ICONO14

Universidad Rey Juan Carlos

From the generational digital divide to the technology divide: a qualitative proposal

De la brecha digital generacional a la brecha tecnológica: una propuesta cualitativa

Da fratura digital geracional à fratura tecnológica: uma proposta qualitativa

Alba-María Martínez-Sala[1*]

Natalia Papí-Gálvez[1**]

Silvia García-Espinosa[1***]

[1] University of Alicante (UA), Spain

[*] Senior Lecturer in the Department of Communication and Social Psychology at the University of Alicante (UA), Spain. Email: albamaria.martinez@ua.es

[**] Senior Lecturer in the Department of Communication and Social Psychology, School of Economics and Business Studies, University of Alicante (UA), Spain. Email: Natalia.p@ua.es (Corresponding author)

[***] Research Fellow in training affiliated with the University of Alicante (UA). Email: silvia.gespinosa@ua.es

This work is licensed under a Creative Commons Attribution 4.0 International License

DOI: 10.7195/ri14.v23i1.2273 | ISSN: 1697-8293 | 2025 Vol. 23 Nº 1 | ICONO14

Received: 29/05/2025; **Revised:** 03/06/2025; **Accepted:** 18/10/25; **Published:** 17/12/2025

Translation to English: Ana María Ayala Casellas, TRIDIOM S.L

To cite this article: Martínez-Sala, Alba-María; Papí-Gálvez, Natalia; & García-Espinosa, Silvia. (2025). From the generational digital divide to the technology divide: a qualitative proposal. *ICONO 14. Scientific Journal of Communication and Emerging Technologies, 23*(1): e2273. https://doi.org/10.7195/ri14.v23i1.2273

Abstract

Purpose: To explore the technological barriers that interfere with online transactions (e-commerce and administrative procedures). The aim is to understand how technology affects the generational digital divide. **Methodology:** A two-phase exploratory study is applied to a sample of four websites: three e-commerce sites and one public administration site. The four have been selected based on their frequency of use and because each type constitutes a key area: the first linked to consumption and everyday life, and the second to the management of public procedures, which are increasingly carried out exclusively online. In the first phase, accessibility, navigability and usability are evaluated using an *ad hoc* instrument. In the second phase, the user experience of 24 older adults is observed. **Results:** The efficiency of the websites and the user experience varies according to their sociodemographic profile and context of use. However, common limitations in the technological field are also identified: inefficient search engines, information overload, excessive pop-ups, lack of adaptive design, etc. **Conclusions:** Compliance with standards and a focus on the user population will attract more visitors and also promote inclusion. In particular, public administration websites should be reviewed for the benefit of citizens. **Collateral information:** The main contribution lies in identifying limiting factors in the use, common in key profiles, confirming the technological dimension as a factor in digital exclusion. The optimisation of digital platforms is proposed as a strategic line of action.

Keywords
Accessibility; Generational Digital Divide; Technology Divide; Digital Competence; Navigability; Usability.

Resumen

Propósito: Explorar las barreras tecnológicas que interfieren en la realización de trámites en línea (compras electrónicas y gestiones administrativas). Se busca comprender cómo la dimensión tecnológica incide en la brecha digital generacional. **Metodología:** Se aplica un estudio exploratorio en dos fases en una muestra de cuatro sitios webs: tres de comercio electrónico y uno de administración pública. Los cuatro han sido seleccionados por su frecuencia de uso y por constituir, cada tipo, un ámbito clave: el primero vinculado al consumo y vida cotidiana, y el segundo, a la gestión de trámites públicos que, en creciente medida, se realizan exclusivamente en línea. En la primera fase, se evalúan la accesibilidad, navegabilidad y usabilidad mediante un instrumento diseñado *ad hoc*. En la segunda, se observa la experiencia de uso de 24 personas adultas mayores. **Resultados:** La eficiencia de los sitios webs y la experiencia del usuario varía según su perfil sociodemográfico y contexto de uso. Sin embargo, también se identifican limitaciones comunes en el ámbito tecnológico: buscadores ineficientes, saturación informativa, exceso de ventanas emergentes, falta de diseño adaptativo, etc. **Conclusiones:** El cumplimiento de los estándares y la orientación a la población usuaria atraerá a más visitantes y también favorecerá la inclusión. Especialmente, las páginas de la administración pública deben ser revisadas en beneficio de la ciudadanía. **Información colateral:** La principal aportación radica en la identificación de elementos limitantes del uso, comunes entre perfiles clave, confirmando la dimensión tecnológica como factor de exclusión digital. Se propone la optimización de las plataformas digitales como línea estratégica.

Palabras clave
Accesibilidad; Brecha digital generacional; Brecha tecnológica; Competencia digital; Navegabilidad; Usabilidad.

Resumo

Objetivo: Explorar as barreiras tecnológicas que interferem na realização de procedimentos en línea (compras eletrónicas e procedimentos administrativos). O objetivo é compreender como a dimensão tecnológica afeta a exclusão digital geracional. **Metodologia:** É aplicado um estudo exploratório em duas fases numa amostra de quatro sites: três de comércio eletrónico e um de administração pública. Os quatro foram selecionados pela sua frequência de uso e por constituírem, cada tipo, um âmbito-chave: o primeiro ligado ao consumo e à vida cotidiana, e o segundo, à gestão de procedimentos públicos que, cada vez mais, são realizados exclusivamente en línea. Na primeira fase, avalia-se a acessibilidade, navegabilidade e usabilidade por meio de um instrumento projetado *ad hoc*. Na segunda, observa-se a experiência de uso de 24 idosos. **Resultados:** A eficiência dos sites e a experiência do utilizador variam de acordo com o seu perfil sociodemográfico e contexto de utilização. No entanto, também são identificadas limitações comuns no âmbito tecnológico: motores de busca ineficientes, saturação de informação, excesso de janelas pop-up, falta de design adaptativo, etc. **Conclusões:** O cumprimento das normas e a orientação para a população utilizadora atrairá mais visitantes e também favorecerá a inclusão. Em especial, as páginas da administração pública devem ser revistas em benefício dos cidadãos. **Informação colateral:** A principal contribuição reside na identificação de elementos limitantes do uso das plataformas, comuns em perfis-chave, confirmando a dimensão tecnológica como fator de exclusão digital. Propõe-se a otimização das plataformas digitais como linha estratégica.

Palavras-chave
Acessibilidade; Lacuna digital entre gerações; Lacuna tecnológica; Competência digital; Navegabilidade; Usabilidade.

1. Introduction

In an increasingly digitalised and ageing society, the generational digital divide leads to situations of greater vulnerability for a growing number of citizens. In Spain alone, almost half of people over 65 lack basic digital skills, and a significant

proportion (20%) have never used the internet (Ministerio de Asuntos Económicos y Transformación Digital, 2023). The acquisition of digital competencies is one of the key lines of intervention promoted by Europe (Comisión Europea, 2023; Observatorio Nacional de Tecnología y Sociedad, 2023). Such competencies are not only considered necessary for lifelong learning, but are nowadays the cornerstone of social inclusion (Recomendación del Consejo de 23 de noviembre de 2023).

The European DigComp model (Vuorikari *et al.*, 2022) serves as a tool for observing the digital divide through the lens of digital competencies. Its application by age attributes information and communication skills to the older adult population, considered internet users, but with limitations in terms of online procedures and problem-solving (Papí-Gálvez and La-Parra-Casado, 2023). However, difficulties with some procedures, especially those related to public administration—such as understanding and completing online forms, lack of personalised assistance or fear of fraud—also affect younger groups. At the same time, an increasingly competent senior consumer profile is emerging, characteristic of the silver generation (Alcaide, 2020; Lozano-Oyola, 2022; Observatorio Nacional de Tecnología y Sociedad, 2024). This evidence leads us to reflect on whether actions aimed at improving digital competencies are sufficient to prevent social exclusion.

In the face of constant technological evolution, this research proposes to analyse platforms from the perspective of their impact on digital divides, as a complementary line of intervention, and their capacity to facilitate digital literacy and guarantee equal opportunities, especially for older adult generations.

The article explores in depth the results of the quantitative and qualitative analysis that form part of a funded project (Generalitat Valenciana y Universidad de Alicante, 2024). It argues for a broadening of the approach to digital literacy, so as to avoid focusing on individual factors or, ultimately, placing the responsibility for their own digital divide on the individuals themselves. Instead, it proposes the term "technological divide" to emphasize what technology itself can do to avoid reinforcing social exclusion.

Unlike the term "digital divide", which has been widely developed in scientific literature, the term "technological divide" has not yet been consolidated as a category of analysis. Existing references tend to use it to describe inequalities in research, education, innovation or access to infrastructures, but not to refer to shortcomings in the design, usability and accessibility of digital platforms that

directly affect the lives of users. Based on this conceptual gap, this study proposes the notion of a "technological divide". This approach could provide a theoretical alternative to other studies focusing on recent technological innovations that impact the relationship between humans and machines.

2. Theoretical framework

The generational digital divide refers to differences among age groups in the access to and use of devices and connectivity technologies, as well as the ability to use them effectively (Papí-Gálvez and La-Parra-Casado, 2023). Access, use and the effective use of information and communication technologies (ICT) thus form the three levels of the divide.

Research conducted in Spain reveals that, although many older adults have access to ICT, universal adoption is still a challenge, particularly in services involving online procedures (Alcaide-Muñoz *et al.*, 2022; Ávila-Rodríguez-de-Mier and Martín-García, 2018; Izquierdo Soto *et al.*, 2024; Manzanera-Román and Haz-Gómez, 2022). With regard to older adults, the divide is accentuated by generational factors attributed to the group, such as lower digital literacy (Hargittai *et al.*, 2019; Menéndez-Álvarez-Dardet *et al.*, 2020; Ramdowar *et al.*, 2024; Salman *et al.*, 2023).

In contrast, the digitalisation of procedures that, prior to the pandemic, were typically carried out in person (Instituto Nacional de Estadística [INE], 2024) creates a barrier to participating on equal terms, a situation evidenced by the rapid implementation of e-government services. This has become a fundamental pillar of the modernisation of public services despite the difficulties faced by citizens as a whole (Panadero-Hernández, 2023; Sánchez-Valle and Llorente-Barroso, 2023). According to the INE (2024), 93% of the population aged 25 to 34 uses the internet for e-government services, compared to 50% of those aged 65 and over. Despite the aforementioned difference, technical problems and usage difficulties top the list for all groups.

Among online procedures, those that require a financial transaction require individuals to trust the platforms (Broeder, 2020; Panadero-Hernández, 2023; Soleimani, 2022). This could be the case for e-commerce, which has become an

indispensable element for accessing basic goods and services (Weltevreden, 2024). The latest data (INE, 2024) show growth in the number of online consumers, also among the older age groups, since the pandemic. In 2024, 57% of people aged 65-74 shopped online, which is a considerable increase from the 30% in 2019.

This evidence highlights the need for studies that provide an up-to-date assessment of the efficiency of platforms requiring an online procedure. Technological and organisational solutions are needed to adapt digital public services to the needs of older adults (Manzanera-Román and Haz-Gómez, 2022; Rodríguez-Martín-Retortillo, 2023). Studies focusing on the analysis of e-commerce platforms also point out that they often have complicated interfaces that can be overwhelming and discourage their use (Pretel-Jimenez *et al.*, 2022).

Accessibility, usability and navigability are fundamental principles in web design focused on improving the experience of accessing and using such sites. All three are assessed by means of different protocols. Their importance lies in their ability to create inclusive and effective digital experiences. A website that incorporates these principles complies with ethical and legal standards, and expands its reach to a more diverse audience (Abad-Alcalá, *et al.*, 2021; Llorente-Barroso *et al.*, 2023).

The protocols and methods for assessing the aspects addressed have evolved significantly over time. This evolution reflects the growing understanding of the diversity of the population's needs and the complexity of digital interactions (Martínez-Sala *et al.*, 2020). The proliferation of mobile devices and the development of their functions and, more recently, artificial intelligence (AI), are redefining what it means to create an accessible, usable and navigable website (Palmer and Oswal, 2024; Panwar, 2024). In this new paradigm, qualitative methods provide a better understanding of the user. A useful method for understanding user experience is the emotional map (Setchi and Asikhia, 2019). This tool allows for the detailing and visualisation of the population's emotional responses while they interact with the platform, identifying moments of satisfaction, frustration, or confusion. All of this helps designers and developers to create effective and emotionally meaningful solutions by optimising touchpoints and improving satisfaction (Izquierdo-Soto *et al.*, 2024).

Consequently, these services (e-government and e-commerce) form two paradigmatic frameworks for observation to answer the research question: What platform-related factors are at play in creating age-based inequalities?

The aim is to identify, from the perspective of older adults as a population in a situation of greater vulnerability, those elements that either hinder or facilitate the use of these types of websites, with particular attention given to the processes that generate the most distrust or difficulties, such as online shopping (Fernández-Bonilla *et al.*, 2022) and e-government (Panadero-Hernández, 2023). Specifically, the aim is to:

1. Detect the elements, both present and absent, that may interfere with navigation when completing an online transaction.
2. Identify the facilitators and obstacles in the process of such procedures that are attributable to visual communication, language adaptation, or interaction with the website, within the framework of the generational digital divide.

3. Method and materials

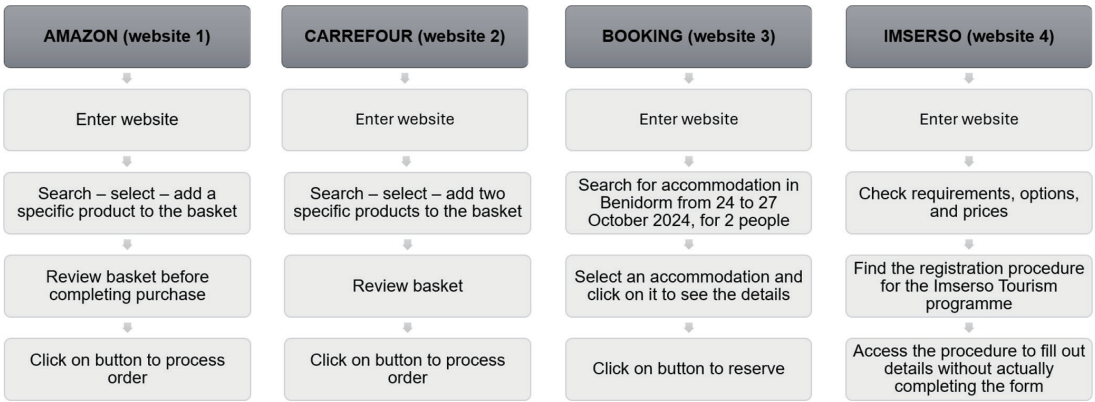
In order to achieve the objectives, two complementary studies were designed. The first reviewed the accessibility, navigability and usability elements of a selection of websites. The second was based on user tests, whose participants were older adults, giving the research an exploratory-experimental nature. Both used the same theoretical or qualitative sample of websites.

The selection of these sites took into account their relevance, but also the possibility of designing an exercise focused on online procedures that could be completed in a single session by older adults. Three B2C e-commerce platforms and one e-government platform were selected. The former are widely known (Amazon, Carrefour and Booking), and significant for this group, according to the categories of products with the highest online purchases observed for the over-64s (INE, 2024). In addition to their traffic and usage figures, the e-commerce websites were selected based on the premise that, given their economic interest, they would be optimised for the general public. The public administration website is national in scope and highly relevant to this social group, as it offers services specifically targeted at them. It is included for the purpose of being compared with the other three, which are presumed to act as benchmarks for the online procedures. The e-government category was added because it represents a mandatory and growing

environment, where essential procedures are concentrated, and where previous studies have identified the greatest difficulties. The combination of private and public platforms not only enables a contrast of the browsing experience in voluntary consumption contexts versus mandatory management contexts, but also the identification of specific technological divides that may be obscured by purely functional or economic design criteria.

For each website, the observation of four main actions was proposed, forming a defined path (Figure 1): 1. Enter the website, 2. Search for the suggested product, 3. Examine its features, 4. Complete the transaction. Therefore, the homepage and three sections (search results, product details and the online shopping basket) were observed.

Figure 1. *Proposed website paths, study 2*



Source: *Authors' own compilation.*

The first study applied a mixed-methods methodology (qualitative and quantitative). The qualitative approach was carried out in two phases: a descriptive phase, covering each and every one of the elements that make up the four pages of each path, and an evaluation phase, in which this information is reviewed and assessed. For quantitative guidance, an instrument for analysing accessibility, navigability and usability was developed (Abad-Alcalá *et al.*, 2021; World Wide Web Consortium, 2010). The instrument consisted of eight categories (Access and navigability, Usability, Processes, Errors, Adaptation, Content, Marketing, Other).

With the exception of "Content," which was addressed in the second study, each category contained several aspects to be coded. A total of 34 variables were reviewed per page, yielding 544 observations for the desktop version of the websites alone. The mobile version of the homepage was also analysed. The same version and page were reviewed by an average of two researchers. The data was collected in the period from June to August 2024.

The second study is based on user experience. It is approached from the qualitative paradigm, employing participant observation during the session and a brief confirmatory interview on non-verbal reactions after the test. Participants were selected according to key profiles: 65-75 years[1], internet users with different levels of intensity (daily, 1-2 times a week, 1-2 times a month), women and men, and varying levels of education. A total of 24 people were contacted, 8 for each province in the Region of Valencia. Three meetings took place (Alicante, Castellón and Valencia) between May and July 2024. Initially they completed a questionnaire so as to discover their profile, experience with the different websites and frequency of use. In terms of the procedure, each observer was assigned two participants. Each participant completed two paths (Figure 1), each corresponding to a different website, such that every website was tested by at least 10 participants. Furthermore, the websites were observed on two devices (mobile and desktop). The emotions observed during each phase of the path were recorded, both positive and negative, following the creation of an eight-category scale to facilitate this task for the observers (negative: nervousness, confusion, frustration, anger; and positive: trust, calm, sense of security, satisfaction). This classification facilitates the analysis of the data by grouping related emotions under a single category, thus allowing for a clearer interpretation of the results. For example, terms such as anxiety or unease were classified under the category of nervousness, while emotions such as disorientation or perplexity were grouped under confusion. This helps to ensure that the diversely captured emotions can be analysed consistently within a common framework. These emotions were verified in a brief follow-up interview. A total of 192 observations (positive or negative) were coded and quantified using a mixed-method emotional mapping design anchored in the circumplex and PAD models, combining multimodal observational coding (verbal/non-verbal) and SAM self-reports for each task episode completed by older adults. Two blind coders rated valence, arousal and

control (κ_w, ICC[3,k] ≥ 0.70) and scores were aggregated into a timeline visualised in Power BI. The team partnered with Grupo Enfoca, a digital consultancy company, for participant recruitment, session management, and initial data processing. This study was approved by the University Ethics Committee (UA-2024-05-17_1).

4. Analysis of results

4.1. Notable features of the selected websites

The homepage of the three e-commerce sites and of Imserso [Spanish Institute for the Elderly and Social Services], representing the public administration, contains elements that facilitate navigation and make the interface intuitive. Differences and some shortcomings were also detected.

All websites have three sections: a header, a body section and a footer (Table 1) in both their desktop and mobile versions. In the header, there are similar elements: a logo, a menu and a search bar. The menu is not the same in all cases. The first two use the 'hamburger menu', albeit indicated differently ('all' or 'menu'). The third and fourth feature a descriptive horizontal menu. In addition, only one website (2) maintains a fixed (sticky) header during vertical scrolling. Another common feature, except for this one, is the rollover effect on the horizontal menu, although each website implements this action differently. The search bars have varying prominence and options.

The body section also typically contains static images. The elements are well structured; although there is a lot of information. In some cases, advertising is indistinguishable from the rest of the content.

In the footer, there are significant variations. The second website includes links to social media, images related to offers and payment methods available. In the case of the first and third websites, the sitemap is not included. For Imserso, the footer is simple, presenting only the basic elements, and includes the sitemap.

In the analysis of the homepage, all of the websites are adapted to mobile devices, applying what is known as responsive web design. The content is generally adapted to a simplified vertical format. There is a more intensive use of icons.

Table 1. *Summary of the homepage comparison for all websites*

	AMAZON (1)	CARREFOUR (2)	BOOKING (3)	IMSERSO (4)
Structure				
Header	Not prominent, search bar and menu. Improves in the MV.	In the MV, it is oriented towards downloading the app.	Prominent. MV features horizontal scroll that is not very intuitive.	Well-structured DV and MV, with carousel.
Main content of the page	Links to listings in no apparent order. A lot of information in MV.	Banners, suggested sections and offers. MV uses vertical scrolling for content.	Offers, banners and travel planner. Horizontal scrolling in MV.	Key information highlighted in MV. Vertical scrolling.
Footer	Links to sections, legal information and help.	Sitemap in the footer in DV. Drop-down menus in MV.	DV has many links. MV uses sub-menus.	Includes contact details, a site-map and legal notice.
Elements of note				
Cookie notice	In MV, occupies one third of the screen.	In MV, occupies the entire screen.	In MV, cookies + app approx. 60%.	In MV, occupies approx. 50%.
Menu	In the header in DV. Appears as "all", not sticky.	Uses "hamburger" menu in DV and MV.	MV: Not sticky. "hamburger" menu, simple navigation.	DV and MV: not sticky. "Hamburger" menu in MV.
Search bar	DV, integrated. MV, visible, predictive.	DV, visible. MV, predictive.	DV, prominent. MV, advanced.	MV and DV: Visible, not predictive.
Links	DV and MV: different colour, no tags.	DV and MV: visible and underlined.	MV and DV: Faint links.	MV and DV: Poorly differentiated links.
Flexibility	DV and MV: modification of searches and personalised recommendations.	DV and MV: provides pathways to access products, but requires registration.	DV: Search options and changes. MV: less flexibility.	MV and DV: Rigid processes. Little flexibility for changes.

Note: *DV (Desktop Version) and MV (Mobile Version).*

Source: *Authors' own compilation.*

In terms of ease of use and flexibility, a general effort to facilitate navigation of the e-commerce platforms and access to their content on internal pages is observed (Table 2). The first website presents the most usability features, although it requires more vertical scrolling, both on desktop and mobile.

Table 2. *Summary of the main elements*

		AMAZON (1)	CARREFOUR (2)	BOOKING (3)	IMSERSO (4)
Page 2: List of results	Access to website	Same structure. Relevant results.	The header is simplified. High search accuracy.	List of options. High accuracy.	Pagination of all results. Low accuracy.
	Local navigation	Menu with filters.	Side menu. Visible filters.	Side menu. Visible filters.	With more search filters.
	Remote navigation	No sitemap included.	Sitemap disappears.	No sitemap included.	Sitemap in footer.
	Links	Differentiated.	In product names.	Visible, with actions.	Semantically differentiated links.
	Flexibility	Search can be easily modified.	Filters can be modified via the side menu and at the top.	Results by category, can be modified quickly.	Predefined filters and options. No advanced customisation.
Page 3: Product details (goods or service)	Access to website	Links to other versions of the product. Purchase buttons.	The page maintains the same structure.	Clear detailed product sheet. Several steps to view terms and conditions.	Extensive information, not very hierarchical.
	Local navigation	Floating menu with "back" option.	Breadcrumbs and links.	Floating menu with links.	Side menu with links.
	Links, buttons	Differentiated, operational and strategic.	Visible and prominent.	Visible. Some unlabelled.	Links not clearly identified.

(continued)

Table 2. *Summary of the main elements (continued)*

Page 4: Transaction or procedure	Access to website	Clear and structured process. Log-in required for purchase.	Clear purchase process, registration required.	Smooth reservation process, no shopping basket.	Rigid and lengthy application process. Access to the official website.
	Local navigation	Floating menu that tracks purchase progress.	Floating menu with access to different phases.	Purchase process with buttons to modify it.	No menu to track the progress of the procedure.
	Links, buttons	Visible, strategic.	Visible.	Visible, with some faults.	Low visibility.
	Flexibility	Flexible process, option to cancel/ modify.	Purchase can be modified.	Booking options can be modified.	Inflexible process, several steps without easy change.

Source: *Authors' own compilation.*

When analysing the navigation and purchase processes, different patterns can be observed in terms of progress visibility and navigation conventions, such as breadcrumbs and progress bars. Overall, the language on e-commerce platforms is considered to be product-appropriate and correct, with the exception of some typos, although the amount of information remains very high.

All internal pages use links and buttons to facilitate navigation within the website itself. They also provide straightforward access to other sections, beyond the header menu. Generally, these elements are easily identifiable, although there are exceptions, particularly in the public one.

Moreover, in terms of accessibility, all the websites analysed show room for improvement. In this case, Imserso is the only one that includes a visible menu labelled "Accessibility" and a widget on internal pages, although its use is complex. Regarding legibility and clarity, all platforms use sans-serif fonts with adequate colour contrast to facilitate on-screen reading. In terms of speed, they load in less than 2 seconds, except for the Imserso website, which takes 2.57 seconds. This load time is acceptable, but the page size (8.1 MB) exceeds the recommended size

for mobile. Additionally, they do not provide a direct link to a contact form, phone number or chatbox, except, once again, for the public administration website.

4.2. Elements that work or do not work

The time taken to complete the exercise and the reactions observed during the suggested activity largely depend on the participant's familiarity with the websites, the device, and the browser. Different reactions were also observed based on the participant's level of education. However, despite the presence of these individual-oriented traits, similar reactions were also detected. Some examples are listed below (Table 3) and the most significant ones are presented according to the phases of the paths.

Table 3. *Summary of field notes, examples*

	Not familiar with the website or has never completed a procedure on it	Familiar with the e-commerce websites and has made purchases on them
AMAZON (1)	*P3: female-secondary school Mobile* Usually uses a tablet. Opens the browser and searches for the platform. Uses the internal search bar, types the name of the product, adds it to the basket, and reviews it.	*P1: male-university Computer* Goes directly to the website using the URL. Uses the internal search bar and types in exactly what is requested. Successfully completes the task.
CARREFOUR (2)	*P18: male-primary school Mobile* Searches using voice commands. Requires help. Does not enter the exact product which leads to an extensive list of results. Ultimately abandons.	*P6: female-university Computer* Enters the URL of the brand. Once on the homepage, she states that she prefers to use the internal search bar. Includes a generic term to search for the product. The pop-up window confuses her.
BOOKING (3)	*P13: female-primary school Computer* After entering the website, she completes all the data except the town/city. She feels insecure and fears making a mistake and not being able to rectify it.	*P5: female-secondary school Mobile* Searches for "hotel in Benidorm" using the external search engine. Once on the website, she enters the rest of the filters. Successful completion, without any difficulty whatsoever.

(continued)

Table 3. *Summary of field notes, examples (continued)*

IMSERSO (4)	*P7: female-secondary school Mobile* Searches for "Imserso bookings", with no satisfactory results. Tries to find the requirements using the menu, with no success. Ultimately finds the procedure, but conveys unease.	*P12: male-university Computer* Searches for "Imserso". Enters a website that is not the official one and, after clicking on one of the sections, he realises. Returns and accesses the official one. Navigates through the menu. Locates the information, but cannot find the link.

Note: *P (participant).*
Source: *Authors' own compilation.*

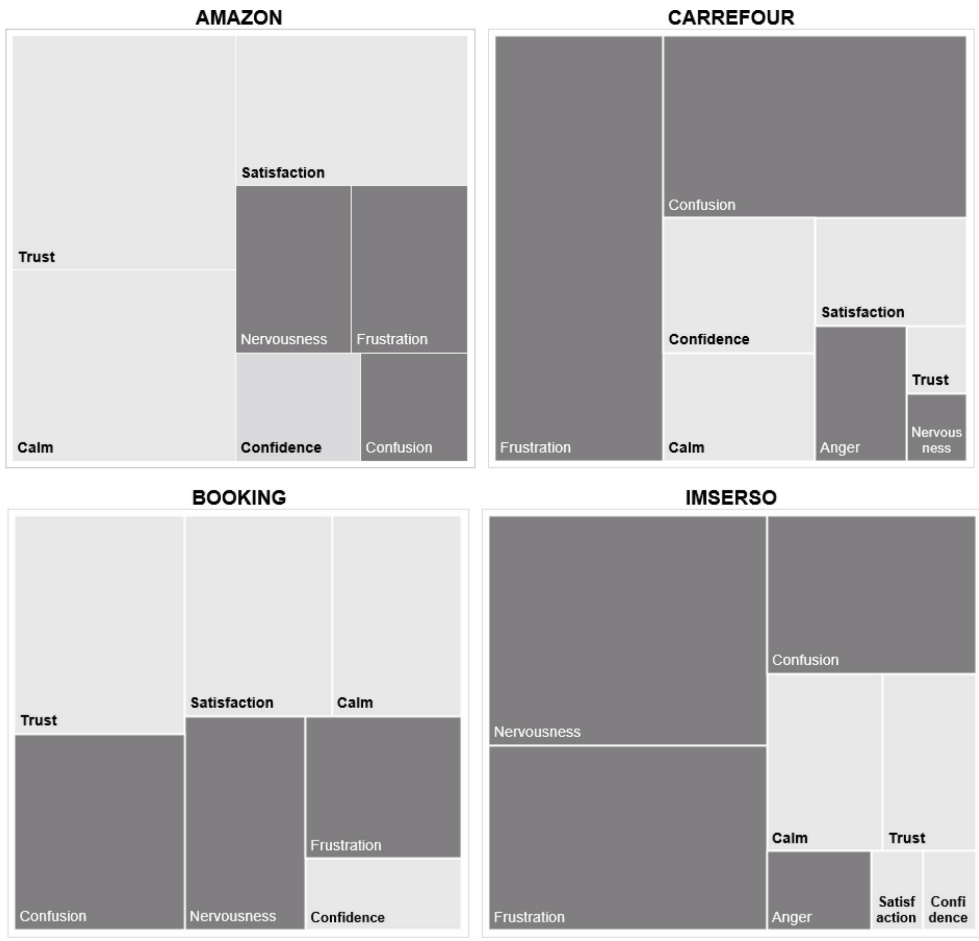
Participants who were less familiar with the website accessed it via an external search. In the case of the public administration website, observations reveal a more complex reality. Participants more experienced with external search engines preferred to use them, as a shortcut, to reach the final phase of the suggested path, rather than using the site's internal search bar due to its low accuracy. However, unofficial websites also appeared among the results.

Among all elements, the function of the internal search bar should be underscored. In the initial phase, difficulties were detected regarding its identification and use. Obstacles continued on the second page analysed, as it displayed a large number of products without highlighting the requested one, and on the public administration website due to a lack of accuracy, as it also provided many search results that were related or similar to the keywords entered.

Other elements that affect the user experience, confirmed by this second study, are the cookie notices, but also those that are out of view, the additional options or purchases typically offered by e-commerce pages that divert attention, as well as pop-up windows or the floating shopping basket. All of these elements distract or disorient the user.

Emotion maps synthesise the user experience in each case, reflecting the elements that work and those that do not (Figure 2). The paths for websites 1 and 3 produced the best reactions, as they are native online shopping platforms. The one that accumulated the most negative emotions (dark grey) is the Imserso website.

Figure 2. *Emotion map*



Note: *The proportions are calculated based on the total number of emotions produced per website.*
Source: *Authors' own compilation.*

5. Discussion

The study presented involves the evaluation of four prominent websites from the perspective of their use by older adults. The results revealed variations in design and functionality, highlighting areas where improvements are required to address the specific needs and limitations of this user group.

A key finding is that the homepage is crucial for the first impression and orientation of the user population. The structure of the information and ease of navigation are determining factors for accessibility, especially for older adults. Some websites, while rich in content, present an information overload that could lead to cognitive fatigue and confusion. This observation aligns with the fact that most websites do not fully comply with the WCAG guidelines (World Wide Web Consortium, 2024), which affects accessibility, particularly at older ages. Ávila-Rodríguez-de-Mier and Martín-García (2018) found that infrequent internet use can increase vulnerability among older adults, highlighting the importance of accessible design to encourage participation. The research by Abad-Alcalá *et al.* (2021) stresses the importance of developing inclusive e-commerce and e-government websites, featuring a clear and simple information structure, defined headings and less cluttered layouts. These recommendations are also consistent with the findings of other authors (Andika and Renaldi, 2024; Jiménez-Iglesias *et al.*, 2017) and with the results of this research.

Another key element is the menu, which acts as the backbone of its structure, guiding the user population through the different sections. A well-designed menu reduces cognitive load, allowing information to be found quickly and efficiently (Martínez-Sala *et al.*, 2020). The study shows that the lack of sticky menus hinders navigation, forcing the participant to repeatedly scroll up. The inclusion of persistent menus that provide constant access to the main sections is a recommendation and is supported by the need to offer greater control over site exploration. This finding resonates with ISO 9241 standards, which emphasise the need for comfortable and effective interfaces (International Organization for Standardization, 2008). The "hamburger" menu must be properly implemented given that, in some mobile versions, its inclusion hinders navigation.

Closely related to navigability, but also influencing accessibility and usability, is the internal search bar. Difficulties were detected in its identification and use, which align with the usage-related digital divide and affect the ability to leverage online tools.

The obstacles persist in the second section analysed (list of results) resulting from the use of the search bar. The amount of information in the search results constitutes the main problem detected. In the case of the public administration website, another key issue is the lack of accuracy, as it provides many search results that are merely related or similar to the keywords entered.

Participants solve the problems arising from internal search bars by resorting to external search engines. Those who were not as familiar with the suggested websites also accessed them later via an external search. Therefore, search engine positioning is key. In the case of the public administration website, Imserso, a more complex reality is confirmed. Some experienced participants chose the external search engine to reach the final phase of the suggested path, using it as a shortcut, rather than using the internal search bar due to its lack of accuracy. This leads to result listings containing unofficial websites. Alcaide-Muñoz *et al.* (2022) also emphasize the adoption of e-government initiatives, such as search mechanisms.

In the sections related to product presentation, results listings, and product pages, detailed presentation and information are essential for a satisfactory experience. Nevertheless, the visibility of interactive elements, such as buttons and links, is a critical aspect. Improving it through the use of contrasting colours and appropriate sizes is another advisable premise resulting from the analysis. Ensuring that interactive elements are easily identifiable, with larger text and contrasting colours to make them easier to read, is crucial for the older user group. This observation is consistent with standard EN 301 549 (European Telecommunications Standards Institute [ETSI], 2021), which focuses on accessibility requirements.

With regard to purchase processes, aspects such as accessibility and navigability are fundamental pillars to guarantee an inclusive user experience (Rodríguez-Carmona *et al.*, 2024). Rigidity in purchase processes or formal procedures hinders the experience for the user population in general, and for the older adult group in particular, who may need to make frequent changes to their selections or feel more comfortable with a less formal process. The registration requirement for purchase processes is also a barrier for this group.

In the same area of online shopping, other elements that affect the user experience include those that are out of view, the additional options or purchases typically offered by e-commerce websites that divert attention, and the floating shopping basket. All of this distracts or disorients users, which aligns with Broeder's (2020) emphasis on the importance of trust and privacy in e-commerce. A more adaptable approach to purchase processes, such as allowing quick changes and providing a clear visualisation of steps, will facilitate the completion of transactions for the group of older adults, and for users in general (Hargittai *et al.*, 2019).

In the field of public administration, there are processes equivalent to purchases, consisting of various types of official procedures. Research by Manzanera-Román and Haz-Gómez (2022) highlights the importance of technological and organisational solutions in adapting e-government to older people. To this end, educational resources or online assistance, the inclusion of video tutorials or step-by-step guides can be especially beneficial, allowing older adults to learn how to use the website more comfortably and effectively. AI is presented as a key tool (Palmer and Oswal, 2024; Panwar, 2024). Voice search and the use of natural language are a great opportunity to bridge the digital divide.

Overall, while each website demonstrates strengths, significant improvements are needed to meet accessibility, navigability and usability standards. The websites caused different feelings among the participants, which were recorded on the emotion maps. It is confirmed that the paths for websites 1 and 3 achieved the best experience, and they are also the ones that contain the most elements facilitating navigation, according to the first study. The Imserso website should be revised in light of the findings of this study. These results are consistent with the age-based usage data observed by the INE (2024).

6. Conclusions

This research focuses on technology as a potential line of intervention to reduce digital divides and foster the digital inclusion of the entire population. In particular, it focuses on online procedures and other transactions, since they are directly related to current citizen demands and the risk of missing out on opportunities that digital resources can offer to all, including older adults. The methodology applied provides conclusive results and is therefore appropriate to address the research objectives.

6.1. Conclusions of the mixed-methods analysis of the websites and recommendations

The preliminary study of the selected websites reveals differences between them in terms of accessibility, flexibility and ease of navigation, which are corroborated

and nuanced by the second study. Despite the strengths identified on the pages, a series of shortcomings are also identified:

a. Internal search bars are not always sufficiently visible or do not function with the required accuracy.
b. In general, there is a large volume of information that distracts or frustrates neophytes. The study confirms that some links and buttons lack visibility, a problem most evident on the institutional website, while other cases demonstrate poor screen adaptation.
c. There are also intrusive elements that interrupt and distract, producing negative reactions.
d. In addition, rigid processes, without much scope for undoing actions taken, create insecurity. There is no quick assistance and, when information is available, it is not always easy to find.
e. Some websites, such as the institutional website, present more drawbacks than the other three, although in this case it does provide accessibility resources and a contact telephone number.

In light of the evidence, the drawbacks detected should be avoided in order to optimise the pages. In this regard, the following is recommended:

Implementing W3C guidelines and other accessibility standards will improve the overall experience, but it is essential to implement changes that consider the specific needs and limitations of less digitally literate groups to ensure websites are inclusive. This will likely increase the autonomy and confidence of such groups, and contribute to bridging the digital divide in an increasingly digitalised society.

6.2. Conceptual contributions of the study

Beyond the traditional digital divide, which focuses on unequal access to or use of technology, the results of this study support the need to explore what we propose to term the "technological divide" or "technology divide". This divide is not limited to a lack of connectivity or use of devices, rather it arises when technology, even when available, is not developed with the needs and capabilities of the entire population in mind.

The technological divide manifests itself when the design, functionality and implementation of technologies are not adapted to the diversity of skills and knowledge of users. This includes the elderly, vulnerable groups and, in general, any group that may have difficulties interacting with technology due to a lack of prior digital skills and unintuitive or poorly adapted designs. From a practical point of view, the findings suggest that intervening in the design, usability and accessibility of platforms can have an immediate impact on bridging the digital divide. The technological divide is a challenge with significant consequences for social inclusion, citizen participation and access to essential services. When technology is not accessible and easy to use, it perpetuates digital exclusion and widens social inequalities.

The proposed concept regarding the technological dimension of the digital divide, derived from the empirical evidence obtained, is not intended to be a closed definition, but rather to open up a field for discussion and future research.

6.3 Contributions to academic and professional fields, and limitations

From an academic perspective, this study offers a comprehensive and up-to-date view of the challenges older adults face in using online transaction platforms and provides a complementary approach to studies focusing on digital literacy by identifying avoidable usage constraints that are attributable to the platforms themselves. In particular, intervention in public administration website designs can provide greater short-term gains in digital inclusion than literacy programmes, if carried out in a coordinated manner. Furthermore, this study also indicates that it would be advisable to include user tests aimed specifically at these groups in public tenders.

From a professional perspective, the findings of this research offer practical recommendations for the design and optimisation of transactional platforms, aimed at improving the experience of the older adult population. These results can be highly valuable for developers and UX/UI designers in the private sector, as well as for public policy makers, as they can foster greater accessibility and trust in the use of these tools.

Despite the advantages noted in the academic and professional fields, it is important to recognise that the study has certain limitations stemming from the

sample size and the geographical location of the data, which affects its generalisability. However, this small sample is justified by the qualitative approach chosen, which has allowed for an in-depth analysis and facilitates an understanding of the real challenges and experiences of older adults when using digital platforms, the findings of which can be expanded upon by future research. Intervening in technology will not only benefit groups in situations of digital vulnerability but will also improve the experience for the entire population.

Authors' contribution

Alba-María Martínez-Sala: Conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing - original draft, writing - review and editing. **Natalia Papí-Gálvez**: Conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, resources, software, supervision, validation, visualization, writing - original draft, writing - review and editing. **Silvia García-Espinosa**: Data curation, formal analysis, investigation, methodology, visualization, writing - original draft, writing - review and editing. The authors have read and agreed to the published version of the manuscript.

Conflicts of interest

All authors declare that they have no conflicts of interest.

Funding and acknowledgements

Generational Digital Divide Chair Agreement. Government of the Valencian Region.

Data availability

A summary data table is made freely available https://doi.org/10.5281/zenodo.17480613. The qualitative study data cannot be shared for ethical reasons.

References

Abad-Alcalá, Leopoldo; Llorente-Barroso, Carmen; Pretel-Jiménez, Marilé; Sánchez-Valle, María, & Viñarás-Abad, Mónica. (2021). *Guía para la elaboración de páginas webs de ecommerce y administración electrónica inclusivas con las personas mayores*. https://acortar.link/WmyjD6

Alcaide, Juan Carlos. (2020). *Silver economy. Mayores de 65: El nuevo target*. Editorial Almuzara.

Alcaide-Muñoz, Laura; Rodríguez-Bolívar, Manuel-Pedro; & Villamayor-Arellano, Cinthia-Lorena. (2022). Factors in the adoption of open government initiatives in Spanish local governments. *Government Information Quarterly, 39*(4), 101743. https://doi.org/10.1016/j.giq.2022.101743

Andika, Redim; & Renaldi, Dam. (2024). Heuristic Evaluation of UI/UX to Enhance Experience and Sales in E-commerce, *bit-Tech*, *7*(2). 2, pp. 244–251. https://doi.org/10.32877/bt.v7i2.1730

Ávila-Rodríguez-de-Mier, Belén; & Martín-García, Noemí. (2018). La frecuencia del uso de internet como determinante de la vulnerabilidad entre la población sénior: Usuario habitual vs. no usuario habitual. *Revista Mediterránea de Comunicación, 10*(1), 13–26. https://doi.org/10.14198/medcom2019.10.1.16

Broeder, Peter. (2020). Culture, Privacy, and Trust in E-commerce. *MID Journal, 3*(1), 14–26. https://acortar.link/XRrjxq

Comisión Europea. (2023). *Marco Europeo de Competencias Digitales para la Ciudadanía (DigComp)*. https://acortar.link/QpsEx6

European Telecommunications Standards Institute [ETSI]. (2021). *Accessibility requirements for ICT products and services*. https://acortar.link/uw137V

Fernández-Bonilla, Fernando; Gijón, Covadonga; & De-la-Vega, Barbara. (2022). E-commerce in Spain: Determining factors and the importance of the e-trust.

Telecommunications Policy, *46*(1), 102280. https://doi.org/10.1016/j.telpol.2021.102280

Generalitat Valenciana y Universidad de Alicante. (2024). Convenio de colaboración entre la Generalitat, a través de la Conselleria de innovación, industria, comercio y turismo y la universidad de Alicante, para la financiación de los gastos de funcionamiento de la Cátedra de brecha digital generacional durante el ejercicio 2024. https://acortar.link/pXZ3x5

Hargittai, Eszter; Piper, Anne-Marie; & Morris, Meredith-Ringel. (2019). From internet access to internet skills: digital inequality among older adults. *Universal Access in the Information Society, 18*(4), 881–890. https://doi.org/10.1007/s10209-018-0617-5

Instituto Nacional de Estadística. (2024). *Encuesta sobre Equipamiento y Uso de Tecnologías de Información y Comunicación en los hogares 2024*. https://acortar.link/Ka1arK

Instituto Nacional de Estadística. (s.f.). *Glosario de términos: Censo — edad (grandes grupos)*. https://acortar.link/RyDdSG

International Organization for Standardization. (2008). *ISO 9241-151:2008 Ergonomics of human-system interaction — Part 151: Guidance on World Wide Web user interfaces*. https://acortar.link/KALF4A

Izquierdo Soto, Yareli-Karina; Talaverano Obregon, Yosef-Angelo; & Zarate Suarez, Jaime Jahir. (2024). *Adaptación de los adultos mayores al comercio electrónico, beneficios y usabilidad: Una revisión de la literatura*. Repositorio de la Universidad Autónoma del Perú. https://acortar.link/R5aUPZ

Jiménez-Iglesias, Lucía; Pérez-Montoro, Mario; & Sánchez-Gómez, Lydia (2017). Diseño de información digital: revisión y clasificación de indicadores heurísticos para contenidos web. *El Profesional de la Información*, *26*(6), 1029–1046. https://doi.org/10.3145/epi.2017.nov.03

Llorente-Barroso, Carmen; Anzanello Carrascoza, João Luis; & Ferreira Ferreira, Ivone. (2023). Compromiso corporativo e inclusión social de adultos vulnerables: De la conciencia empresarial e institucional al valor de marca y la participación ciudadana. *Revista ICONO 14. Revista científica de Comunicación y Tecnologías emergentes*, *21*(1). https://doi.org/10.7195/ri14.v21i1.1982

Lozano-Oyola, Macarena. (2022). Silver economy y marketing. Una oportunidad de negocio en el ámbito de las personas mayores. En J. L. Sarasola Sánchez-Serrano y E. Barrera Algarín (Eds.), *Investigaciones en gerontología social* (pp. 87–96). Dykinson.

Manzanera-Román, Salvador; & Haz-Gómez, Francisco-Eduardo. (2022). Soluciones tecnológicas y organizativas en la adaptación de la Administración electrónica a las personas mayores. *Sociología y Tecnociencia, 12*(2), 73–95. https://doi.org/10.24197/st.2.2022.73-95

Martínez-Sala, Alba-María; Monserrat-Gauchi, Juan; & Alemany-Martínez, Dolores-de-la-Encarnación. (2020). User Usable Experience: A three-dimensional approach on usability in tourism websites and a model for its evaluation. *Tourism Management Perspectives*, *33*, 100579. https://doi.org/10.1016/j.tmp.2019.100579

Menéndez-Álvarez-Dardet, Susana; Lorence-Lara, Bárbara; & Pérez-Padilla, Javier. (2020). Older adults and ICT adoption: Analysis of the use and attitudes toward computers in elderly Spanish people. *Computers in Human Behavior, 110*, 106377. https://doi.org/10.1016/j.chb.2020.106377

Ministerio de Asuntos Económicos y Transformación Digital. (2023). *Plan Nacional de Capacidades Digitales (2023-2025)*. Gobierno de España. https://acortar.link/rU7dVY

Observatorio Nacional de Tecnología y de la Sociedad de la Información. (2023). *Competencias digitales: medición y desarrollo en la Unión Europea y España*. Gobierno de España. https://acortar.link/tnwEfY

Observatorio Nacional de Tecnología y de la Sociedad de la Información. (2024). *Compras online en España. Edición 2024-Datos 2023*. Gobierno de España. https://acortar.link/KV4ueG

Palmer, Zsuzsanna-B.; & Oswal, Sushil-K. (2024). Constructing Websites with Generative AI Tools: The Accessibility of Their Workflows and Products for Users With Disabilities. *Journal of Business and Technical Communication*, *39*(1), 93–114. https://doi.org/10.1177/10506519241280644

Panadero-Hernández, Hungría. (dir.) (2023). La brecha digital y la administración digital en España. Conocimiento clave sobre las competencias digitales de la población para la promoción de la inclusión digital en relación a la Administración digital. Fundación Ferrer i Guàrdia. https://acortar.link/tXigbj

Panwar, Vijay. (2024). Web Evolution to Revolution: Navigating the Future of Web Application Development. *International Journal of Computer Trends and Technology*, *72*(2), 34–40. https://doi.org/10.14445/22312803/ijctt-v72i2p107

Papí-Gálvez, Natalia; & La-Parra-Casado, Daniel. (2023). Age-Based Digital Divide: Uses of the Internet in People Over 54 Years Old. *Media and Communication*, *11*(3), 77-87. https://doi.org/10.17645/mac.v11i3.6744

Pretel-Jimenez, Marilé; Viñaras-Abad, Mónica; & Abad-Alcalá, Leopoldo. (2022). Factores clave que determinan la relación y el uso del comercio electrónico por parte de las personas mayores en España. *Cuadernos.info,* (53), 253-272. https://doi.org/10.7764/cdi.53.39399

Ramdowar, Harshini; Khedo, Kavi-K.; & Chooramun, Nitish. (2024). A comprehensive review of mobile user interfaces in mHealth applications for elderly and the related ageing barriers. *Universal Access in the Information Society, 23,* 1613–1629. https://doi.org/10.1007/s10209-023-01011-z

Recomendación del Consejo de 23 de noviembre de 2023 sobre la mejora de la provisión de capacidades y competencias digitales en la educación y la formación. (2024).

Official Journal of the European Union, C/2024/1030. https://acortar.link/W9RP26

Rodríguez-Carmona, Laura-Melendo; Yustres-Duro, Pilar; & Cuesta Baliño, Pedro. (2024). Keys to Usability in Retail E-Commerce: A Systematic Review of the Literature. *UCJC Business and Society Review, 21*(80), 778–815. https://doi.org/10.3232/UBR.2024.V21.N1.17

Rodríguez-Martín-Retortillo, María-del-Carmen. (2023). La necesaria implicación de las administraciones públicas ante la brecha digital. *Anuario Da Facultade de Dereito Da Universidade Da Coruña, 27*, 134–149. https://doi.org/10.17979/afdudc.2023.27.0.9878

Salman, Hasanin-Mohanmed; Wan-Ahmad; Wan-Fatimath; & Sulaiman, Suziah. (2023). A design framework of a smartphone user interface for elderly users. *Universal Access in the Information Society, 22*, 489–509. https://doi.org/10.1007/s10209-021-00856-6

Sánchez-Valle, María; & Llorente-Barroso, Carmen. (2023). eGovernment challenges for the inclusion of elderly in the digital society. *Revista Espanola de la Transparencia*, *16*, 217–243. https://doi.org/10.51915/ret.239

Setchi, Rossitza; & Asikhia, Obokhai-K. (2019). Exploring user experience with image schemas, sentiments, and semantics. *IEEE Transactions on Affective Computing*, *10*(2), 182–195. https://doi.org/10.1109/TAFFC.2017.2705691

Soleimani, Marzieh. (2022). Buyers' trust and mistrust in e-commerce platforms: a synthesizing literature review. *Information Systems and E-Business Management, 20*(1), 57–78. https://link.springer.com/article/10.1007/s10257-021-00545-0

Vuorikari, Riina; Kluzer, Stefano; & Punie, Yves. (2022). *Digcomp 2.2: The digital competence framework for citizens—With new examples of knowledge, skills and attitudes*. European Commission's Joint Research Centre. https://acortar.link/XBoAYV

Weltevreden, Jesse. (2024). *European E-commerce Report 2024*. Amsterdam/ Brussels: Amsterdam University of Applied Sciences & Ecommerce Europe. https://www.eurocommerce.eu/app/uploads/2024/10/european-e-commerce-report-2024-light-version.pdf

World Wide Web Consortium. (2010). *Developing websites for older people: how Web Content Accessibility Guidelines (WCAG) 2.0 applies*. https://acortar.link/3E7Dn8

World Wide Web Consortium. (2024). *W3C Accessibility Guidelines (WCAG) 3.0*. https://encr.pw/EUZfD

Notes

[1] The use of 65 years as the threshold for defining older adults is based on official criteria (INE, s.f.). This age marks a significant transition in people's lives, generally coinciding with stages of retirement or pre-retirement, and with changes in consumption patterns, technology use, and social and healthcare needs (Alcaide, 2020).