Cultivating continuing learning and active aging through digital literacy: A digital and social approach

Cultivando el aprendizaje continuo y el envejecimiento activo a través de la alfabetización digital: Un enfoque digital y social

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Abstract: Active aging promotes healthier lifestyles and quality of life. However, the growing digital divide limits older adults' ability to engage in today's technology-driven world fully. The Capacid@de Digital project addresses this challenge by empowering the aging population with digital skills. This paper aims to evaluate the project's impact on the active aging of individuals with limited digital knowledge. Based on structured questionnaires, interviews, and focus groups with 20 participants aged 60 to 90, the main findings show that digital training improved technological proficiency and strengthened social connections. The results indicate that capacity-building initiatives enabled participants to gain essential digital skills, supporting a more active aging process. These skills enhanced digital Literacy and fostered relationship-building among participants, promoting greater social and digital inclusion. This social impact is vital for reducing isolation and improving the overall well-being of older adults. These results highlight the crucial role of digital Literacy in promoting active aging and provide valuable insights for community programs and policies aimed at bridging the digital divide.

Keywords: Aging, active aging, continuing learning, digital inclusion, digital literacy, empowerment, social impact.

Resumen: El envejecimiento activo promueve estilos de vida más saludables y una mejor calidad de vida. Sin embargo, la creciente brecha digital limita la capacidad de las personas mayores para integrarse plenamente en el mundo actual, impulsado por la tecnología. El proyecto Capacid@de Digital aborda este desafío al empoderar a la población adulta mayor con habilidades digitales. Este trabajo busca evaluar el impacto del proyecto en el envejecimiento activo de personas con conocimientos digitales limitados. Basándose en cuestionarios estructurados, entrevistas y grupos focales con 20 participantes de entre 60 y 90 años, los principales resultados muestran que la capacitación digital mejoró la competencia tecnológica y fortaleció las conexiones sociales. Los resultados indican además que las iniciativas de desarrollo

de capacidades permitieron a los participantes adquirir habilidades digitales esenciales, apoyando un proceso de envejecimiento más activo. Estas habilidades mejoraron la alfabetización digital y fomentaron la construcción de relaciones entre los participantes, promoviendo una mayor inclusión social y digital. Este impacto social es vital para reducir el aislamiento y mejorar el bienestar general de las personas. Estos resultados resaltan el papel crucial de la alfabetización digital en la promoción del envejecimiento activo y brindan información valiosa para programas y políticas comunitarias destinadas a reducir la brecha digital.

Palabras clave: Envejecimiento, envejecimiento activo, aprendizaje continuo, inclusión digital, alfabetización digital, empoderamiento, impacto social.

1. Introduction

Aging is a growing global concern due to its significant impact on societies. In Portugal, an aging country, life expectancy has increased from 67.1 in 1970 to 80.9 years in 2020 (PORDATA, 2022). As people live longer, the concept of active aging is linked to rising life expectancy and the challenges of longevity, health, and quality of life (Bowling, 2007; Shmotkin et al., 2003). It involves staying engaged in the social environment and adapting as the population ages (Smith & Gay, 2005; Socci et al., 2020).

In parallel, the digital transformation of society has introduced new opportunities and challenges for older adults. Digital Literacy, emerging in the late 20th century, has become essential in an increasingly digitalized society, affecting areas from work automation to reading habits (Patrício & Osório, 2016). Information and Communication Technologies (ICT) can enhance the quality of life, particularly for adults and seniors, making digital Literacy crucial. Similarly, the discussion about digital inclusion as a core component of social inclusion contributes to advancing digital work within several communities (Reisdorf & Rhinesmith, 2020). However, challenges such as the exclusion of older adults from new technologies persist (Coelho et al., 2021), and there is a need for more research on educational practices aimed at promoting older adults' digital skills and literacies (Rasi-Heikkinen & Doh, 2023).

There are various initiatives where priority is given to universal access to ICT; however, there is a lack of target efforts to encourage and facilitate ICT adoption among older adults (Vega et al., 2020). While digital inclusion policies exist, they often focus on infrastructures and general access rather than addressing specific barriers that older adults face, such as fear of technology and accessibility issues (Tomczyk & Kielar, 2025). Despite the increasing recognition of digital Literacy as a key factor in social inclusion, there is still limited research on how digital skills contribute to active aging. Empowering older adults with these skills can have a considerable social impact translated into an isolation reduction, facilitate integration into the digital society, and contribute to active aging. This paper explores the relationship between active aging and digital Literacy, specifically how digital skills can promote active aging and, therefore, digital and social inclusion. It focuses on the Capacid@de Digital project (Carvalho et al., 2021) from the School of Management and Technology at the Polytechnic of Porto. The project seeks to promote digital inclusion for older adults with limited digital competencies by providing training that empowers them to perform basic digital tasks, such as managing email, conducting online searches, and using digital public services.

The article is structured as follows. Section 2 presents the theoretical foundations of active aging and digital Literacy, examining their interrelationships and relevance. This section also includes the presentation of Capacid@de Digital as one of Portugal's initiatives for Digital Literacy. Section 3 outlines the research approach, including participant selection and data collection methods. Section 4 presents the findings from the Capacid@de Digital project, examining the impact of digital Literacy on active aging. Finally, Section 5 summarizes the key insights and potential directions for future research.

2. Active aging and digital literacy

Active aging is a concept that emphasizes maintaining engagement and enhancing quality of life as individuals grow older. It addresses the challenges associated with increased longevity, including health, social Participation, and overall well-being. Digital Literacy, however, refers to effectively using digital technologies and navigating the digital environment. These two frameworks are deeply interconnected: Digital Literacy enables older adults to access health resources, participate socially, and engage in continuing learning—key pillars of active aging. This section provides an overview of both active aging and digital Literacy, exploring their individual definitions, significance, and relevance in modern aging. It also includes a presentation of Capacid@de Digital as one of Portugal's initiatives for Digital Literacy.

2.1 Active aging: concept and importance

The global aging population has become an increasingly prominent issue, necessitating various interventions to address the evolving needs of older adults (Rudnicka et al., 2020). While aging reflects socioeconomic progress and improvements in public health, it also presents challenges for societal adaptation (World Health Organization, 2021). This demographic shift requires public policies tailored to support the aging population, incorporating diverse theoretical perspectives such as successful, productive, healthy, and active aging (Costa et al., 2021; Veloso, 2015).

- **Successful aging** focuses on maintaining an active lifestyle in old age, characterized by low risks of illness and disability, high mental and physical functioning, and active societal Participation (Álvarez-García et al., 2018; Walker, 2006).

- **Productive aging**, which emerged in the 1980s, values the elderly's contributions through both paid and unpaid activities but often emphasizes economic productivity (Veloso, 2015).

- **Healthy aging**, primarily concerned with health and disease prevention, focuses on promoting physical and mental functioning to maintain autonomy and independence (Botelho, 2005; Robine & Michel, 2004). However, its traditional biomedical approach is sometimes critiqued for framing aging mainly as a problem linked to illness and dependence (Almeida, 2007).

The World Health Organization has framed 2021-2030 as the "Decade of Healthy Aging," expanding the concept to include functional abilities such as meeting basic needs, mobility, and maintaining relationships (World Health Organization, 2021). Recent discussions suggest integrating social capital into healthy aging strategies to enhance its scope beyond medical aspects (Lu et al., 2023).

Active aging, which emerged in the 1960s, challenges the disengagement theory by advocating for continuous engagement in roles and relationships in old age (Walker, 2006). It integrates principles from successful, productive, and healthy aging perspectives, promoting the optimization of opportunities for health, Participation, and security to improve quality of life as people age (Organização Pan-Americana da Saúde, 2005). This approach highlights the importance of physical, social, and mental well-being, ensuring that older adults remain active agents in their aging process (Álvarez-García et al., 2018).

Active aging is built on four core components: Health, Continuing Learning, Participation, and Security (Álvarez-García et al., 2018).

- **Health** encompasses physical, mental, and social well-being, and the aim is to reduce health inequalities among the elderly (International Longevity Centre Brazil, 2015). Digital tools, such as telehealth platforms and health apps, increasingly support this pillar by enabling remote care and health monitoring.

- **Continuing learning** is crucial for maintaining a sense of purpose and autonomy. It involves both formal and informal education that enhances personal and social engagement (International Longevity Centre, 2019). Digital

Literacy is foundational here, as it equips older adults with skills to access online learning resources and participate in intergenerational knowledge exchange (Patrício & Osório, 2016).

- **Participation** refers to active societal involvement, which fosters positive health outcomes and social stability (International Longevity Centre Brazil, 2015). Digital inclusion—through social media, civic platforms, or virtual communities—can amplify older adults' voices and opportunities for engagement.

- **Security** addresses the need for protection and access to services that ensure a dignified life, supporting the elderly's ability to live safely and confidently (Álvarez-García et al., 2018). Digital Literacy ensures safe navigation of online services (e.g., banking, healthcare) and protects against scams or misinformation.

Recent studies highlight the importance of environmental and psychosocial factors in promoting active aging, suggesting that interventions should extend beyond traditional health-focused strategies to include elements that support social connectedness, community participation, and continuing learning (Sánchez-González et al., 2020). Digital inclusion initiatives address social isolation and resource access and are critical to this expanded approach.

2.2 Digital Literacy: concept and significance to digital and social inclusion

The modern concept of digital Literacy is often credited to Paul Gilster, who, in 1997, defined it as the ability to understand and use information from technological sources like computers and the Internet (Gilster, 1997). The importance of digital Literacy has grown alongside the global surge in digitization. As digital technologies proliferate and automation becomes more widespread, proficiency in these technologies has become crucial in contemporary society (Acs et al., 2022). The rapid advancement of ICT has significantly impacted various aspects of daily life, making it essential for individuals to be proficient in their use (van Laar et al., 2017). For older adults, digital Literacy is not merely a technical skill but a gateway to achieving active aging—enabling access to healthcare, social networks, and continuing learning.

The digital divide represents the gap between those with access to modern information and communication technologies and those without. This divide encompasses disparities in access to technology, the Internet, and digital literacy skills, contributing to inequalities in education, employment, and socioeconomic opportunities. Proficiency in digital skills, including information literacy and problem-solving, empowers individuals to engage with the digital world effectively. Conversely, inadequate digital Literacy exacerbates existing inequalities, particularly when combined with limited access to technology. For aging populations, this divide risks compounding social exclusion and limiting opportunities for active Participation.

The significance of digital Literacy has been further highlighted by the COVID-19 global pandemic, which accelerated reliance on digital platforms for work, education, and communication (Acs et al., 2022). As lockdowns pushed more activities online, effectively navigating and using digital tools became an essential skill (Deschênes, 2024). This shift has underscored digital Literacy's critical role in bridging or widening the digital divide (Bach et al., 2018). Older adults with limited digital skills faced heightened isolation during this period, emphasizing the urgency of integrating digital inclusion into active aging policies.

Research on digital Literacy is expanding, reflecting a growing interest in its diverse impacts and applications across various sectors, as evidenced by recent reviews (Gutiérrez-Ángel et al., 2022; Reddy et al., 2020; Tinmaz et al., 2022; van Laar et al., 2017). This interest extends beyond academia, engaging government agencies, non-profit organizations, and industry bodies. These stakeholders increasingly use research findings to implement initiatives to empower various demographics, from children to seniors, digitally. One prominent initiative in this field is the Digital Competence Framework for Citizens (Vuorikari et al., 2022), commonly known as DigComp. Developed by the European Commission, this framework outlines essential digital competencies required in today's digital society, including information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving.

Digital inclusion helps ensure that all people, regardless of social class, ethnicity, religion, or economic power, have access to technological means of communication and information. E-inclusion is just one aspect of a broader range of policies to promote social inclusion and cohesion (Zemaitaityte et al., 2024). For older adults, digital inclusion directly supports active aging by facilitating access to healthcare (e.g., telemedicine), continuing learning (e.g., online courses), and social Participation (e.g., virtual communities). The intersection of digitalization and social inclusion has become increasingly significant, as recent research has shown that access to digital technologies directly influences education, healthcare, and economic participation (Kumar et al., 2022).

Borg et al. (2019) suggest that not only physical access is problematic, but also digital ability and attitudes toward technology pose challenges. The authors advocate for an effective focus on accessibility, enhancing digital Literacy and social support through direct user experience and collaborative learning/design.

For instance, digital tools like patient portals and health apps improve health outcomes by increasing patient engagement (Carini et al., 2021). However, the lack of digital Literacy and access can deepen health disparities, making digital literacy skills key social determinants of health (Sieck et al., 2021). Similarly, in education, digital inclusion might enhance learning opportunities and economic development, but success depends on the quality of digital Literacy of both students and educators (Gutiérrez-Ángel et al., 2022). The literature emphasizes the need for effective digital inclusion strategies for both digital and social inclusion and a significant social impact (Reisdorf & Rhinesmith, 2020). This social impact can be translated into social isolation reduction (Chen & Schulz, 2016) and integration into the digital society (Muñoz & Valencia, 2023), which can support active aging.

3. The context of the study

This section provides an overview of the study's context, focusing on national efforts to promote digital empowerment and inclusion in Portugal. This context is essential to understanding the relevance and scope of the case study, Capacid@de Digital Project.

3.1 Digital Literacy in Portugal: context and challenges

In Portugal, digital proficiency in 2021 reveals some distinct characteristics. Approximately 29% of the population exhibits proficiency levels above the basic threshold, while 27% possess a basic level of digital competence. However, 24% fall below the basic proficiency level, and 3% report no discernible digital skills. Furthermore, 18% of individuals in Portugal are categorized as non-Internet users, reflecting a significant digital divide within the population.

Portugal ranks 12th among the EU27 countries in terms of the proportion of individuals demonstrating digital Literacy beyond the basic level. Notably, 29% of the Portuguese population possesses this higher level of proficiency, surpassing the EU27 average of 26% (Autoridade Nacional de Comunicações, 2023). These statistics highlight the varying degrees of digital competency across the Portuguese population and underscore the country's relative strength in digital Literacy within the European context.

Faced with challenges similar to those faced by the rest of Europe, Portugal has implemented various strategies for digital empowerment among its population. One of the most relevant is the National Digital Skills Initiative e.2030 (INCoDe.2030, 2019), launched in 2017. This comprehensive public policy program aims to enhance digital skills across the Portuguese population, recognizing the critical role of the digital economy in future economic activities. The initiative supports the development of essential digital competencies, thereby facilitating a successful transition through the ongoing digital shift.

Central to INCoDe.2030 is the Dynamic Framework of Reference for Digital Competence (INCoDe.2030, 2019), aligned with the European DigComp framework. This tool serves three primary purposes: aiding in the development of policies and strategies, designing educational programs, and assessing and certifying digital competencies. The framework emphasizes various aspects of digital Literacy, including information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving.

3.2 Case Study: The Capacid@de Digital Project

Under the umbrella of the INCoDe.2030, many other initiatives, opportunities, and tools have emerged, with most of them listed on the Ponto Digital website[1]. One such initiative, and the focal point of this article's case study, is the Capacid@de Digital project (Carvalho et al., 2021; Oliveira et al., 2023). This initiative is promoted by a Portuguese higher education institution (HEI) namely the School of Management and Technology at the Polytechnic of Porto.

The Capacid@de Digital project aims to improve digital skills and inclusion among adults with limited computer proficiency in Portugal's Tâmega e Sousa region. The project offers short-term training sessions designed and facilitated by the HEI volunteer students under academic supervision. These sessions are held in municipal venues. As the INCoDe.2030 program is committed to providing means to qualify individuals in the thoughtful utilization of technology, fostering equitable access, competitiveness, and overall well-being, the training modules for the Capacid@de Digital were designed in accordance with their Dynamic Reference Framework for Digital Competence.

Carvalho et al. (2021) detail the project's modules, teaching roadmap, and the assessment questionnaire used to gauge digital competencies. The "Capacid@de Digital" initiative includes 38 training modules designed to cover the digital competence framework provided by the INCoDe.2030 program at both basic and intermediate proficiency levels. These modules are structured to address five key areas of digital competence: Information Literacy, Communication and Citizenship, Content Creation, Security and Privacy, and Development of Solutions. To better manage dependencies between the modules, they have been aggregated into five sections:

Introduction to IT: This section was designed to prepare individuals without experience using digital equipment. The modules in this area aim to provide basic proficiency in operating a computer and include: First Contact with a Computer, First Steps in Windows, and Use of Basic Computer Tools.

Internet: This section enables trainees to navigate and search the Internet. Examples of modules in this area include Browse the Internet and Advanced Internet Searches.

Online Services: This group includes modules related to services available online. Examples include Email and the Use of Online Public Services.

Information: This section comprises modules related to information. Modules such as Information Digitalisation and Digital Storage fall under this category.

Security: This module group focuses on data and equipment security in digital environments. Examples include Personal Data Protection and Cybersecurity.

Applications: This section includes modules related to the use of digital applications, such as Word Processing and Spreadsheet

The approach, centered on problem-based learning, addresses real-world issues to engage participants effectively and enhance their digital Literacy. The project directly supports the pillars of active aging by focusing on practical skills—such as accessing healthcare portals, communicating via digital platforms, and navigating online services.

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[1]   https://pontodigital.pt/

The Secretary of State for the Digital Transition's endorsement of the project highlights the significant support from governmental authorities, underscoring the importance of digital empowerment in the region. This initiative exemplifies how targeted digital literacy programs can bridge the gap between active aging policies and equitable social inclusion.

4. Methodology

A case study approach is utilized, focusing on the Capacid@de Digital project, implemented in the county of Baião in the North of Portugal. This method enables an examination of the project's impact on digital Literacy and active aging within the community. This approach allows for an in-depth exploration of the phenomenon in a real-life context (Yin, 2018). This is particularly useful for understanding complex processes and interventions in a specific setting. The research design (illustrated in Figure 1) follows a mixed-methods approach, integrating quantitative surveys and qualitative interviews/ focus groups to triangulate findings. Using a mixed-methods approach allows for a more comprehensive understanding of the research objectives by combining detailed data from participants, enhancing the validity and depth of the results (Creswell & Clark, 2017).

Figure 1. Research design
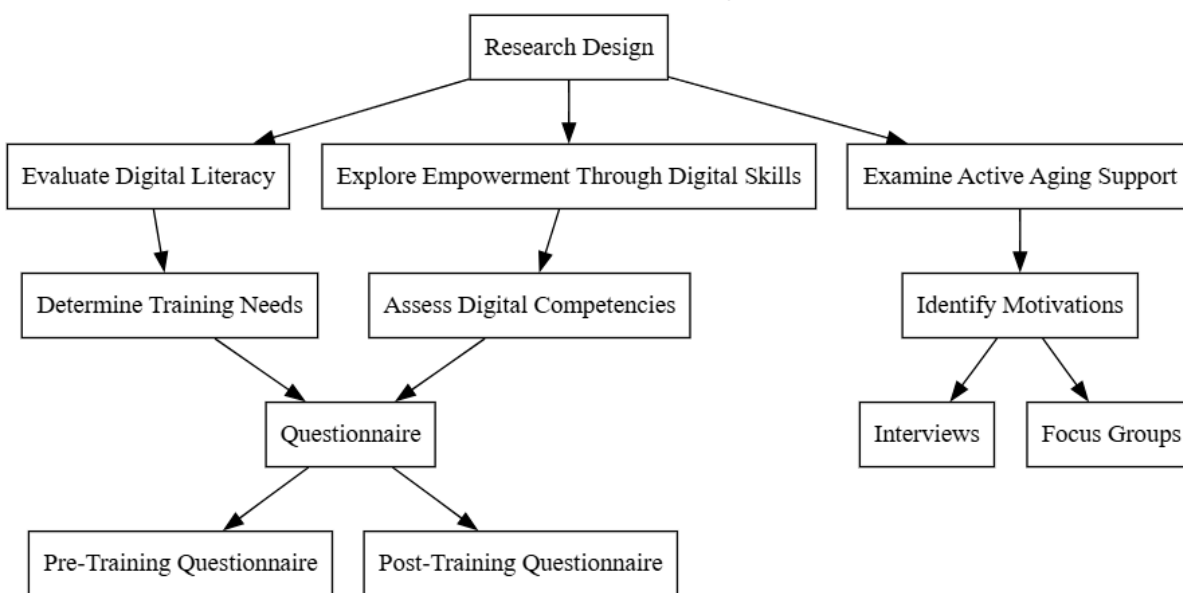
Clearly defined general and specific objectives are essential for guiding and planning the study, providing a structured framework for the research process. Table 1 outlines the general and specific objectives and the data collection methods, serving as a guide to the study's scope and focus.

Table 1. General and specific objectives

General Objectives	Specific Objectives	Data Collection
1. To evaluate the participants' understanding and perception of digital Literacy.	1.1. Determine the specific training needs of the target audience.	Questionnaire
2. Examine how the project supports and enhances active aging.	2.1. Identify the motivations and needs of older adults for learning ICT.	Interview and Focus Groups
	2.2. Assess the participant's appreciation of the learning experience and evaluate the impact of the training on their personal and social lives.	
3. Explore how digital literacy skills contribute to the empowerment of the elderly participants.	3.1. Assess the level of usage and digital competencies among the participants.	Questionnaire

To operationalize these objectives, the questionnaire (Carvalho et al., 2021) was adapted to identify training needs and map participants' competencies. The questionnaire was developed within the framework of the Capacid@de Digital project and was specifically structured to reflect the content and learning objectives of the project's training modules. While it did not draw on pre-existing academic scales, its design resulted from a collaborative effort among experts involved in the project. This ensured that the instrument was closely aligned with the project's pedagogical objectives and operational relevance, thus enhancing its applicability to the study's context. Figure 2 presents the demographic data of the 20 participants based on the questionnaire. Although the questionnaire was administered to 44 individuals who joined the initiative, only 20 responses are considered, as these participants attended and completed all the sessions.

Figure 2. Demographic Data
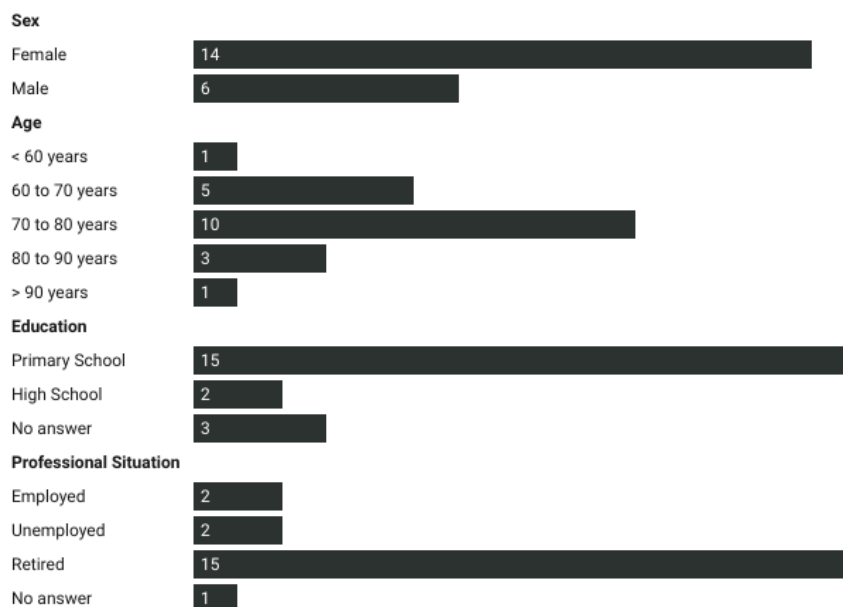
Overall, participants exhibited low levels of technological knowledge. Most (14 participants) reported not knowing how to use a computer. Additionally, many were unfamiliar with applications for writing and formatting texts, calculating and analyzing data, editing photos, creating digital presentations, or editing videos. Regarding digital communication, 8 participants noted they do not use voice or video calls. Nearly all participants stated they do not access their bank accounts or government services online. A significant number also reported not synchronizing their email accounts or social networks with their mobile phones.

Regarding digital security, 12 participants indicated they do not disclose personal codes when their bank contacts them by phone. Despite their limited ICT knowledge, participants are aware of the importance of not providing sensitive personal information, such as debit card PINs. Concerning passwords, 3 participants remember them by heart, while 4 participants store them on paper. When accepting terms of use for new services or applications, 7 participants claimed to read the terms carefully.

4.1 Data collection and integration

Quantitative data was collected through pre- and post-training questionnaires. After completing the initial two modules (Introduction to Computers and Navigating the Internet) in four sessions, 12 participants completed a questionnaire in June 2023 to assess their acquired knowledge. The complete set of questions included in the instrument is provided in the Appendix of this paper. Although all participants initially completed the questionnaire before training began, only 12 responded to the same questionnaire after the fourth session, as some could not attend.

Qualitative data was gathered through in-person interviews and focus groups. Interviews (~30 minutes each) were conducted post-training with 18 participants (coded E1–E18) in two locations. These interviews explored individual motivations (Objective 2.1) and perceived impacts on daily life (Objective 2.2). Two focus groups (FG1: 8 participants; FG2: 10 participants) were then organized to identify collective perspectives on technology and training efficacy. FG1 focused on barriers to digital adoption, while FG2 discussed social empowerment outcomes (Objective 3).
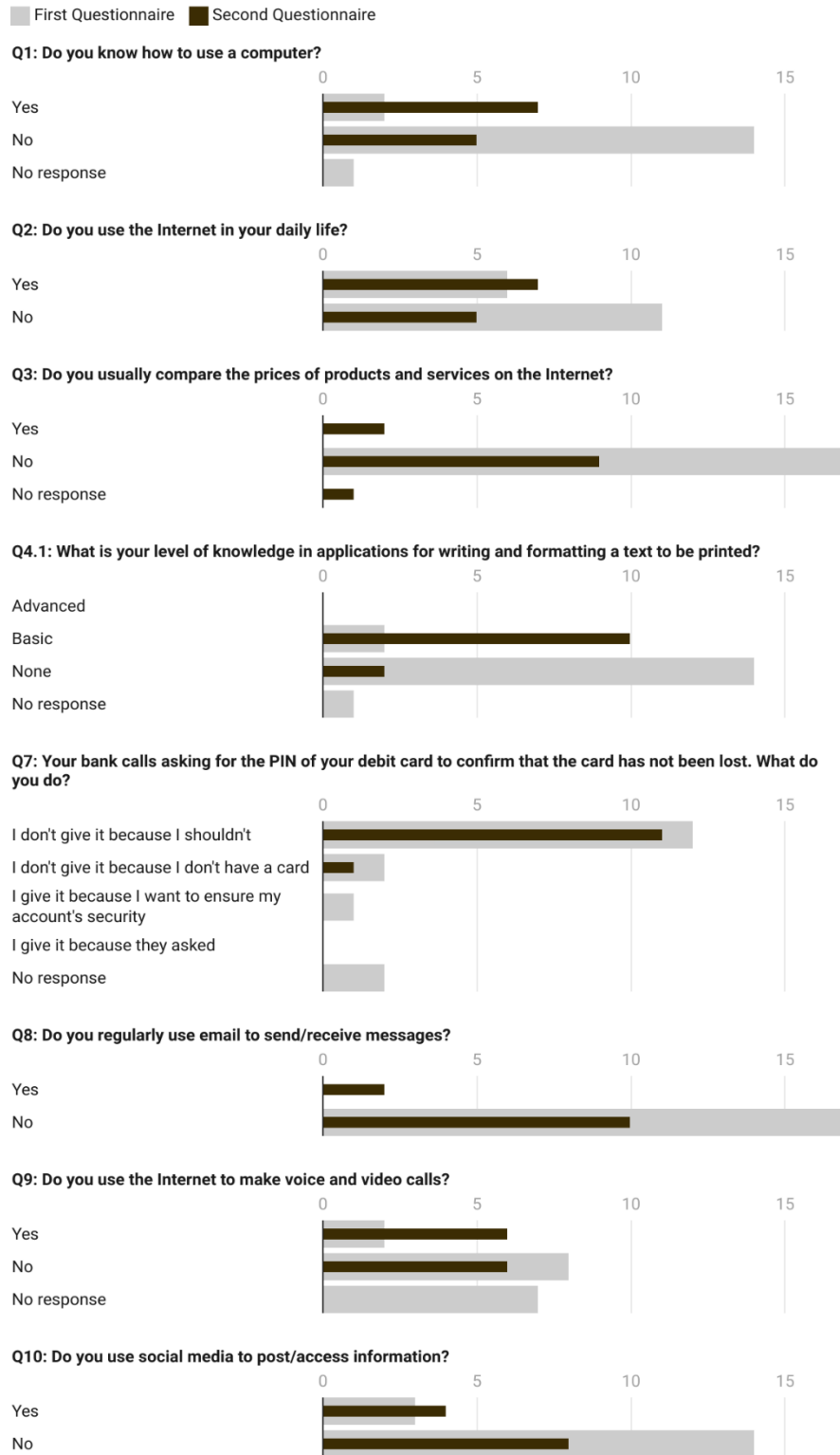
The quantitative analysis from questionnaires identified skill gaps and improvements following training. Qualitative data from interviews and focus groups provided context, illustrating the impact of digital Literacy on participants' social engagement, autonomy, and sense of security. The triangulation of these data sources enhanced the validity of conclusions regarding active aging and empowerment.

5. Findings and Discussion

This section presents the results obtained from the second questionnaire, as well as the interviews and focus groups. Finally, a discussion subsection analyses and interprets the outcomes of these data sources.

Figure 3 presents the most relevant answers to six questions from both questionnaires, considering the sessions conducted and the subjects addressed in this study. The first questionnaire received 17 responses, while the second obtained 12.

Figure 3. Questionnaire responses

First Questionnaire   Second Questionnaire

Q1: Do you know how to use a computer?

Q2: Do you use the Internet in your daily life?

Q3: Do you usually compare the prices of products and services on the Internet?

Q4.1: What is your level of knowledge in applications for writing and formatting a text to be printed?

Q7: Your bank calls asking for the PIN of your debit card to confirm that the card has not been lost. What do you do?

Q8: Do you regularly use email to send/receive messages?

Q9: Do you use the Internet to make voice and video calls?

Q10: Do you use social media to post/access information?

Created with Datawrapper

5.1 Second questionnaire

From the responses to the second questionnaire, it was evident that most participants had acquired basic digital skills, with many indicating they were now comfortable using a computer after completing the initial two modules. Regarding information literacy, most participants reported incorporating Internet use into their daily routines and gained basic knowledge for writing and formatting texts. Notably, two participants mentioned independently installing antivirus software on their computers. Regarding digital communication and citizenship, half of the participants used the Internet for voice and video calls, while two regularly used email to send and receive messages.

In the area of digital security, it is encouraging that most participants reported not disclosing their personal codes when their bank contacted them over the phone.

5.2 Interviews

The 18 interviews were conducted in person following a training session and were subsequently transcribed and analyzed (see Table 2 for more details). These interviews took place at the end of Module 1, where participants were expected to learn basic skills such as turning the computer on and off, editing the screen background, using the calculator to perform calculations, utilizing Microsoft Paint tools for drawing, and creating documents in Microsoft Word.

Based on the answers, all participants listed at least one activity they engaged in. The favorite activities during the sessions were practicing calculations with the calculator, writing in Microsoft Word, and creating drawings in Microsoft Paint; and 3 participants did not specify a favorite activity because they enjoyed all of it. Regarding the difficulties, participants mentioned turning on and off the computer, finding letters on the keyboard, and using the mouse. The use of Microsoft Paint tools and performing calculations with the calculator was also mentioned. In the interviews, several participants highlighted key aspects concerning difficulties. For instance, one participant noted: "The difficulty in drawing was where to get the colors and (pause) in writing it's the keys, I don't know the keys." (E14).

Regarding their motivations, participants cited several reasons for joining the training sessions. The majority expressed a desire to learn how to use the computer, with others wanting to engage with technology, participate due to encouragement, or connect with others. One participant humorously reflected on the motivations, stating: *"My wife pressured me (laughs)."* (E10). *The participant's response suggests that external encouragement, especially from family members, motivated their engagement with the digital transformation process.* All participants reported being satisfied with the training sessions provided by the project. However, some suggested increasing the number of sessions to enhance learning, noting that the limited sessions and the time gaps between them made it challenging to complete activities. In contrast, six participants felt no need for additional support, while two mentioned relying on their peers during the sessions for assistance.

Most participants reported significant improvements in their lives following the training sessions regarding the impact and benefits. They felt more knowledgeable and gained a better understanding of previously unfamiliar subjects. Participants also noted positive changes in their daily routines, including strengthened friendships and enhanced social interactions with other attendees. Additionally, most participants expressed a greater sense of inclusion and increased Participation in society due to the training. "The difference I feel is that we are starting to build friendships with each other... and socializing is very important." (E11) This quote reinforces the social value of the project's training approach.

Table 2. Interview Analysis

Dimension	Question	Answers	
Methods	What did you learn in this module?	*"I learned to do calculations with the calculator, some drawings in Paint, and to write." (E1)*	*"Turning on the computer and turning it off, doing various activities (…) the drawings ... calculations on the calculator ... writing." (E3)*
		"I learned to make drawings, calculations on the calculator, and to handle the computer." (E14)	*"We were doing several things ... those shapes, drawing, and we went to the calculator, ... and writing in Word." (E11)*
Learning Examples	Which activity did you enjoy the most?	*"Writing." (E9)*	*"Drawing, I really like it." (E10)*
		"... calculations on the calculator, I really like." (E11)	*"I liked everything I did, I don't have one that I like more, because you know, it makes me gain experience." (E6)*
Competences	What were your main difficulties?	*"Turning on the computer and turning it off … using the computer mouse was very challenging." (E2)*	*"Only turning on the computer and turning it off was challenging." (E4)*
		"The difficulty in drawing was where to get the colors and (pause) in writing it's the keys, I don't know the keys." (E14)	*"In going to the calculator, drawing, and writing, searching where they are on the computer (…)" (E17)*
Motivations	Why did you take part in these training sessions?	*"Learn to work on the computer and to be with other people." (E1)*	*"my wife pressiored me (laughs)." (E10)*
		"Learn (…)" (E18)	*"I like being involved in these activities, to learn and have fun." (E3)*
Meeting Expectations	Do you think your expectations and motivations are being met?	*"Yes, because it's something new... I didn't know certain things before, and now I do. I'm enjoying it, very much indeed (…)" (E2)*	*"Yes, but... (pause) you know, it's, from a long way off, and I would like to learn more... I would like to practice more, but yes, I'm enjoying it." (E5)*
		"Yes, within the possibilities... you know, they should be more frequent." (E3)	*"Yes, yes, I'm very happy, but... (pause) I'm sorry it's such a short time, it should be more." (E13)*
Guidance and Monitoring of Activities	What about the sessions, do you feel there's a lack of guidance?	*"Yes, you know... we need more support." (E5)*	*"I don't feel supported, I miss having more support." (E8)*
		"Yes, I feel it, I need more support... I don't know, and I need them to be here more often. You know, the first time they were sitting next to me helping, it's easier to learn." (E14)	*"We have guidance, yes. If we have a doubt, we ask." (E11)*
Problems in ICT Use	What are the positive and negative aspects of using ICT?	*"The positive is the advancement of technology, the negative in this is the little time that is given (...)" (E4)*	*"There is no negative, all aspects are positive... we are still learning (…)" (E7)*
		"The advantage is learning to use the computer, of course, and the disadvantages... is having difficulties." (E12)	*"For me, the positive aspects were good to learn and be a little, see new people, and socialize." (E18)*
Impact/Benefits	Do you feel that your life has improved after taking part in the project? In what ways?	*"It improved in aspects... for example, in culture and in writing. You know, I only have a fourth-grade education, miss, and culturally it also changed, you also learn many things with the computer." (E4)*	*"I am alone... and while I come, I am socializing and learning more, too." (E18)*
		"I really want to learn more, but I need more time (…)" (E14)	*"I think so, because I am learning something new... new knowledge." (E4)*
	Do you feel any difference in your relationships with others, in your day-to-day life?	*"Yes, it's more... up-to-date, you see, in relation to people, it's also different, on Facebook, I talk to many people, I make video calls with grandchildren, children, they are not here (pause)... but we talk every day, yes, and I also talk to friends." (E5)*	*"Now... I deal with them more and talk to them more." (E12)*
		"The difference I feel is that we are starting to build friendships with each other... and socializing is very important." (E11)	*"Yes, yes, I'm always eager to come here because... I like being with people and socializing." (E17)*
	Do you feel that you are now more included and more involved in society?	*"Yes, for sure... for now, I'm a very cheerful person, but there's no doubt that this helps us, this here (points to the mobile phone) also helps us to evolve." (E4)*	*"Yes, very much so (...) Look miss, I'm in a setting I wasn't in before, because I come here to do the training, people are all acquaintances, although I'm from another parish." (E5)*

5.3 Focus Groups

The two focus groups were conducted face-to-face at the training sessions after completing the Navigating the Internet module. The objective was to gather participants' opinions on technology and understand their motivations for participating in the project. Table 3 summarizes the results, indicating that the majority of participants mentioned at least one activity they engaged in during the sessions. Participants expressed enjoyment of all activities, particularly highlighting drawing, performing calculations, and writing in Microsoft Word as favorites.

Regarding the difficulties encountered, participants in FG1 identified handling the computer as the primary obstacle. In contrast, participants in FG2 reported having no significant difficulties, attributing their positive experience to the support provided by the session facilitators. As one of the participants mentioned, "I did not feel any difficulties, because you helped" (E9.FG2).

The motivations for participating in the sessions varied, with most participants wanting to learn something new. One participant emphasized: "Because we wanted to leave home and we wanted to learn." (E4.FG2). Participants indicated that their expectations and motivations were largely fulfilled, although many wished for additional sessions. They reported feeling adequately supported during the sessions and noted that they often relied on their peers to complete the proposed activities.

Regarding the positive and negative aspects of ICT, the vast majority of participants viewed technology favorably, emphasizing its significant potential to enhance their lives. However, a common negative aspect mentioned was the limited number of sessions conducted. Additionally, participants highlighted the importance of exercising caution while browsing the Internet, noting that they could be vulnerable to online scams, with some even reporting previous experiences of being scammed. One participant highlighted the concern for digital security, stating: "We need to be aware of the potential security problems." (E2.FG1), emphasizing the importance of addressing security risks in the digital transformation process.

Participants indicated that the sessions significantly improved their lives by providing new knowledge and facilitating social interactions. They reported feeling more included and engaged in society due to the training.

6. Discussion

This section addresses the key research questions by analyzing the above data and reviewing the literature in light of the objectives outlined in Table 1.

Continuing learning is a cornerstone of active aging, fostering integration and autonomy for older individuals (Patrício & Osório, 2016). The Capacid@de Digital project, as a community-based program, exemplifies this by combining formal and informal training, which enriches participants' skills and knowledge (Socci et al., 2020; Villar et al., 2020). While some difficulties have been encountered, such as a perceived lack of support and the infrequent scheduling of sessions, participants generally express satisfaction with the training. Despite these limitations, participants found the sessions valuable, emphasizing the desire for additional training opportunities. Therefore, the results indicate a positive evaluation of participant's understanding and perception of digital literacy training (in line with objective 1).

The results indicate significant positive development in the participants' knowledge, especially regarding the use of computers and the Internet (in line with objective 2). Given that the target audience initially had limited ICT knowledge, these findings align with prior research on digital exclusion among older adults. These challenges are related to global trends highlighting the common barriers older adults face in digital adoption, such as the fact that many individuals aged 65 to 74 have never used the Internet (Álvarez-García et al., 2018; PORDATA, 2022; Zaidi & Howse, 2017). Consequently, the project emphasized real-life scenarios to alert participants about ICT risks like fraud.

Table 3. Focus Groups

Dimension	Question	Answers	
Methods	What did you learn in this module?	*"We learned how to use a computer." (E3.FG1)*	*"We learned how to draw." (E6.FG1)*
		"Doing math, writing, and reading." (E1.FG1)	*"Doing math using the computer calculator." (E1.FG2)*
Learning Examples	Which activity did you enjoy the most?	*"All of the activities." (E3.FG1)*	*"All of the activities because all of them were useful." (E7.FG1)*
		"Doing math, writing reading, drawing---everything (laughs)." (E9.FG1)	*"Writing and reading." (E7.FG2)*
Competences	What were your main difficulties?	*"Concentration." (E5.FG1)*	*"I felt many difficulties." (E10.FG2)*
		"The use of technology in general, turning on the computer (…)." (E2.FG1)	*"I did not feel any difficulties, because you helped." (E9.FG2)*
Motivations	Why did you take part in these training sessions?	*"So that we can learn a bit more about new technologies because we are from a generation that did not have any of these technologies that are now available and it is always good for us to learn because you are always learning until you die." (E2.FG2)*	*"Because we wanted to leave home and we wanted to learn." (E4.FG2)*
		"Because we like to learn." (E1.FG2)	*"Because it is good to do these things that we have never done before." (E3.FG2)*
Meeting Expectations	Do you think your expectations and motivations are being met?	*"Yes." (E4.FG2)*	*"Yes." (E3.FG2)*
		"Yes." (E1.FG1)	*"Yes." (E4.FG1)*
Guidance and Monitoring of Activities	What about the sessions, do you feel there's a lack of guidance?	*"No, we work like a team and help each other." (E5.FG1)*	*"Sometimes is difficult to follow all the new information, so yes, we would like to have had more guidance." (E1.FG2)*
		"No." (E1.FG1)	*"We would like to have had more sessions." (E2.FG2)*
Problems in ICT Use	What are the positive and negative aspects of using ICT?	*"All is positive." (E3.FG1)*	*"We need to be aware of the potential security problems." (E2.FG1)*
		"It is very useful for us." (E5.FG1)	*"Negative is our obstacles and difficulties." (E1.FG1)*
Impact/Benefits	Do you feel that your life has improved after taking part in the project? In what ways?	*"In general knowledge yes." (E3.FG1)*	*"We follow closely the everyday news, and we can be with friends." (E4.FG1)*
		"Drawing and other activities." (E1.FG2)	*"Yes, of course. And additionally, I feel less lonely." (E5.FG2)*
	Do you feel any difference in your relationships with others, in your day-to-day life?	*"No, I keep the same routines and do not grab." (E9.FG2)*	*"No, it is the same thing." (E9.FG1)*
		"Yes, now I talk." (E3.FG1)	*"No." (E1.FG1)*
	Do you feel that you are now more included and more involved in society?	*"Yes, also because we talk to each other and socialize." (E5.FG1)*	*"I believe yes." (E2.FG1)*
		"No." (E1.FG1)	*"No." (E7.FG1)*

Additionaly, digital Literacy is crucial for fostering the digital inclusion of older individuals, as its significance is well-documented (Karpati, 2011; Patrício & Osório, 2016) as well as social inclusion (Reisdorf & Rhinesmith, 2020). By enhancing digital Literacy, older adults can lead more autonomous, healthy, and engaged lives. The Capacid@de Digital project effectively enabled participants to acquire essential digital skills, such as using computers and the Internet for everyday tasks. According to the Dynamic Reference Framework for Digital Competence (INCoDe.2030, 2019), digital communication involves interacting through digital technologies, and the project facilitated significant advancements in this area for the participants. Moreover, digital Literacy encompasses the use of technology and its safe use. Understanding digital security is vital for older adults to ensure their protection and inclusion in the digital world (Patrício & Osório, 2016). The Capacid@de Digital project addressed this by emphasizing the importance of safeguarding personal data and avoiding disclosure to third parties. Despite most participants being aware of these security issues, the project's focus on digital safety provided added value by reinforcing best practices and helping to mitigate potential risks (Tucker, 1974).

Acquiring new knowledge is crucial for enhancing the quality of life for older adults, as it provides new stimuli and fosters better social integration (Álvarez-García et al., 2018; Narushima, 2005; Patrício & Osório, 2016; Wagg et al., 2021; Walker, 2002). Our findings reinforce work on intrinsic motivation (Grano et al., 2008): participants primarily joined the sessions to learn something new, with additional drivers including peer encouragement and a desire to connect with others (Silva, 2018) (in line with objective 3). Enhancing digital skills strengthens their abilities and increases their autonomy, contributing significantly to active aging (Álvarez-García et al., 2018; Bowling, 2007).

One of the key aspects of active aging is promoting a healthier lifestyle, encompassing physical activity, health, inclusion, and Participation in social and cultural activities (Glass & Lawlor, 2021; Udo, 2016; Wagg et al., 2021). The findings indicate that the Capacid@de Digital project positively impacted the elderly participants. The impact of this project extends beyond digital Literacy, as participants reported improvements in their lives, particularly through acquiring new ICT knowledge, which enhanced their sense of informativeness and capability. These findings mirror previous literature since using computers can increase digital inclusion and improve the quality of life for older adults by enhancing their technological self-efficacy and sense of connectedness (Tsai et al., 2015). The project also fostered social connections among participants, leading to the development of friendships and a greater sense of community.

Furthermore, participants felt more included and active in society. These outcomes align with the literature on the benefits of active aging, which highlights improvements in mood, vitality, and reductions in feelings of loneliness (MacCallum et al., 2010; Villar et al., 2020). Overall, the project contributed to healthier aging by providing a supportive environment for skill development, thereby enhancing participants' self-esteem, social inclusion, and overall quality of life. These results resonate with the third pillar of active aging, emphasizing the importance of Participation in increasing elderly individuals' self-esteem, inclusion, and social stability (Gholipour et al., 2020; Udo, 2016; Walker, 2002).

7. Conclusions

The aging population presents challenges and opportunities for societies, requiring strategies to enhance older adults' quality of life. Aging is a complex and individualized process influenced by various factors, including genetics and lifestyle. The concept of active aging emphasizes health, autonomy, Participation, and continuing learning as key elements that can improve the aging experience. Within this framework, digital Literacy is increasingly recognized as a vital skill that directly supports active aging by enabling older adults to maintain independence, engage in social activities, and access essential services—bridging the gap between aging populations and a digitizing society. However, despite its benefits, many older adults face significant barriers due to limited ICT skills, which can contribute to digital and social exclusion and reduced opportunities for engagement.

The Capacid@de Digital project was developed to address these challenges by providing digital literacy training to adults with limited computer skills in Portugal's Tâmega e Sousa region. The project, supported by a higher education institution and conducted in collaboration with local municipalities, offers short-term training sessions focused on basic and intermediate digital competencies. These sessions, facilitated by volunteer students under academic supervision, are aligned with the INCoDe.2030 framework, which seeks to promote equitable access to digital skills. The curriculum emphasizes problem-based learning, which connects digital skills to practical, everyday issues relevant to the participants' lives. This approach improves digital skills and operationalizes active aging principles by fostering autonomy (e.g., online banking) and social Participation (e.g., virtual communication).

The research findings indicate that the Capacid@de Digital project has positively impacted participants by improving their ICT knowledge and supporting aspects of active aging, such as Continuing learning and Participation. The project helps older adults engage more actively in society, perform everyday tasks online, and maintain connections with family and community by equipping older adults with essential digital skills. Participants reported increased confidence in using digital tools and a greater sense of inclusion, demonstrating that digital Literacy can effectively address social exclusion among older adults. This underscores the project's dual contribution: advancing digital inclusion while directly supporting active aging goals.

Beyond skill development, the Capacid@de Digital project also positively influenced the participants' sense of community. Many older adults involved in the project reported feeling more integrated and capable of engaging in social and cultural activities. This increased Participation highlights the role of digital Literacy in improving social well-being and reducing isolation. By providing opportunities for learning and interaction, the project helps older adults build connections and engage more fully with the world around them. These outcomes illustrate how digital literacy initiatives can serve as catalysts for broader societal cohesion, particularly in aging populations.

From a theoretical standpoint, this study provides empirical evidence for the intersection between active aging and digital Literacy. It highlights how digital skills can significantly enhance the aging experience and promote social inclusion, which are key social impact dimensions for the elderly. Specifically, it demonstrates that digital literacy interventions can operationalize active aging's four pillars (health, learning, Participation, and security), offering a replicable model for policymakers. Practically, the success of the Capacid@de Digital project provides insights into the design of community-based initiatives to support active aging through digital Literacy, aligned with the literature recommendations. These findings can inform policy and intervention strategies, offering guidance on effectively empowering older adults and increasing their engagement in society. For instance, partnerships between higher education institutions and municipalities—as exemplified here—can amplify the reach and sustainability of such programs. For policymakers, the study highlights the need for a multi-stakeholder community approach to create sustainable digital literacy programs, requiring an institutional approach to go beyond the initial training period (Lafuente et al., 2022).

However, this study has some limitations. The small sample size, the varying levels of prior knowledge, and the limited number of sessions restrict the ability to generalize the findings to a broader population. Additionally, the short-term nature of the intervention does not capture the long-term impacts of digital Literacy on active aging. To address these gaps, future research should prioritize longitudinal studies tracking sustained effects over 5–10 years, as well as comparative analyses of similar programs across diverse cultural contexts. Expanding the Capacid@de Digital model to different regions and populations—including those with diverse educational backgrounds, socioeconomic statuses, and geographical locations—could further validate its scalability. Collaborations with healthcare providers, NGOs, and private-sector stakeholders could also enhance program impact, embedding digital Literacy into broader active aging ecosystems. Future research should also explore how different pedagogical approaches and digital tools affect learning outcomes.

Finally, this work contributes to society by showcasing how equitable access to digital skills can reduce age-related inequalities. By addressing the digital literacy gap, projects like Capacid@de Digital empower older adults to explore the

digital landscape independently, fostering inclusion, Participation, and dignity. However, achieving this digital inclusion requires policies considering affordability, accessibility, and ongoing support. As the aging population continues to grow, integrating digital Literacy into active aging strategies will be critical to ensuring older adults remain engaged, connected, and valued members of society. Policymakers and community leaders must prioritize such initiatives to build age-inclusive societies where technological progress benefits all generations.

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Appendix

Appendix 1. Questionnaire

Question	Answers
Do you know how to use a computer?	Yes No
Do you use the Internet in your daily life?	Yes No
Do you often compare prices of products and services on the Internet?	Yes No
… write and format a text to be printed? (Usually referred to as word processing applications, e.g., Microsoft Word)	Advanced Basic None
… calculate and analyse data? (Usually referred to as spreadsheet applications, e.g., Microsoft Excel)	Advanced Basic None
… edit photos to, for example, publish on a social network? (Usually referred to as image processing applications, e.g. Photoshop)	Advanced Basic None
… create a digital presentation to be presented in public? (Usually referred to as digital presentation editing applications, e.g. Microsoft PowerPoint)	Advanced Basic None
… editing videos to, for example, publish on a social network? (Usually referred to as video editing applications, e.g. OpenShot)	Advanced Basic None
Which of the following devices do you use to store your digital documents?	Computer External drive or USB stick Cloud storage (e.g., OneDrive) None
If you have selected at least one storage device on the previous question, do you backup your data to another device?	Yes No
Do you have antivirus on your computer?	Yes, I installed it Yes, someone installed it No/No
Your bank calls to ask for your debit card pin to confirm the card has not been lost, what do you do?	I do not give because I should not. I do not give, because I do not have a card. I give because I want to ensure the security of my account. Yes, because they asked.
Do you regularly use email to send/receive messages?	Yes No
Do you use the Internet to make voice and video calls?	Yes No
Do you use social networks to publish/access information	Yes No

Do you publish videos on YouTube or discuss topics on your website or blog?	Yes
	No
Do you access your bank account via Internet?	Yes
	No
Do you access the government online services?	Yes, through the digital mobile key
	Yes, through normal authentication
	No
Where are your credentials (e.g., passwords, pins) stored?	I use an application for credential management.
	I have memorized them, but they are all different
	I memorized them because I always use the same
	They are hidden in the wallet or phone
	They are at home on a paper
Do you use/used digital applications to control your tasks or agenda?	Yes
	No
Do you use/have you used in any situation an application for agenda/task management in a collaborative environment?	Yes
	No
Have you adhered to the electronic invoice for any of your services?	Yes, for ecological reasons
	Yes, because I had to
	No
Do you usually read news on information sites?	Yes
	No
Have you ever commented on a news item, information site or discussion forum?	Yes
	No
Have you ever made a formal complaint digitally, or a requested for clarification to a state department, bank, etc.?	Yes
	No
Have you ever denounced a situation of harassment or offenses (moral, physical, …) to the authorities?	Yes
	No
Do you have your accounts (email, social networks, calls, …) synchronized with your mobile phone?	Yes
	No
When you join a service or install an application, do you carefully read the conditions or terms of use?	Yes
	No