



# Research on vulnerable people and digital inclusion: toward a consolidated taxonomical framework

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## Abstract

The COVID-19 pandemic has not only caused a worldwide health crisis, but it has also deepened existing inequalities, and “has exacerbated the vulnerability of the least protected in society” (United Nations, 2020). Nowadays, there are many population groups that would be regarded as vulnerable. In daily life, citizens deal with a wide range of issues—social injustices, social marginalization and lack of impartiality—due to many reasons: culture, class, ethnicity, race, ideology, religion, gender, etc. To respond effectively to this problem—as the United Nations proposes in the goal 10 of the Sustainable Development Goals (SDGs)—we first need to understand and clearly define the phenomenon of vulnerable people, and how digital inclusion could represent an asset to help vulnerable people to bridge inequalities. There is no commonly agreed typology framework, and specific categorization criteria as a basis to assist the further investigation of the area. Our work is focused on filling this gap. In doing so, our contribution is twofold. First, we conduct a systematic review of the literature ( $N=331$  studies) providing an overview of the overall definitions, trends, patterns, and developments that characterize the research on vulnerable people and digital inclusion. Second, we propose a taxonomy to frame the phenomenon of vulnerable people and digital inclusion. The categorization criteria can promote and support further multidisciplinary research to study and explore the relation existing between vulnerable people and digital inclusion.

**Keywords** Digital inclusion · Inequalities · Minority communities · Systematic review · Vulnerabilities · Vulnerable people

## 1 Introduction

Anyone can be *vulnerable* at any certain point in time due to life circumstances or to response to illness or events [23], as has happened, for example, on the coronavirus crisis. The COVID-19 pandemic has not only caused a worldwide health crisis, but it has also deepened existing inequalities, and “(it) has exacerbated the vulnerability of the least protected in society” [80].<sup>1</sup> Mechanic and Tanner [48] maintain that *vulnerability* means susceptibility to harm [23] and results from “an interaction between the resources available to individuals and communities and the life challenges they

face” [48]: 1220). For that reason, vulnerability emerges from the complex interaction of various factors—developmental problems, personal incapacities, disadvantaged social status, inadequacy of interpersonal networks and supports, degraded neighborhoods and environments—over the life course [48].

Therefore, *vulnerable people* are those at risk for a variety of reasons, physical, cognitive, emotional or social [1, 84]. Nowadays, there are still many segments of the population that would be regarded as vulnerable. In daily life, citizens deal with a wide range of issues—social injustice, social marginalization and lack of impartiality—due to many reasons, including culture, class, ethnicity, race, ideology, religion, gender, etc. However, to be part of a vulnerable group

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<sup>1</sup> Given the circumstances, the United Nations 2030 Sustainable Development Goals become more urgent now than ever before, to understand how to address the global challenges we are currently facing. In this regard, the 17 goals proposed by the United Nations seek to develop more sustainable societies that contribute to a better world. Specifically, Goal 10 is particularly connected with the aims of this study, since both are focused on reducing inequalities. Further information about Goal 10 is available at <https://bit.ly/3aJUIcJ>.

does not necessarily imply that a person actually is vulnerable. Many people who belong to vulnerable communities would resist being labeled as *vulnerable* because “they prefer to focus on their strengths rather than their weaknesses” [48]: 1220). In this context, *digital inclusion* represents an asset to help vulnerable people bridge inequalities.

Although the term *digital divide* is commonly used by some scholars [6, 8, 38, 39, 81], we consider more convenient to adopt the concept *digital inclusion*, since *digital inclusion* considers the intersections of class, ethnicity, race, ideology, religion, gender and disability. Thus, moving beyond the dualistic understanding of the digital divide toward a versatile interpretation of digital inclusion. Drawing upon Parsons and Hick’s [57] statements, we agree that the notion of *digital inclusion* “more accurately captures the phenomenon of ICT gaps”, since the *digital divide* approach does not “address the broader issues implicated in the digital gap as the priorities of business and e-commerce supersede citizen rights and social inclusion” Parsons and Hick [57].

The *digital divide* concept was originally used by the National Telecommunications and Information Administration in its report entitled *Falling Through The Net II: New Data on the Digital Divide* [53]. Nowadays, the digital divide is generally defined as “the gap between people who do and do not have access to forms of information and communication technology. These forms are primarily computers and the Internet” [83]. Nonetheless, *digital inclusion* is much more than universal access to the Internet or the use of digital technology [61]. This term entails “having proper support and the right digital skills to achieve personal and professional success” [61]: 11), as well as “the availability of hardware and software, relevant content and services; and training for the digital literacy skills required for effective use of information and communication technologies” (Institute of Museum and Library Services et al., 2012: 1). Bradbrook and Fisher (2004) summarize that digital inclusion encompass the following 5Cs: connectivity, capability, content, confidence and continuity.

Therefore, there is a need to foster the principal digital skills and competences to encourage people to become a fully digitally included citizen. It is complicated to provide here a full theoretical framework about the required digital skills [27, 43] to tackle social and digital inequalities, but scholars and experts [27, 61, 82, 85] seem to agree that digital literacy relies in training users in the following main digital skills and competences:

- Capacity to access, find, select, decode and interpret information and knowledge in the Internet;
- Critical thinking;
- The readiness to respond pragmatically and intuitively to challenges and opportunities in a manner that exploits the internet’s potential;

- Having motivation to access and use ICTs;
- Digital creativity encourages users to participate actively in the online scenario;
- The capacity to create meanings and feelings in the digital arena, as well as the ability to generate and adapt new knowledge by using ICTs.

Considering this overview about the phenomenon of vulnerable people and digital inclusion, we have detected that exists no common understanding about how digital inclusion could represent an asset to help vulnerable people to bridge inequalities. Therefore, our work is focused on filling this gap. In doing so, our contribution focuses on performing a thorough and systematic review of the literature to identify the overall definitions, trends, patterns, and developments that characterize the research on vulnerable people and digital inclusion. We propose a conceptual taxonomy to frame the phenomenon of vulnerable people and digital inclusion. The categorization criteria can promote and support further multidisciplinary research to study and explore the relation between vulnerable people and digital inclusion.

This paper is organized as follows. First, we present our method—systematic review of the literature regarding the terms vulnerable people and digital inclusion—to approach the research questions of this study. Second, we discuss the results relating to how digital inclusion represents an asset to help vulnerable people to bridge inequalities, and tackle social and digital discriminations. Finally, we present some concluding remarks, study limitations and further research issues.

## 2 Methodology

A systematic review is a qualitative and structured method for identifying previous studies in a given area of research [12, 18, 54, 71], helping to categorize the literature to answer specific research questions [35, 86], as well as to shed light on trends, to reveal connections across many studies [7], and to detect any gaps that need to be filled [58, 59]. Whereas reviewing literature “involves selectively discussing the literature on a particular topic to make the argument that a new study will make a new and/or important contribution to knowledge” [71]: 750–751), the literature review is a research method in its own right that addresses much wider questions, leading researchers to draw firm conclusions based on existing conceptualizations [7, 71]. In doing so, the present systematic review provides a database comprising of all the relevant literature related to vulnerable people and digital inclusion. Specifically, the methodological design of the present systematic review is structured following the three stages—which are inspired by the key stages in conducting a systematic review, proposed by Siddaway

et al. [71]—and described in what follows: scoping, planning, identification and eligibility.

## 2.1 Scoping

The formulation of research questions is one of the first steps in terms of defining the scope of a systematic review, guiding the decision-making throughout the whole review process, and ensuring more focused findings [13, 19, 59, 71]. Given this, the present study attempts to respond to the following core research questions:

**RQ1:** What vulnerable community is the most likely to be excluded or marginalized from the digital realm?

**RQ2:** What are the main sources of vulnerability?

**RQ3:** What solutions are proposed by literature to assist vulnerable people?

Addressing these research questions is expected to produce a typology, in which we identify victims of vulnerability—RQ1—sources of the vulnerability—RQ2—and solution to vulnerability—RQ3—in digital contexts. This taxonomical framework aims at explaining how digital inclusion represents an asset to help vulnerable people to bridge inequalities, and tackle social and digital discriminations.

## 2.2 Planning

The second step, proposed by Siddaway et al. [71], is to apply the inclusion and exclusion criteria, which allow to focus the research questions, narrow the existing literature and delimit the systematic review. Hence, the eligible literature responds to the following principles:

1. Publications focused on digital inclusion and vulnerable people;
2. Publications written in English.

Because this study seeks to offer an overview of different types of narratives, no exclusion criteria have been established at this step concerning the kind of publication, the nature of the method, the study designs, the outcome variables, the participants, the study population, or the methodological quality, among other criteria. Moreover, considering “a narrow time frame may severely limit the number of eligible studies” [49]: 23), no time limits were used, including any publications since records began right up until the end of 2020. The search was conducted in January 2021.

## 2.3 Identification and eligibility

We conducted a methodical and comprehensive literature search [71]. In doing so, the databases used were the most relevant in the disciplines concerned, i.e., Web of

Science (WoS) and Scopus. In both databases, the search terms were limited to the «title», the «abstracts» and the «keywords» to ensure highly relevant results. The terms used were identified from a scoping study, in which we set out to find concepts in accordance with the research questions proposed. Given this, we firstly decided to use the term “vulnerable people” in the initial search, but then, we chose not to add the noun “people” because we realized there was another commonly used expression that was “vulnerable group.” Moreover, we also observed that “vulnerability” is a known synonym for “vulnerable people,” so we agreed on including it in the search. Thus, the initial search strategy was formulated as follows:

TITLE-ABS-KEY ("digital inclusion" AND (vulnerable OR vulnerability)).

After this step, we undertook another search in which we added the terms “vulnerable people” and “vulnerable group” to double check, also because we did not want to miss any relevant publications related to our topic. Thus, the second search strategy was formulated as follows:

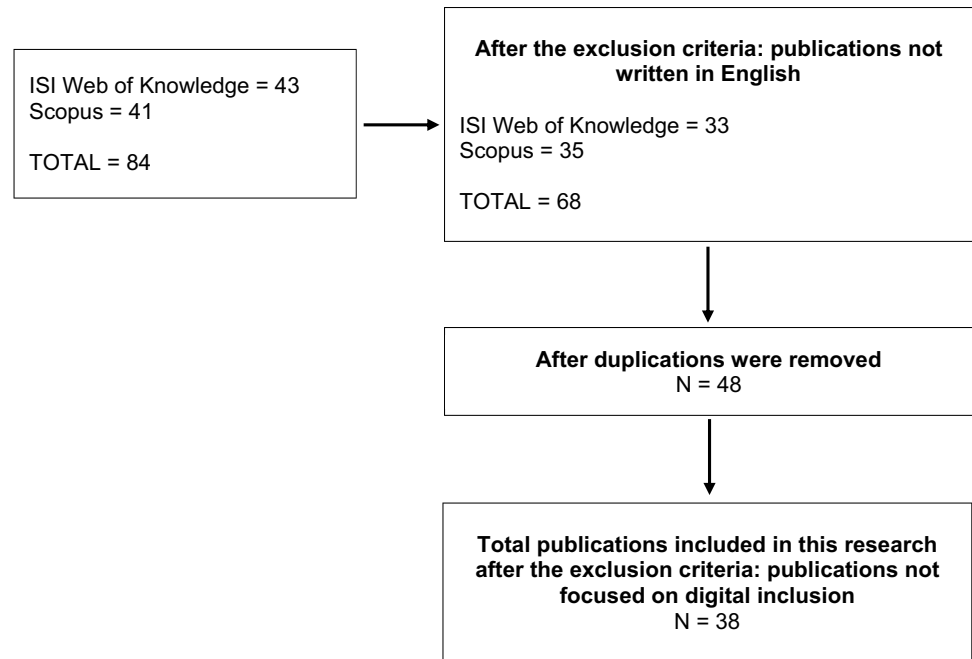
TS (“digital inclusion” AND (vulnerable OR vulnerability OR “vulnerable people” OR “vulnerable group”)).

We found that both search processes returned  $N=43$  items in WoS, and  $N=41$  in Scopus. Taking into consideration the second criteria established, ten references in WoS and six references in Scopus were excluded because they were written in Portuguese and Spanish. The remaining references— $N=33$  in WoS, and  $N=35$  in Scopus—were assessed for duplicates, leaving  $N=48$  unique items from both databases. The  $N=48$  references were screened, examining the title, the abstracts and the full text to identify the appropriate studies that meet the first criteria established. Finally,  $N=10$  items were excluded because they were not focused on digital inclusion, leaving a total of  $N=38$  publications that fully satisfied the requirements detailed. The full process is shown in Fig. 1.

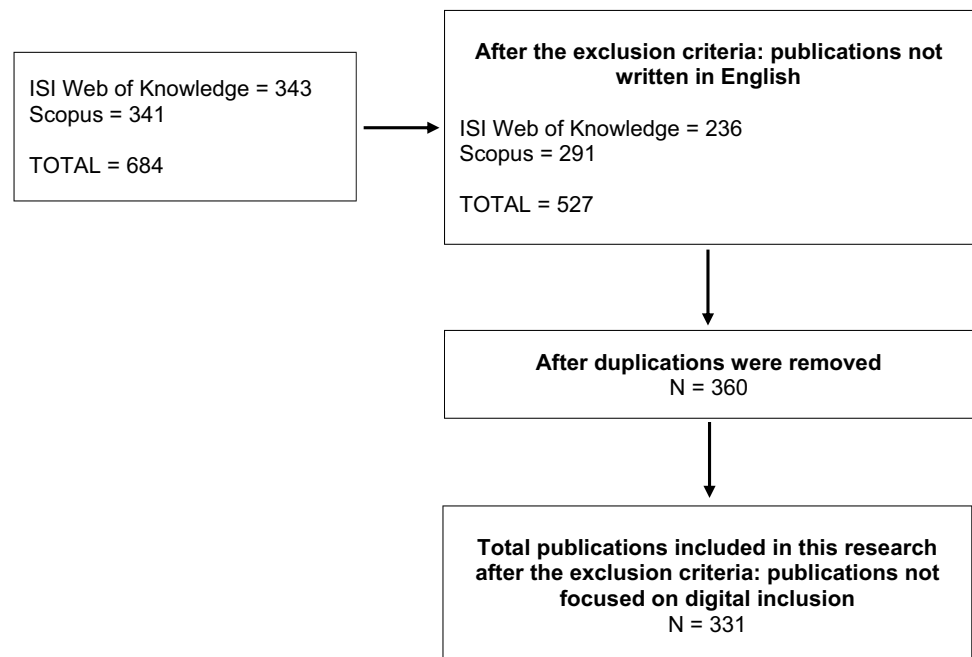
Nevertheless, we realized that the  $N=38$  remaining publications are not too broad in terms of population. This finding might reveal that the study of the delineation between digital inclusion and vulnerable people is not consolidated yet; however, these data might also indicate that researchers do not employ the terms “vulnerable people,” “vulnerable group” or “vulnerability” when addressing these topics in their analysis. Then, we might be excluding significant publications in this search process. For that reason, we carried out a new search strategy this time focusing on digital inclusion in order to better approach our purpose and to find the potential different groups included under the term of vulnerable people. In order to set up this priority, the search was limited in this case to the “title” category, thus, the second search was formulated as follows:

TITLE (“digital inclusion”).

**Fig. 1** Preliminary search—Planning, identification and eligibility initial process workflow



**Fig. 2** Final search—Planning, identification and eligibility process workflow



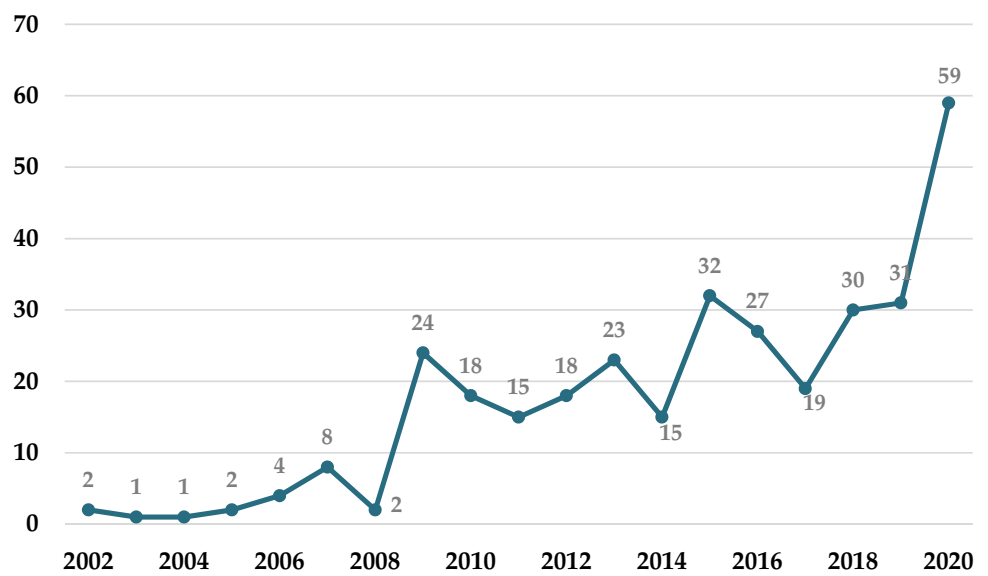
The search process returned  $N=343$  items in WoS, and  $N=341$  in Scopus. Taking into consideration the second criteria established, 107 references in WoS and 50 references in Scopus were excluded because they were written in Portuguese and Spanish. The remaining references— $N=236$  in WoS, and  $N=291$  in Scopus—were assessed for duplicates, leaving  $N=360$  unique items from both databases. The  $N=360$  references were screened examining the titles and the abstracts to select the studies that meet the first criteria

established. Duplicates were removed and, after applying the inclusion and exclusion criteria—publications no focused on digital inclusion—the remaining publications were  $N=331$ . The full process is shown in Fig. 2.

## 2.4 Developing the taxonomical framework

The taxonomical framework employed was designed as a result of an in-depth analysis of the  $N=331$  studies

**Fig. 3** Number of publications over time



remaining in the last searching. We conducted a thematic coding analysis by using the NVivo qualitative data analysis software, where the main topics and trends emerged from the  $N=331$  publications. This qualitative data analysis ( $N=331$ ) was limited to the abstracts to ensure highly relevant results. The development of the taxonomical framework is detailed in the “Results” section.

### 3 Results and discussion

This section presents the core findings derived from the NVivo qualitative data analysis ( $N=331$ ). The results are framed around the three research questions we have previously formulated, and they are expected to produce a typology regarding victims of vulnerability—RQ1—sources of the vulnerability—RQ2—and solution to vulnerability—RQ3—in digital contexts.

#### 3.1 Preliminary descriptive analysis: an overview

The first research on digital inclusion— $N=331$  publications—started to appear at the beginning of 2000; specifically, a total of  $n=20$  publications (6,04%) were issued between 2002–2008. Interestingly, the first significant increase in publications occurred in 2009 ( $n=24$ ; 7,25%), remaining relevant in the last five years: 2015 ( $n=32$ ; 9,67%), 2016 ( $n=27$ ; 8,16%), 2018 ( $n=30$ ; 9,06%), 2019 ( $n=31$ ; 9,36%) and, especially, 2020 ( $n=59$ ; 24,47%). Figure 3 demonstrates the release, over time, of the published literature concerning digital inclusion discussed in this article.

In addition, a list of the most prolific scholars in the field of digital inclusion is portrayed in Table 1. In this line,

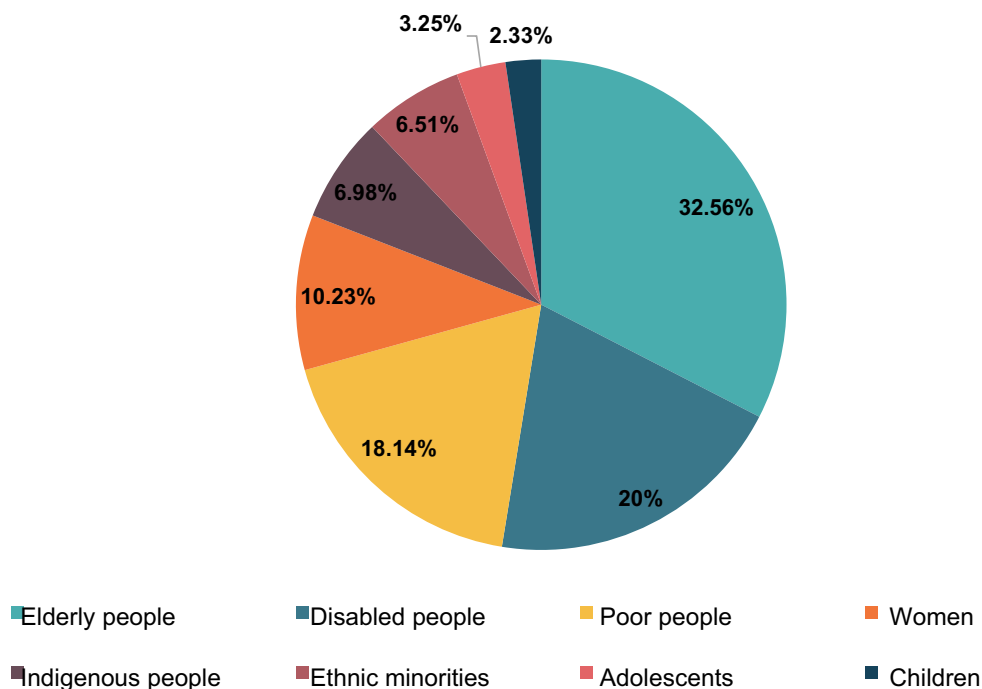
**Table 1** Most prolific scholars

Author	Studies
Bertot, John Carlo	5
Costa, João Crisóstomo Weyl Albuquerque	5
Francês, Carlos Renato Lisboa	5
Tsatsou, Panayiota	5
Jaeger, Paul T	4
Aires, Luísa	3
Da Rocha, Cláudio Alex Jorge	3
De Brito, Silvana Rossy	3
Hawkins, Wayne	3
Martins, Dalton Lopes	3
Real, Brian	3
Reinhard, Nicolau	3
Rojas-Mendizabal, Veronica	3
Salman, Ali	3
Serrano-Santoyo, Arturo	3
Thompson, Kim M	3
Vijaykumar, Nandamudi Lankalapalli	3

The authors listed in this figure are not necessarily first-authors on their respective publications

among the  $n=32$  total studies published by these prolific scholars, an overwhelming majority of  $n=19$  were articles (59,38%),  $n=7$  were book chapters (21,87%), and  $n=6$  were papers published at conference proceedings (18,75%). Based on these findings, there is a growing trend, introduced in 2018, for the publication of articles in prestigious journals, while there is a significant drop in the number of book chapters and papers. Note that these kinds of publications were common between 2006 and 2010, though articles have been gathering pace since 2011.

**Fig. 4** Distribution of vulnerable groups



In general, the majority of the  $N=331$  publications were articles ( $n=199$ ; 60,12%), followed by  $n=87$  papers published at conference proceedings (26,28%),  $n=49$  book chapters (14,8%),  $n=4$  book reviews (1,2%), and  $n=1$  book (0,3%). A clear interest in research articles and proceedings is reflected, mainly in the last five years.

### 3.2 RQ1: What vulnerable community is the most likely to be excluded or marginalized from the digital realm?

When analyzing the publications related to digital inclusion— $N=331$ —we have observed that  $n=215$  studies include, in the abstract, the vulnerable community they aim to help. Given this, as Fig. 4 shows, we have identified that older adults are the most likely group to be excluded from the digital realm, since  $n=70$  (32,56%) publications reflect the concern about assisting older people in achieving digital inclusion. This group is followed by people with disabilities ( $n=43$ ; 20%) and poor communities, homeless or low-income families ( $n=39$ ; 18,14%) who are also at risk of digital exclusion. Thirdly, women and the gender divide ( $n=22$ ; 10,23%), indigenous people or native communities ( $n=15$ ; 6,98%) as well as other ethnic minorities ( $n=14$ ; 6,51%) are identified as a vulnerable groups in a situation that is also of great concern. Finally, adolescents and teenagers ( $n=7$ ; 3,25%), as well as children ( $n=5$ ; 2,33%), who are the least vulnerable, according to the publications related to digital inclusion.

### 3.3 RQ2: What are the main sources of vulnerability?

As a natural step after studying the main victims of vulnerability, we spot the main sources of vulnerability to better understand the difficulties and their adverse effects that vulnerable people face their daily lives. After examining the  $N=331$  publications, we deduce there are different determining sources that exacerbate digital exclusion, as follows:

- Gender. Ultimately, the major part of the population is vulnerable because there is a gender digital divide or the gender gap is the digital divide (Adkins and Sandy, 2020; [89], that is, how digital exclusion disproportionately affects women, since digital exclusion is particularly acute among female citizens and other subgroups, like rural older women for example [89] or Latinas [2];
- Geographical location and race. Physical location is a barrier that exacerbates digital exclusion, e.g., living in rural areas [4, 17, 50, 52, 66, 74], living in developing countries or communities [88] and poor communities [37], lack of universal access [14, 36, 51, 55, 66, 70, 87], internet non-users [36, 40] or lack of web accessibility [60] and lack of skills [14, 36]. More specifically, vulnerable groups are also represented in Adkins and Sandy [2], who examine immigrant people who live in rural areas, in concrete, female Latino immigrants, Saleminck [66], who studies Gypsy-Travelers; and Gangadharan [30], who explores black and minority ethnic groups,
- Poverty and education. Low income or limited economic resources [24, 55, 74], Martinez [50] from early life

also means low level of education [55, 74], Martinez [50]. For that reason, both sources are commonly associated with a wide range of vulnerabilities. Helsper and Reisdorf ([40]: 1253) reflect on the socioeconomic circumstances and cultural practices that influence “people who are disadvantaged in areas of economic, social, and personal wellbeing” on being the “least likely to engage with ICTs.”

- **Personal limitations.** Physical and cognitive impairments exacerbate vulnerabilities, although most of the literature focuses on the study of physical illness—e.g., visual disabilities (Martinez [50], motor problems or musculoskeletal problems [55]. Disabled people also represent a group that is explored in Sheon et al. [70], who studied people suffering from Type 2 Diabetes (T2D), Eckhardt et al. [28], who aimed attention at people with activity limitations, or Quaresma and Borges [60] who focused on people with visual disabilities.

- **Age.** Young adults and children are considered a less vulnerable group, but they are also a group of interest for scholars like Dedding et al. [24], who deal with the boundaries and constrains of this community in terms of local policy for digital inclusion. Older adults are examined in general terms by Xie et al. [88], Morales et al. [51] and Olphert et al. (2013). Meanwhile, there are also other scholars who provided a more detailed profile of old people, e.g., Yang and Du [89], who focus on older women who live in rural areas, or Gibson et al. [31] on disabled older people.

### 3.4 RQ3: What solutions are proposed by these publications to assist vulnerable people?

When analyzing the studies concerning digital inclusion— $N=331$ —we identify that the provided solutions are two-fold: offline and online. However, these improvement proposals are interdependent and should not be approached separately, since actions carried out in online spaces also affect and have implications in the offline landscape, and vice versa. In short, we identify eight core forms of intervention: providing universal *access to technology*; creating *Internet Spaces Network*; bridging the digital divide; investing in *Information Technology in Education*; investing in *Health Information Technology*; promoting *active aging*; using *libraries* as an inclusive place for vulnerable people; and *digital literacy*—this last element is not explicitly detailed in the results, but is a compendium of all the contributions that the  $N=331$  studies have made implicitly on digital literacy. The *digital literacy* factor is fully shown in Table 2.

#### 3.4.1 Accessing technology

There is a significant number of scholars who focus on explaining how access to technology help vulnerable people to avoid forms of digital exclusion or digital discrimination; For example, Adkins and Sandy [2] argue that Latina immigrants to the Midwest region of the USA were able to use their devices freely to access the social media platforms they preferred, leading to the conclusion that communication through the use of social media was not hindered by the digital divide.

In addition, Chico (2018:1) introduced the concept of “universal digital inclusion policy” as “a set of programs and strategies emitted by the Federal Executive committed to providing Information and Communication Technology (ICT) access, including broadband to the whole population, placing special emphasis on the most vulnerable segments of society” in Mexico (Table 2).

In a similar manner, Haddad and Oliveira ([37]: 6779) identified the BH Digital Program, in Belo Horizonte (Brazil), as a state policy and strategy to promote digital citizenship among poor social classes, which also implies “discussing it in the context of the new cycle of capitalist expansion and accumulation, seeking to evaluate the outcomes, limits and possibilities of digital inclusion policies.”

Finally, Grošelj et al. ([36]: 213) focus on the Proxy internet use (PIU), “where internet non-users ask internet users to perform online activities on their behalf, is a strategy for obtaining (indirect) internet access.” Thus, the PIU operates “in a context where internet users perform activities such as sending emails, buying products, searching for information, or using government services on behalf of non-users” [36]: 215). This study highlighted the importance of looking out for vulnerable communities who are most likely to be excluded from the digital arena, e.g., older adults and people with low levels of education or income. According to these authors, the problem of accessibility to digital technology tools of the most disadvantaged groups revealed that skills are an important element in PIU and Internet engagement. Xie et al. [88] also identified old people as the most disadvantaged population segment for digital exclusion, but they drew their attention in instant messaging services, in concrete, in predicting the emotions of older people when they use mobile applications, like WeChat or WhatsApp.

#### 3.4.2 Internet spaces network

Aires et al. [4] proposed the Internet Spaces Network as the public sphere to promote digital inclusion, by facilitating Internet access in municipalities located in the inner areas of the country. Aires et al. ([4]: 210) confirmed that “it is necessary to rethink public places for Internet access [...],

**Table 2** Solutions for assisting vulnerable groups in the context of digital inclusion

Accessing technology	Internet Spaces Network	Bridging the digital divide	Information Technology in Education	Health information technology	Active ageing	Libraries	Digital literacy
			<ul style="list-style-type: none"> <li>• Educational apps</li> <li>• Inclusive Digital Literacy Framework (IDLf)</li> <li>• Low-cost devices for low-resource environments</li> <li>• Mobile learning model</li> </ul>				<ul style="list-style-type: none"> <li>• Health literacy</li> <li>• Social interaction skills</li> <li>• Development of collaborative initiatives</li> </ul>
• Access to social media platforms	• Telecenters as public spaces	• New digital inclusion policies and privacy	• Mobile learning model	• Health Information Technology	• Collaborative projects to address	• Access to digital content	• Job skills
• Universal digital inclusion policy, e.g. BH	• Personal learning environments (PLE)	• New practices and techniques of online surveillance	• Open Access Repositories	• Online Social Networks through E-Health Systems Design	• Promoting the autonomy and independence of older people, e.g. the project Sus-IT in the UK	• Inclusive place for sustainable communities	• Life skills
Digital Program			• Collaborative learning and sustainable online education –e.g. universities–				• Computer skills
• Free Internet coverage			• Participatory Action Research (PAR)				• Computer education
• Proxy internet use (PIU)							• Online participation skills; enhance a sense of empowerment
							• Encourage Internet engagement
							• Abilities in the use of different devices, e.g. tablets and smartphones
							• Abilities in the use of Internet



proposing their reshaping as spaces for the development of digital participation and citizenship.” This way, the “use of personal learning environments (PLE) integrated with the e-learning platform will be facilitated and stimulated so that they provide a place to reflect learning experiences and establish professional links with colleagues from other workplaces” [4]: 209). Along the same lines, Haddad and Oliveira [37] explored the potential of telecenters as public spaces, offering free and universal access to computers and the Internet for people living in extreme poverty who aim at improving their digital skills, while promoting social interaction and the development of collaborative initiatives. Gangadharan [30] named these vulnerable groups as “chronically underserved communities” or “the underserved.” This author recommended the adoption of new practices and techniques for online surveillance instead, to ensure that the entire population, including the most disadvantaged, “have access to and use of information and communication technologies” [30].

### 3.4.3 Bridging the digital divide

In the USA, digital inclusion policies designed to introduce these “chronically underserved communities”—including those living in poverty, communities of color, Native American populations, and migrants—to the economic, social, and political benefits of broadband stand in tension with new practices and techniques of online surveillance. While online surveillance activity affects all broadband users, members of chronically underserved communities are potentially more vulnerable to the harmful effects of surveillance technologies. Gangadharan [30] examines specific examples of commercial data profiling against a longer history of low-tech data profiling of members of these underserved communities. It concludes by calling for issues of online privacy and surveillance to punctuate digital inclusion discourse. Until this happens, digital inclusion policies threaten to bring chronically underserved communities into online worlds that, as Gandy (2009) argued, reinforce and exacerbate social exclusion and inequalities.

### 3.4.4 Information technology in education

From a different perspective, Dedding et al. [24] aimed attention toward the development of educational apps for toddlers and the expansion of the current free laptop arrangement for young children. In this sense, it is necessary to develop more inclusive practices in a society with a growing recognition of the value of participation. Nedungadi et al. [52] recommended an Inclusive Digital Literacy Framework (IDLF) and developed an educational model, based on this framework, in which low-cost tablets and low-cost android devices were adaptable to low-resource environments with intermittent

electricity. This mobile learning model not only “promotes safe use of digital technologies to access information, communication, e-governance services, job skills, learning, and financial services such as online banking and eHealth services” [52]: 518), but it is also a “path for empowerment and use of technology that will help bridge the digital divide” [52]:517), since it is used “to teach computer skills, increase awareness and life skills, enhance a sense of empowerment and conduct for low-literate learners living in remote tribal settings. Specially this model offers the benefits of literacy and empowerment to tribal people, particularly the youth, through computer education”. [52]:524).

Likewise, Tomczyk et al. [74] alluded to citizen empowerment in the context of SELI Project (Smart Environment for Learning and Inclusion), and Aires et al. [4] and Nedungadi et al. [52] reflect on the mission of the European Digital Competence Framework for Citizens, also known as Dig-Comp, to stimulate digitally literate citizens in places without adequate access to the Internet—e.g., inland municipalities in Portugal [4] or rural communities in India [52]. These approaches are similar to the Sustainable Digital Inclusion model, outlined by Morales et al. [51], to bridge the problem of usability and accessibility of digital technology tools. Quaresma and Borges ([60]: 28) identified that open-access repositories are useful assets to remove all access barriers, since they facilitate the democratization of the scientific knowledge in terms of “promoting both the institution and the researchers and bringing greater and wider visibility to the research developed.”

Yang and Du [89] also focused on the use of smartphones, finding that digital exclusion was particularly severe among older people, and specifically among female citizens and rural female individuals. For that reason, these authors propose strategies to nurture their abilities in the use of smartphones and digital tablets, as well as to increase free Internet coverage, to help older people become familiar with these products and life in the digital era. Eckhardt et al. (2017) emphasize the use of ICTs to enable social innovation actions. According to these authors, ICTs are also important drivers leading to digital social innovations as instruments for addressing the needs of vulnerable people. Moreover, according to Eckhardt et al. (2017), “the active involvement of people with activity limitations seems to be a common approach within social innovation initiatives.”

In this line of thought, there are also other studies concerning collaborative learning and sustainable online education, e.g., the work by Morales et al. [51] is focused on the context of the university, which acts as a pedagogical strategy and a mediator between the cross-sectional teaching competences, social responsibility competences, ICT competences and sustainable digital inclusion.

More recently, the study by Dedding et al. ([24]: 12) operates in the context of Participatory Action Research (PAR),

involving a collaborative strategy based on the idea that knowledge is co-produced with a community and, therefore, there is a strong motivation for reaching “democratic participation, equality and inclusion, respect, and collective action to identify needs, to stretch the boundaries of science (if necessary) and to co-create knowledge for action.”

### 3.4.5 Health information technology

Borg et al. [14], Sheon et al. [70] and Gibson et al. [31] proposed Health Information Technology as a facilitator of digital inclusion. Borg et al. [14] recognized there are multiple barriers that patients face daily, and that need to be addressed to guarantee social support and social health inequalities. For that reason, Sheon et al. [70] propose providing citizens with “low-cost Internet service, equipment, and basic digital skills training (health literacy acquisition)” to avoid inequalities and digital exclusion. In addition, Gibson et al. [31] stressed the importance of connectedness and social support to empower patients and give them a more active role in their own healthcare, by enhancing Online Social Networks through E-Health Systems Design.

However, despite the technology suggested by these publications to assist vulnerable people, we have observed that it is important and more effective to first identify the problems and issues of vulnerable people, and then select what technological innovations can help solve those obstacles and help people to acquire the digital competencies and skills needed to use this technology, “instead of developing a technology and then looking for a context where it can be used” [11]: 243). This statement coincides with the definition introduced by Parsons and Hick [57], Ragnedda and Mutsvairo, [61], the Institute of Museum and Library Services et al. (2012) or Bradbrook and Fisher (2004), among others, on the meaning of «digital inclusion».

From another angle, the book chapter by Gibson et al. ([31]: 197) aims to raise attention at E-health resources, like social connectedness and social support, to reduce social exclusion and enhance quality of care in order to guarantee “public health information and access to online communities and self-help groups for those experiencing ill-health,” e.g., the European Commission's Europe Action Plan that encourages the creation of personalized e-health services to patients.

### 3.4.6 Active ageing

Some studies also discuss the digital inclusion issue in the context of active aging, whereas Olphert and Damodaran [55] referred to diverse collaborative projects, older people promote their autonomy and independence—like the Sus-IT project which was developed in UK—to address the needs of the digitally disengaged older population.

### 3.4.7 Libraries

Gomez-Hernandez et al. (2017:24) frame libraries as “an agora or ‘third place by democratizing social space’” for the purpose of cultivating citizens in terms of “social, digital, employment, or digital inclusion,” e.g., the Murcia Regional Library (Murcia, Spain). Understanding libraries as a center for the empowerment of vulnerable users is also described in a significant number of publications ( $n = 22$ ; 7,83%) related to digital inclusion ( $N = 331$ ). We have observed that these studies focus on libraries as a potential bridge across the communities’ digital inclusion processes. The first study was published in 2006, but the majority of this research concerning libraries and digital inclusion ( $n = 13$ ; 59,1%) started gaining importance in the last five years, reaching a peak in 2016 ( $n = 4$ ; 18,18%). The main ground for all these studies involves conceiving libraries not only as a service that provides universal access to digital contents, but also as an inclusive place that favors digital inclusion and creates sustainable communities in terms of reducing inequalities and ensuring equal access opportunities for all. For that reason, Bertot ([9]: 95) emphasized the need for further studies “in the area of the impact of library and digital inclusion services on the United Nations Sustainability Goals (e.g., poverty, equality, and inclusion)”. In this line of thought, research by Alabi and Mutula ([5]: 14) provides “highlights on trends that may inform academic libraries in the quest to providing assistive technologies (Asts) for students living with visual impairments.”

Having explained this, we aggregated all the information provided below in a single table—Table 2—where each column corresponds to a solution. We then list the suggested types of solutions identified and proposed by the authors of the  $N = 331$  studies.

## 4 Conclusions

The main conclusion which can be drawn, in light of the above, stresses the importance of digital inclusion projects, initiatives and programs to achieve the social inclusion of vulnerable people. However, the digital divide seems to be a significant constraint in the process of achieving digital inclusion. Digital exclusion is especially acute among vulnerable groups like older adults and disabled people, although there is also growing concern about the gender divide and the development of Internet accessibility and resources to reduce digital inequalities between rural and urban areas, as well as those that exist among poor and wealthy populations. In this sense, we have observed a lack of research concerning digital inclusion and other significant vulnerable communities, such as refugees, the unemployed, single parent households and LGTBI individuals.

Interestingly, and without any clear prompting, the first significant increase in publications occurred in 2009, with these remaining relevant for the last five years. Yet, a significant number of studies were written in Portuguese and Spanish. However, due to the fact that these publications did not meet the established criteria, we had to exclude them. We encourage future researchers to replicate this method exploring publications written in Portuguese and Spanish to identify and compare overall trends and common patterns.

Although we sought to identify the main trends and patterns, there are still other factors that should be analyzed in future studies, such as the methodology employed in the studies or the strategies used in the projects developed, among other elements.

Situational factors, like technological possibilities, are relevant to foster the digital inclusion of vulnerable people, but the absence of these conditions is not the only cause that explains the digital divide, personal, dispositional, generational and cultural variables are also important. Therefore, it is not only necessary to develop projects that guarantee universal access to these technologies but also campaigns to raise awareness and education that overcome the possibility of lack of interest, motivation and knowledge on the part of vulnerable people. Lastly, due to its connection with current new technologies, digital inclusion is a relatively new field, with two decades of research mainly conducted in the last five years. Most importantly, the relationship between vulnerable people and digital inclusion is not consolidated yet, further justifying the appropriateness of future research. Hopefully, we expect that the taxonomical framework proposed in this article helps to carry out this purpose.

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## Declarations

**Conflicts of interest** The authors have no conflicts of interest to declare that are relevant to the content of this article.

**Ethics approval** The submitted work is original and has not been published elsewhere in any form or language (partially or in full). Results are presented clearly, honestly, and without fabrication, falsification or inappropriate data manipulation (including image based manipula-

tion). All authors whose names appear on the submission adhere to discipline-specific rules for acquiring, selecting and processing data. No data, text or theories by others are presented as if they were the author's own ("plagiarism"). Proper acknowledgements to other works is given (this includes material that is closely copied (near verbatim), summarized and/or paraphrased), quotation marks (to indicate words taken from another source) are used for verbatim copying of material, and permissions secured for material that is copyrighted.

**Consent to participate** All authors whose names appear on the submission made substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data; or the creation of new software used in the work; drafted the work or revised it critically for important intellectual content.

**Consent for publication** All authors whose names appear on the submission approved the version to be published; and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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