Glorieux, I. (2023b). Bridging the 'instruction gap': how ICT instructors help older adults with the acquisition of digital skills. *Int. J. Lifelong Edu.* doi: 10.1080/02601370.2023.2174197

Gibson, B., and Hartman, J. (2013). *Rediscovering grounded theory*, London: Sage.

Gilster, P. (1997). *Digital literacy.* Wiley, New York.

Hanson, V. (2011). Technology skill and age: what will be the same 20 years from now? *Univ. Access Inf. Soc.* 10, 443–452. doi: 10.1007/s10209-011-0224-1

Hargittai, E. (2002). Beyond logs and surveys: in-depth measures of people's web use skills. *J. Am. Soc. Inf. Sci. Technol.* 53, 1239–1244. doi: 10.1002/asi.10166

Hargittai, E., and Dobransky, K. (2017). Old dogs, new clicks: digital inequality in skills and uses among older adults. *Can. J. Commun.* 42, 195–212. doi: 10.5167/uzh-148144

Helsper, E. (2021). *The digital disconnect: the social causes and consequences of digital inequalities.* Sage, London.

Hill, R., Betts, L. R., and Gardner, S. E. (2015). Older adults' experiences and perceptions of digital technology: (dis) empowerment, wellbeing, and inclusion. *Comput. Hum. Behav.* 48, 415–423. doi: 10.1016/j.chb.2015.01.062

Hunsaker, A., and Hargittai, E. (2018). A review of internet use among older adults. *New Media Soc.* 20, 3937–3954. doi: 10.1177/1461444818787348

Ilomäki, L., Kantosalo, A., and Lakkala, M. (2011). *What is digital competence? In linked portal* Brussels: European Schoolnet.

Iordache, C., Mariën, I., and Baelden, D. (2017). Developing digital skills and competences: a quick-scan analysis of 13 digital literacy models. *IJSE* 9, 6–30. doi: 10.14658/pupj-ijse-2017-1-2

Kellner, D., and Share, J. (2005). Toward critical media literacy: core concepts, debates, organizations, and policy. *Discourse* 26, 369–386. doi: 10.1080/01596300500200169

Martin, A. (2009). Digital literacy for the third age: sustaining identity in an uncertain world. *ELearn. Papers* 12, 1–15.

Martínez-Bravo, M.-C., Sádaba-Chalezquer, C., and Serrano-Puche, J. (2020). Fifty years of digital literacy studies: a meta-research for interdisciplinary and conceptual convergence. *Prof. de la Inf.* 29:e290428. doi: 10.3145/epi.2020.jul.28

Morris, A., Goodman, J., and Brading, H. (2007). Internet use and non-use: views of older users. *Univ. Access Inf. Soc.* 6, 43–57. doi: 10.1007/s10209-006-0057-5

Neves, B. B., and Mead, G. (2021). Digital technology and older people: towards a sociological approach to technology adoption in later life. *Sociology* 55, 888–905. doi: 10.1177/0038038520975587

Neves, B. B., Waycott, J., and Malta, S. (2018). Old and afraid of new communication technologies? Reconceptualising and contesting the 'age-based digital divide'. *J. Sociol.* 54, 236–248. doi: 10.1177/1440783318766119

Oh, S. S., Kim, K. A., Kim, M., Oh, J., Chu, S. H., and Choi, J. Y. (2021). Measurement of digital literacy among older adults: systematic review. *J. Med. Internet Res.* 23:e26145. doi: 10.2196/26145

Olsson, T., and Viscovi, D. (2020). Who actually becomes a silver surfer? Prerequisites for digital inclusion. *Javnost-The Public* 27, 230–246. doi: 10.1080/13183222.2020.1794403

Pachis, J., and Zonneveld, K. (2019). Comparison of prompting procedures to teach internet skills to older adults. *J. Appl. Behav. Anal.* 52, 173–187. doi: 10.1002/jaba.519

Peine, A., and Neven, L. (2021). The co-constitution of ageing and technology–a model and agenda. *Ageing Soc.* 41, 2845–2866. doi: 10.1017/S0144686X20000641

Peral-Peral, B., Arenas-Gaitán, J., and Villarejo-Ramos, Á. F. (2015). From digital divide to psycho-digital divide: elders and online social networks. *Comunicar* 23, 57–64. doi: 10.3916/C45-2015-06

Picatoste, J., Pérez-Ortiz, L., and Ruesga-Benito, S. M. (2018). A new educational pattern in response to new technologies and sustainable development. Enlightening ICT skills for youth employability in the European Union. *Telematics Inform.* 35, 1031–1038. doi: 10.1016/j.tele.2017.09.014

Pihlainen, K., Korjonen-Kuusipuro, K., and Kärnä, E. (2021). Perceived benefits from non-formal digital training sessions in later life: views of older adult learners, peer tutors, and teachers. *Int. J. Lifelong Educ.* 40, 155–169. doi: 10.1080/02601370.2021.1919768

Quan-Haase, A., Williams, C., Kicevski, M., Elueze, I., and Wellman, B. (2018). Dividing the grey divide: deconstructing myths about older adults' online activities, skills, and attitudes. *Am. Behav. Sci.* 62, 1207–1228. doi: 10.1177/0002764218777572

Robinson, L., Cotten, S. R., Ono, H., Quan-Haase, A., Mesch, G., Chen, W., et al. (2015). Digital inequalities and why they matter. *Inf. Commun. Soc.* 18, 569–582. doi: 10.1080/1369118X.2015.1012532

Schreurs, K., Quan-Haase, A., Martin, K., and Schreurs, K.Martin (2017). Problematizing the digital literacy paradox in the context of older adults' ICT use: aging, media discourse, and self-determination. *Can. J. Commun.* 42, 59–77. doi: 10.22230/cjc.2017v42n2a3130

Schirmer, W., Geerts, N., Vercruyssen, A., and Glorieux, I. (2022). Digital skills training for older people: The importance of the 'lifeworld'. *Arch. Gerontol Geriatr.* 101 doi: 10.1016/j.archger.2022.104695

Selwyn, N. (2004). The information aged: a qualitative study of older adults' use of information and communications technology. *J. Aging Stud.* 18, 369–384. doi: 10.1016/j.jaging.2004.06.008

Tun, P., and Lachman, M. (2010). The association between computer use and cognition across adulthood: use it so you won't lose it? *Psychol. Aging* 25:560. doi: 10.1037/a0019543

Van Deursen, A., and Van Dijk, J. (2010). Measuring internet skills. *Int. J. Hum. Comput. Int.* 26, 891–916. doi: 10.1080/10447318.2010.496338

van Laar, E., van Deursen, A. J. A. M., van Dijk, J. A. G. M., and de Haan, J. (2017). The relation between 21st-century skills and digital skills: a systematic literature review. *Comput. Hum. Behav.* 72, 577–588. doi: 10.1016/j.chb.2017.03.010

Vuorikari, R., Kluzer, S., and Punie, Y. (2022). DigComp 2.2: the digital competence framework for citizens-with new examples of knowledge, skills and attitudes. In Joint Research Centre.

Zimba, M., Nyirenda, M., and Khonje, P. (2021). *Basic digital skills: next critical skills set towards a resilient nation.* Blantyre, Malawi: The 7th Annual ACIST Proceedings.