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Is digital world accessible to all? A Comprehensive Review of Digital Accessibility Research (1996-2024)

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Is Digital World Accessible to All? A Comprehensive Review of Digital Accessibility Research (1996-2024)

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Keywords: Digital accessibility, Media accessibility, Web accessibility, Systematic literature review, Bibliometric analysis, Digital inclusion

Abstract

Digital accessibility is not static, but a dynamic process that actively interacts with both physical and digital contexts. This study provides a comprehensive overview of digital accessibility by analyzing 416 scholarly articles published from 1996 to 2024 from SCOPUS and Web of Science to capture digital accessibility in current context. First, a bibliometric analysis examines publication trends, including years, countries, affiliations, authors, and keywords, to identify overall trends and emerging themes. This is supplemented by a qualitative analysis of 80 selected articles, providing an in-depth understanding of current research themes. Additionally, the study collects and analyzes 70 relevant quotations to enhance conceptual understanding and provide a standardized definition of digital accessibility. The results offer an extensive overview of digital accessibility literature using both quantitative and qualitative method, providing both surface level and in-depth analysis of what is being discussed in digital accessibility in academia. It contributes to digital accessibility literature by providing a steppingstone as well as guidelines for future research.

1. Introduction

Digital technology permeates every aspect of our society, mediating communications in education, the workplace, and interpersonal relationships. With people spending over 12 hours daily on digital media as of 2020, losing access to digital technology is a significant setback in our interconnected world (Nielson, 2020). Particularly

during the Covid-19 outbreak, where the absence of digital accessibility poses a tangible threat to basic social engagement, digital accessibility turns out to be a precondition for social and economic activities.

The growing emphasis on building an inclusive society, as seen in initiatives like the European Accessibility Act, has propelled research on digital accessibility. However, digital world is still suffering from substantial accessibility gaps, with disparities in internet connectivity and usage across geographic locations, gender, ages, and disabilities as of 2022 (Signe, 2023). While technological advances, such as artificial intelligence-supported services, are widely acclaimed, there is much less focus on those who are technologically marginalized. For instance, a survey by WebAIM revealed that 95.9% of the top 1 million websites have WCAG conformance failures on their homepages (Parker, 2024). ADA digital accessibility lawsuits increased to 4,605 cases in 2023, indicating growing conflicts over digital accessibility for those excluded from digital services (Belova, 2024). Significant digital barriers still affect 1.3 billion people with disabilities worldwide, highlighting a gap between technological advancements and actual accessibility (Sommer, 2023). This emphasizes the need for a comprehensive understanding that will serve as the foundation for future research, decision-making, and policy development to achieve digital accessible society (Prado et al., 2023).

Surveying digital accessibility literature is crucial as a guiding framework for future research. Identifying mainstream accessibility studies will

help understand who is missing and what should be addressed in current accessibility literature. Also, having a comprehensive conceptual understanding of digital accessibility will serve as a foundation for accessibility-related research, standards, and legal measures. While most conceptual definitions are limited to web accessibility literature, broadening the scope to digital accessibility will increase its relevance in the digital context. To our knowledge, there is no comprehensive review of digital accessibility over an extensive time frame, leaving each piece of literature in isolation. Prado et al (2023) manually examined 13 articles on educational digital accessibility, while Kulkarni (2019) qualitatively organized the concept through round table discussions. This paper utilizes both bibliometric analysis and a systematic literature review (SLR) to conduct a quantitative analysis of 416 collected articles, supplemented with qualitative analysis of 80 articles in the field of digital accessibility literature.

This study is organized as follows: it begins with identifying 28 years of research trends using a bibliometric analysis on 416 articles, followed by an extensive qualitative analysis of 80 scholarly articles from the same dataset. By synthesizing themes and findings from existing literature, it further identifies research gaps and proposes future avenues. Additionally, it explores the conceptual understanding of digital accessibility based on definitions collected from the qualitative analysis. Therefore, building upon the evolutionary context, this study aims to develop an interconnected network within accessibility literature and provide guidelines for future research and practice in digital accessibility.

2. Literature review

2.1 Research trend of digital accessibility

Digital accessibility is a dynamic, multidimensional process that interacts with physical and cultural environments (Botelho, 2021). Increasing visual complexity and information transfer highlight the growing importance to

explore digital accessibility in current digital context (Brophy & Craven, 2007). Acknowledging the academic foundation is necessary to conduct up-to-date research on digital accessibility literature. This highlights the importance of reviewing 28 years of research on digital accessibility to identify its progress, priorities, and gaps.

However, current literature reviews on digital accessibility are mostly limited to qualitative analyses with a small number of scholarly articles (Kulkarni, 2019; Prado et al., 2023) or focus on specific domains such as web accessibility (Ahmi & Mohamad, 2019). No study has yet explored digital accessibility from a social science perspective on a wide scale, which would provide practical guidelines and an overview of the current accessibility landscape. By conducting both quantitative bibliometric analysis and qualitative SLR, this paper analyzes the current research trend of digital accessibility based on the year of publication, research location, affiliation country, journal publications, and research themes.

Not only does it offer a practical summary of digital accessibility, but also it identifies the shifts in the accessibility literature. For example, digital accessibility is closely related to the concept of digital divide, digital inclusion, and disability. Scholars have attempted to identify academic fluctuations within respective concepts. For instance, the digital divide has been categorized into First-wave and Second-wave (Rodino-Colocino, 2006). Former research emphasized access to technology from a technological determinist perspective, while the latter focused on socio-economic inequalities, characterized by soft technological determinism (Adam & Kreps, 2009; Rodino-Colocino, 2006). Similarly, digital inclusion has been categorized into two. The first wave focuses on basic access, while the second wave includes more complex usability criteria such as effectiveness, efficiency, and satisfaction (Adam & Kreps, 2009; Rodino-Colocino, 2006). The concept of disability has largely transitioned from the medical model to the social model,

encompassing a broader range of disabilities within our society. Just how all these concepts have been systematically categorized based on evolving academic focus, digital accessibility should also be structured within this framework. Identifying shifts is an effective tool to organize the past and present state of digital accessibility. Therefore, this study will reveal how the focus of accessibility literature has shifted over time with technological advancements and the progression of disability rights.

At the end, the study will present a research overview map and the current flow of digital accessibility, integrating relevant concepts such as digital divide, digital inclusion, and disability. Using this map as a foundation, the study will identify underdeveloped issues and domains for future exploration, contributing to the evolution of digital accessibility literature across diverse sectors.

RQ1. How has the research trend in digital accessibility literature evolved over time?

2.2 Conceptual definition of digital accessibility

Digital accessibility is defined as a cohesive integration of training, hardware, software, content, and standards to ensure inclusive access (Botelho, 2021; Prado et al., 2023). Given its dynamic and multi-faceted nature, digital accessibility is being diversified (Yesilada et al., 2015). Now it is an umbrella term covering a diverse range of accessibility aspects, including disabilities (e.g.deafness), platforms (e.g.web), services (e.g.social media), content (e.g.e-books), and devices (e.g.computer). Particularly, the situational impairments paradigm further expands the scope of accessibility beyond the traditional notions, encompassing the general population (Yesilada et al., 2015). Elderly and those with age-related disabilities is another emerging subject in accessibility literature (Becker, 2004; Moreno & Martinez, 2013). Accessibility coverage extends not only to the elderly but also to children and inexperienced users (Schmutz et al., 2017).

Digital accessibility is not only

conceptually expanding but also multi-tiered and overlapping, intertwined with diverse concepts and terms. This complicates its concrete definition even further. For example, discussions about digital accessibility often involve digital inclusion, digital divide, digital usability and literacy (Adam & Kreps, 2009; Kolotouchkina et al., 2022; Yesilada et al., 2015). For instance, in SLRs on digital divide and digital exclusion, accessibility is identified as a key factor, often described as "digital divide is about accessibility" (Khalid & Pedersen, 2016, p. 618).

The lack of distinction between digital literacy and digital usability is concerning. Digital literacy has been defined as "the ability to effectively use and evaluate information" (Ha & Kim, 2023, p. 11), primarily focusing on user capability. Consequently, in previous literature, illiteracy is identified as a barrier to accessibility, while enhancing one's literacy skills is recognized as a key factor for improving it (Beyene et al., 2023; Kulkarni, 2019). The distinction between usability and accessibility is also challenging. Few literatures attempted to distinguish accessibility and usability. For instance, Federici et al (2005) defined accessibility as the "objective end of the user interaction," whereas usability concerns the subjective differences of individuals (p. 781). On the other hand, from a systemic-constructivist viewpoint, accessibility and usability is a single system, exhibiting bidirectional user interactions (Federici et al., 2005).

Despite its conceptual expansion, there is no comprehensive understanding of the concept, as its definition spans from individual rights and ability to practical practice. Yesilada et al (2015) organized a conceptual definition of digital accessibility based on expert survey. However, the proposed definition is limited in its time scope and domain (Yesilada et al., 2015) This study utilizes qualitative analysis, involving manual coding and thorough reading of each article to organize the conceptual definition and identify any evolution within the concept. The aim is to establish a conceptual foundation for future literature.

RQ2. How has the digital accessibility concept evolved over time?

3. Methodology

This study uses bibliometric analysis and a SLR on digital accessibility. There are different typologies for scoping reviews, such as literature review, meta-analysis, scientometric analysis and umbrella reviews. This study adopts a mixed-method approach, employing both bibliometric analysis and SLR (Smit & Scherman, 2021). RQ 1 involves both a bibliometric analysis and a SLR to identify research trends in digital accessibility. Combining these two methods provides a comprehensive understanding of the current discourse on digital accessibility. While bibliometric analysis offers a broad overview of research trends, the SLR delves deeper into the in-depth discourse on the topic. Then, for RQ 2, this study follows the methodological approach suggested in Kirchherr et al (2017) and collects the definitions from the scholarly articles to organize a conceptual understanding of digital accessibility.

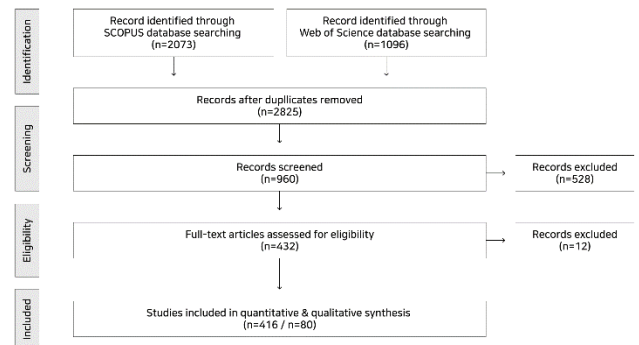
3.1 Data collection

For comprehensive review, this study ensures to collect journal papers relevant to the digital accessibility. To ensure the degree of value in a literature review, only scholarly articles is used as a source (Denney & Tewksbury, 2013). Mainly adopting database search using search query, scholarly papers and articles were gathered from two international databases: SCOPUS and Web of Science on 1 April, 2024. These two databases have been selected as previous systematic reviews primarily retrieve scholarly data from these two databases due to its extensive scope and global reputation (Echchakoui, 2020). The articles that include the terms "digital accessibility," "media accessibility," and "web accessibility" in their title and keywords were included, as these terms are widely discussed within the context of digital accessibility.

The article was selected based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) to ensure transparency. As a result, a total of 416 research papers from the social science fields without specifying any restrictions on the publication year were collected as a final sample (Figure 1).

Figure 1

Data collection process based on the PRISMA



3.2 Data analysis

Bibliometric analysis, a form of literature review, is effective in presenting large quantities of bibliometric data comprehensively to identify emerging research topics (Donthu et al., 2021). It is particularly useful when dealing with a broad and extensive dataset, where manual review would be difficult. In this study, the collected data were analyzed using Bibliometrix 3.0 and VOS viewer, which are commonly used data analytic tools for bibliometric analysis papers (Fatehi et al., 2020; Koo, 2021; Kumar et al., 2021). However, combining bibliometric data from SCOPUS and Web of Science can be problematic due to disparate tag fields (Echchakoui, 2020). Therefore, this study follows the guideline provided by Echchakouri (2020) in merging two databases using Rstudio.

Unlike bibliometric analysis, SLR is oriented towards a qualitative review method with the objective of summarizing the findings of previous literature. It is particularly applicable when the scope and the size of data is limited (Donthu et al., 2021). This qualitative SLR utilizes the ATLAS.ti 22, a computer-assisted qualitative

data analysis software (CAQDAS) tool, to effectively organize and capture the detailed findings and essence of collected data.

4. Results

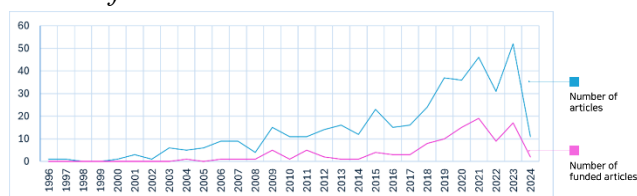
4.1 Research trend

4.1.1 Number of publications

This study collected 416 scholarly papers from 1996 to 2024. There is a steady growth in publications, with a mean annual growth rate of 8.94%. Despite yearly fluctuations, the overall trend indicates increasing academic interest in digital accessibility. Regarding funding, no articles were funded from 1996 to 2003. However, from 2018 onwards, there was a significant and consistent rise in the number of funded articles, indicating growing interest and investment in digital accessibility. Figure 2 shows the number of scholarly papers from 1996 to 2024 with the number of funded articles per year.

Figure 2

Annual number of scholarly articles and funded articles from 1996 to 2024.



4.1.2 Leading country/continent in digital accessibility

Scientific production by country is measured by counting the number of authors from that country in publications. Based on collected data, the United States (n=108) leads in digital accessibility, followed by Spain (n=84) and the United Kingdom (n=47). Figure 3 displays annual scholarly publications by country. While the USA maintains the top position, Spain has shown noticeable growth, surpassing the United Kingdom's yearly production in 2012.

Figure 3

Annual number of scholarly articles by countries

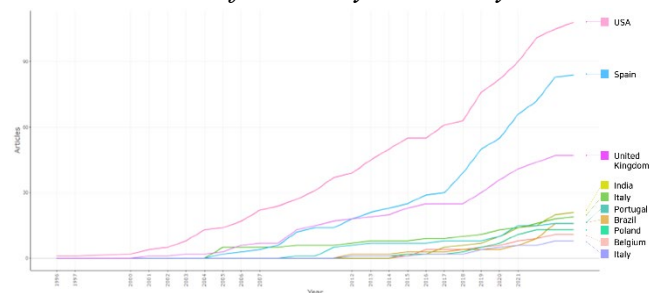
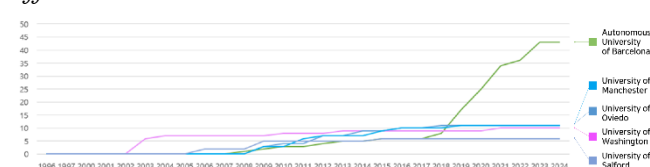


Figure 4 presents annual scholarly publications based on author affiliations, highlighting a substantial increase from the *Autonomous University of Barcelona* since 2018, contributing to Spain's overall rise. The top three most productive countries are the USA, Spain, and the United Kingdom. India (n=21), Italy (n=19), Brazil (n=16), Portugal (n=16), Poland (n=13), Belgium (n=11), and Turkey (n=8) do not show significant differences in scholarly publications. Europe leads in digital accessibility literature, comprising 53.8% of collected scholarly articles (n=235), followed by North America (n=113, 25.9%) and Asia (n=43, 9.8%), highlighting a significant gap among the continents.

Figure 4

Annual number of scholarly articles by top 5 affiliations



More than 20% of the collected data is published in the top 8 journals listed in Table 1. The journal with the most articles is the *Journal of Audiovisual Translation* (n=18), published by the European Association for Studies in Screen Translation (ESIST). Among the top 8 journals, those focusing on translation—including audiovisual translation, specialized translation, and translation theory—are prominent, highlighting the importance of audiovisual translation for visual and hearing-impaired individuals in digital accessibility.

Disability-specific journals, such as *Disability and Rehabilitation* and the *Journal of Accessibility and Design for All*, prioritize disability-centered topics within accessibility literature. While the number of relevant articles in these journals doesn't directly correlate with academic impact, the dominant distribution of European publishers and author affiliations suggest that Europe leads in accessibility literature both in terms of production and distribution in academia.

Table 1.

The Top 8 journals based on the number of published articles in digital accessibility.

Rank	Journal	Publisher	Freq	%
1	Journal of Audiovisual Translation	European Association for Studies in Screen Translation (UK)	18	4.3%
2	Journal of Specialised Translation	University of Roehampton (UK)	15	3.6%
3	Behaviour and Information Technology	Taylor & Francis (UK)	13	3.1%
4	Disability and Rehabilitation: Assistive Technology	Taylor & Francis (UK)	10	2.4%
5	Library Hi Tech	Taylor & Francis (UK)	10	2.4%
6	Perspectives: Studies in Translation Theory and Practice	Routledge, Taylor & Francis (UK)	7	1.7%
7	International Journal of Environmental Research and Public Health	MDPI (Switzerland)	6	1.4%
8	Journal of Accessibility and Design for All	Fundación ONCE and Universitat Politècnica de Catalunya-BarcelonaTech (Spain)	6	1.4%

From 416 articles, 826 authors have

contributed to the digital accessibility literature. International co-authorship is extremely limited, accounting for only 1.2% of the data. There are 97 single-authored articles, making up 11% of the total. The average number of co-authors per article in this field is 2.63. Compared to other domains, where single-authored articles and international collaborations are 3.8% and 2%, respectively, digital accessibility shows a lack of collaboration both domestically and internationally (Koo, 2021). Table 2 presents the most relevant authors in digital accessibility literature. The top 8 scholars are all affiliated with European institutions, predominantly in translation and computer science. Spanish scholars, concentrated in groups like Transmedia Catalonia Research Group and AccessCat Network, focus on audio description. Notably, Anna Matamala contributes to scholarly discourse and ISO standardization. This concentration reinforces Spain and Europe's leadership in the field.

Table 2

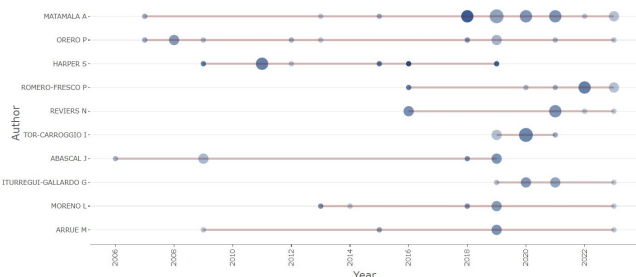
The top 8 authors in terms of article frequency.

Author	Affiliation	Freq	Articles Fraction
Matamala A	UAB, Translation, Autonomous University of Barcelona, Spain	19	8.39
Orero P	UAB, Translation, Autonomous University of Barcelona, Spain	11	4.84
Harper S	School of Computer Science, University of Manchester, Manchester, United Kingdom	8	2.67
Romero-Fresco P	Faculty of Philology and Translation, University of Vigo, Spain	8	5.50
Reviere N	Department of Applied Linguistics/Translators and Interpreters, University of Antwerp, Belgium	7	3.33
Tor-Carroggio I	Translation and Intercultural Studies, Autonomous University of Barcelona, Spain	7	4.50

Abascal J	Department of Computer Architecture and Technology, University of the Basque Country UPV/EHU, Spain	6	1.45
Iturregui-Gallardo G	Department of Translation and Interpreting, Universitat Autònoma de Barcelona, Spain	6	3.31
Moreno L	Department of Computer Science, University Carlos III of Madrid, Spain	6	1.90
Arrue M	School of Computer Science, University of the Basque Country, Spain	5	1.23

Figure 5 visualizes the authors' annual production from 1996 to 2024. The line represents the author's scholarly timeline, while the size and color intensity of the bubbles represent the number of documents and the total citations per year, respectively (Bibliometrix, 2024). Matamala and Orero have the longest scholarly timeline in the digital accessibility domain while increased citation is noticeable after 2019. While no significant shift in cited authors has been observed, there is a progress from infancy to developing phase centering in 2019 with more publications and citations.

Figure 5
Top 10 authors' annual publication timeline.



4.1.3 Intellectual base of digital accessibility

The number of citations is closely linked to the year of publication, so older publications tend to appear more frequently. Notably, all top 10

references focus on web accessibility, highlighting its dominant position, especially before 2016. The most cited referenced was Lazar (2004) which presents Web Accessibility Integration Model based on the survey of 300 web masters. Similarly, Yesilada et al (2015) surveyed over 300 people interested in accessibility to specifically explore the relationship between accessibility, user experience, and usability. The most recent publication from landmark references is Ahmad & Mohamad (2019). It presents a bibliometric analysis on web accessibility, providing a broad review of web accessibility from a quantitative approach (Ahmi & Mohamad, 2019). Specifically, Harper et al. (2009) define and categorize visual complexity in web design, offering guidelines for those interested in its impact on accessibility. Aizpurua et al. (2016) explore the relationship between accessibility and user experience, bridging these two important concepts.

Additionally, accessibility evaluation is a major focus in digital accessibility literature. Schmetzke (2001) examined accessibility in educational settings, while Kamoun & Almourad (2014) and Goodwin et al. (2011) studied e-government. This highlights that accessibility initiatives primarily start in public sectors. Brajnik et al (2011) particularly focused on the expertise effect that may influence the validity of web accessibility method using a Barrier Walkthrough study. Appendix A lists the top 10 landmark references in digital accessibility literature.

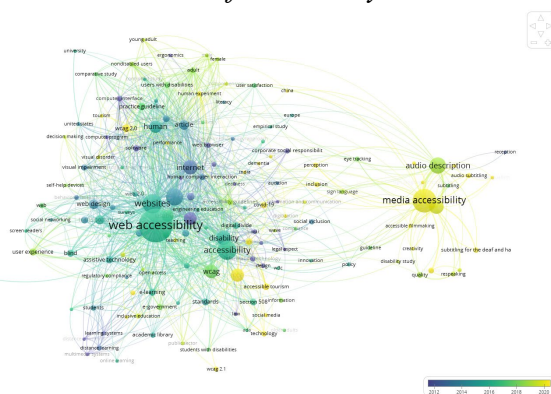
4.1.4 Thematic trend in digital accessibility literature

Along with technological development, digital accessibility research evolved throughout time. To quantitatively examine the thematic trend in digital accessibility literature, this study utilized co-occurrence network (Figure 6), three-field plot (Figure 7), and thematic map (Figure 8).

From 416 scholarly articles, a total of 1636 keywords have been collected. Using a threshold of 3, 155 keywords have been included in the network map after data cleaning with thesaurus file. Figure

6 visualizes the longitudinal progress of the digital accessibility literature from 1996 to 2024 using co-occurrence network. While three main key terms: web accessibility, digital accessibility, and media accessibility were used in a search query, bimodal network centering on web accessibility and media accessibility can be examined. The co-occurrence network based on authors' keywords shows that media accessibility centers on terms like audio description and subtitling for the deaf and hard of hearing, highlighting its focus on audiovisual translation as an assistive technology for disabled users. Additionally, there is a longitudinal shift from web accessibility to media accessibility. While web accessibility is mostly focused on before 2018, media accessibility becomes a more prominent theme after 2019.

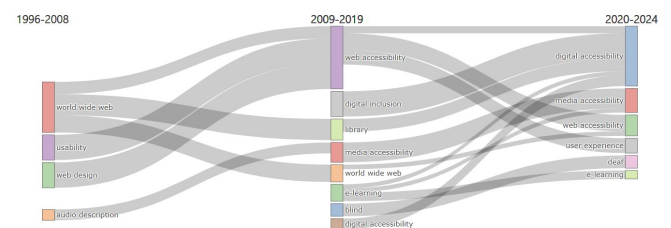
Figure 6
Co-occurrence network of author keywords



If the co-occurrence network shows how media accessibility is emerging in digital accessibility literature, thematic evolution provides a more structured examination of themes based on periodic time intervals. A three-field plot (Figure 7) based on a Sankey diagram visualizes the thematic evolution based on a time split. The height of each rectangle indicates the frequency of occurrences within this network. The width of lines is proportional to the number of connections. It is divided into two-time splits: 2008, the year of the mobile evolution with smartphones, and 2019, the year of the COVID-19 outbreak. These two time-splits are chosen, because digital accessibility

evolves in conjunction with technological advancements, and both the mobile revolution and COVID-19 outbreak have greatly altered how people interact with technology.

Figure 7
Thematic evolution from 1996-2008, 2009-2019, and 2020-2024



From 1996 to 2008, there is no evident discussion on accessibility. Instead, accessibility is approached primarily from technological aspects, including the World Wide Web and audio description. The initial focus is on service aspects such as web design and usability. However, from 2009 to 2019, the conceptual aspect becomes more noticeable, with discussions on web accessibility, digital inclusion, media accessibility, and digital accessibility. Alongside these accessibility concepts, specific domains such as library and e-learning, and subjects including the blind become more prominent in accessibility literature. After 2019, following the COVID-19 outbreak, digital accessibility and media accessibility surpass web accessibility, which had been a dominant theme in the accessibility domain. More user-specific concepts such as user experience (UX) appear. As described in the occurrence network analysis (Figure 6), audio description in the initial timeframe evolves into media accessibility in the second timeframe. The connection between the blind and the deaf in the second and third timeframes implies how disability, in general, progresses in conjunction with accessibility.

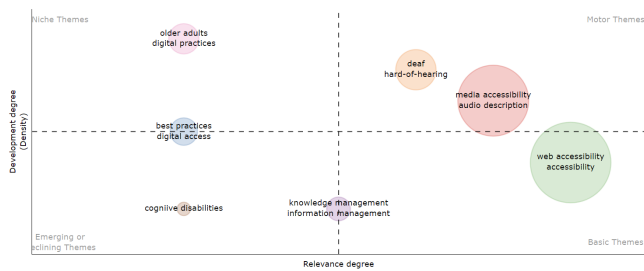
Lastly, thematic map (Figure 8) is based on the clusters of collected author keywords. This study followed a strategic diagram using thematic networks proposed by Cobo et al (2011). Previous

bibliometric analysis utilized this thematic map to examine the current status and to identify possible future agenda (Agbo et al., 2021; Alkhamash, 2023).

Utilizing co-word analysis, the clusters of keywords are positioned based on two parameters: density and centrality. X-axis represents the relevance of topic based on keyword centrality while Y-axis indicates the level of theme development based on keyword density (Agbo et al., 2021; Alkhamash, 2023).

This results in a strategic diagram composed of four main clusters: niche-themes, motor-themes, emerging/declining themes, and basic themes. Niche theme refers to a “specialized topic with minor relevance to the research area but have connections to other low-relevance topics” (Kaiser & Kuckertz, 2023, p. 13). A motor theme encompasses a well-developed central topic, while emerging and declining themes are characterized by weakly developed and marginal topics (Cobo et al., 2011; Kaiser & Kuckertz, 2023; J. Yu & Muñoz, 2020).

Figure 8
Thematic analysis based on Strategic Diagram



Web accessibility and general accessibility are identified as basic themes in the digital accessibility domain, indicating their overarching and fundamental nature. In contrast, elderly and digital practices are positioned as niche themes, suggesting they are highly specialized and peripheral. Deaf and hard of hearing, media accessibility, and audio description, on the other hand, are categorized as motor themes, which constitute an important structure of this research field (Cobo et al., 2011). Comparing the topics

within niche themes (elderly) and motor themes (disability-related) hints at a comparable dominance of disability over broader subjects, including the elderly, in accessibility literature. Lastly, cognitive disability is identified as emerging/declining theme. This aligns with previous literature. Not much study targeted the users with cognitive disability including autism (Eraslan et al., 2019) and intellectual disability (Kennedy et al., 2010). Kulkarni (2019) also emphasize the lack of accessibility study on cognitive disability compared to perceptual disabilities including vision and hearing limitations. (Eraslan et al., 2019; Kulkarni, 2019).

Based on the identified research trend in digital accessibility literature with co-occurrence network (Figure 6), three-field plot (Figure 7), and thematic map (Figure 8), this study categorizes current digital accessibility research into two phases.

- (1) Infancy phase (1996-2018). Before 2019, the number of digital accessibility studies is limited, with most focusing on web accessibility and disability.
- (2) Developing phase (2019 onward). Not only the publication and citation increased from 2019 onwards, but it also marks the transition from web-dominated perception to media context, broadening the range of accessibility in digital space. It acknowledges previously excluded subjects including elderly and cognitive disability as well as widening the domain to commerce and social media.

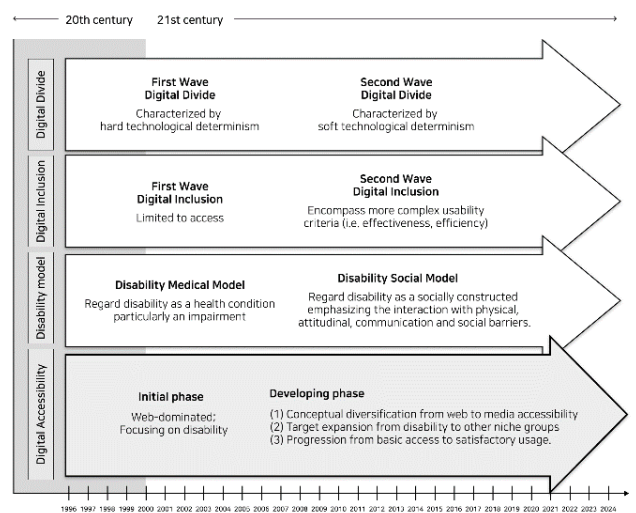
4.1.5 Flow of digital accessibility research

Digital accessibility is closely related with the concept of digital divide, digital inclusion, and disability literature, all of which are dynamic and intimately intertwined with social and technical contexts. Therefore, it is important to examine digital accessibility in conjunction with these proposed concepts. First, Rodino-Colocino (2006) categorized the digital divide into two waves: the First Wave and the Second Wave. The former research primarily adopts a technological

determinist perspective, emphasizing digital access, while the latter is more focused on socio-economic disparities, characterized by soft technological determinism (Adam & Kreps, 2009; Rodino-Colocino, 2006). Second, Power et al (2019) similarly categorized digital inclusion into First Wave Inclusion, primarily focusing on basic access, and Second Wave Inclusion, which incorporates usability criteria such as effectiveness, efficiency, and satisfaction (Vollenwyder et al., 2023). Lastly, there are two major types of models within disability literature: social model of disability and medical and charity model of disability (Kennedy et al., 2010). Historically, disability was viewed as a personal issue that required correction through medical treatment. However, with recent endeavors from disability studies scholars and disability rights activists, disability is not predetermined nor biological, but is shaped by social practices. Focus on medical model rather than the social model of disability, initiated by Marxism and second wave feminism is under criticism (Adam & Kreps, 2009). Digital accessibility should not be isolated from this discussion. Quantitative and qualitative analyses of digital accessibility literature reveal three main trends: Conceptual diversification from web to media accessibility, target expansion from disability to other niche groups, and progression from basic access to satisfactory usage. Figure 9 visualizes how these four trends coexist in the current social context.

Figure 9

Flow of digital accessibility in conjunction with digital divide, digital inclusion, and disability literature



Note. This figure utilizes the conceptualization of digital divide (Rodino-Colocino, 2006), digital inclusion (Power & Barlet, 2018), and disability model (Shakespeare, 2016) from previous literature.

4.1.6 Future research topics

Considering how society transforms in terms of digital divide, digital inclusion, disability, and digital accessibility, several research topics are suggested for further exploration.

Expansion to new media Current accessibility literature predominantly focuses on web platforms due to the dominance of web accessibility. Although the rapidly changing ICT environment makes it challenging to address every issue individually, scholars should explore accessibility in a dynamic and evolving context (Botelho, 2021; H. Yu, 2002). Conducting accessibility research on new media may include emerging platforms such as social media or new technologies like virtual and augmented reality (Cavallaro & Dianin, 2022; Jenkinson, 2017). Especially as media consumption increasingly shifts to smartphones, mobile accessibility emerges as another potential topic for future discussion.

Niche targets Current accessibility literature primarily targets people with disability. While most studies frequently dichotomized the disability into the disabled and non-disabled, there is a limitation as most impairment lies on a continuum (Federici

et al., 2005; Schmutz et al., 2017). Understanding disability from a social model of disability will broaden the spectrum of disability. Also, widening the target spectrum to different ages, barriers (financial barrier, cultural barrier, gender barrier), languages, countries will provide a diverse discussion within digital accessibility literature.

Beyond accessibility evaluation Current academic papers on digital accessibility primarily focus on identifying problems. The dominant research topic is the assessment of accessibility levels across web platforms using evaluation tools guided by the Web Content Accessibility Guidelines (WCAG) and the Section 508 Guidelines. Strategies to enhance or achieve digital accessibility are limited in current literature, highlighting the need for studies to practically tackle the issue and evaluate their effectiveness.

Novel methodological approaches Current accessibility literature heavily relies on web evaluation using either manual or automated evaluation tools. The dependence on WCAG-based evaluation tools in previous literature even raises questions about whether compliance with WCAG truly correlates with user experience (Vollenwyder et al., 2023). A novel approach to evaluating current accessibility levels, extending beyond web platforms to encompass diverse digital mediums, would be necessary. Another suggestion is the integration of Community-Based Participatory Research Program (CBPR) in accessibility literature. CBPR is a research orientation that "supports collaborative interventions involving scientific researchers and community members." (Castille, 2024, para. 1). Considering the disability slogan "Nothing about us without us," which empowers persons with disabilities to take control over decisions affecting their lives, incorporating community members within the research will be a strong starting point to identify and effectively address necessary problems.

Conceptual distinction Comparing and

establishing a clear conceptual understanding of digital accessibility alongside other relevant concepts is crucial. For instance, the distinction between digital accessibility and digital usability should be elaborated. Accessibility, usability, and user experience are all interrelated (Yesilada et al., 2015). Usability, with a longer history compared to accessibility, as shown by Shackel (1991), is frequently discussed in accessibility literature. Some consider accessibility synonymous with usability, while others view accessibility as a component of usability (Yesilada et al., 2015). Additionally, a more concrete framework for digital divide, inclusion, and accessibility is crucial due to conceptual confusion in implementing legal standards. This study provides a foundational understanding of digital accessibility, serving as a steppingstone to compare the conceptual components of these interrelated concepts.

Active interdisciplinary collaboration There are two main methods to improve accessibility: technical approaches, which can be empirically tested, and design-centered approaches (Brophy & Craven, 2007; Yesilada et al., 2015). For instance, accessible web design, design for all, and universal design all reflect design-centered perspective in digital accessibility (Brophy & Craven, 2007; Yesilada et al., 2015). Accessibility, particularly in the service domain, is closely connected to both computer programming and user-experience design. This emphasizes the need for active interdisciplinary collaboration, not only to identify problems but also to propose solutions for achieving digital access equity. For instance, Ha et al., (2024) conducted an interdisciplinary study to enhance webtoon accessibility using deep learning technology based on design science research framework. Furthermore, digital accessibility extends beyond technological products; it also encompasses legal, ethical, technical, and social contexts, including legal implementation and urban accessibility (Kulkarni, 2019). This highlights the need for broader collaboration, extending beyond academia to encompass various public institutions

and industries.

4.2 Conceptual understanding of digital accessibility

RQ 2 focuses on the conceptual evolution of digital accessibility. The importance of establishing a standard definition of digital accessibility has been repeatedly emphasized to reduce any ambiguity and to reach consensus (Yesilada et al., 2015). One of the oldest conceptualizations of accessibility is the work by Hansen (1959), defining accessibility as “potential of opportunities for interactions” (p. 73). The initial conceptualization of accessibility focuses on mobility in the physical world (Morris et al., 1979). In current digital accessibility literature, the most dominant definitions were established by Web Accessibility Initiative (WAI) and the International Standardization Organization (ISO). According to WAI, web accessibility means “that websites, tools, and technologies are designed and developed so that people with disabilities can perceive, understand, navigate, and interact with the Web as well as to contribute to the Web” (Henry, 2024, para. 3). According to the ISO (2008), accessibility is defined as “the ease of use of produce, service, environment or facility, regardless of individual’s capabilities” (ISO, 2018 as cited in Giraud et al., 2018, p. 23). While the range and level may be intermixed, the core of accessibility remains the same. Therefore, this study aims to provide a comprehensive definition of digital accessibility with these three main terms.

There are diverse methodological approaches to develop a robust conceptual definition. Dahlsrud, (2008) proposed two methods to have a comprehensive understanding of a concept. These are either by conducting interviews or by systematically collecting the written definitions. The former was conducted by Kulkarni (2019) through round table discussion. Considering that latter approach is more valid according to previous literature, this study qualitatively collects the definitions in scholarly article (Kirchherr et al., 2023). For a conceptual understanding of digital

accessibility, this study follows the methodological approach suggested in Kirchherr et al (2017)

4.2.1 Sample development

While bibliometric analysis is an effective tool for identifying general trends, SLR is essential for defining and conceptualizing specific terms. Previous SLRs categorized the collected definitions into three: those citing previous definition, those in official policy documents, and original definitions (Rosalina et al., 2021, p. 136). While Kirchherr et al (2023) include non-academic sources in their data collection, this study focuses solely on data from scholarly papers. The detailed data sources are described in section 3.1. Specifically, this study adopted Kirchherr et al. (2017)’s second approach: searching databases (i.e., Scopus and Web of Science) using a predefined search string and collecting definitions by skimming through the identified articles. 80 scholarly articles out of 416 have been randomly selected, resulting in 70 quotations discussing digital accessibility. Following the previous study of Kirchherr et al (2017), this study not only collected the definition itself but also the neighboring text that help understand the ongoing conceptual evolution in digital accessibility. Plus, instead of strictly limiting the concept to three terms, other terms including accessible web and universal design (Martins et al., 2017) have been added. Overall, 70 quotations are collected. It should be noted that this does not decisively represent the digital accessibility but fairly represent the definitions discussed in academia.

4.2.2 Coding

The coding framework was developed in an iterative process. The initial coding was conducted inductively throughout the coding process. The eventual coding process results in the dimensions related to *target*, *context*, *actionable objective*, and *desired outcome* of digital accessibility. Table 3 shows the coding framework for each dimension.

Target The collected definitions primarily discuss who the accessibility targets are. The subject of accessibility is being diversified from those with different disabilities to all the users. Disability encompasses sensory (hearing, vision), motor (tremor, limited physical movement), and cognitive (learning disability) impairments (Vollenwyder et al., 2023). However, the overly narrow conceptualization of accessibility for people with disabilities has frequently been criticized (Kurt, 2019). ISO broadened the perspective to all users regardless of their abilities. Few literature further consider surrounding environment including “particular circumstances, needs, and preferences” including age, educational level, software, device requirements (Abu-Doush et al., 2013; Fajardo et al., 2006; Kurt, 2019, p. 207). Therefore, the scope now includes elderly, disadvantaged individuals, those with lack of social and financial opportunities, and those in developing countries (Yesilada et al., 2015). There is a radical perspective that accessibility should encompass users with different languages as well as countries (Hendler, 2012). Some argue that digital accessibility should focus only on users with disabilities, while broader subject coverage should be included in universal access (Henry, 2007).

Context Context refers to specific digital spaces, platforms, services, content, and devices where digital accessibility practices are implemented. This includes websites, web applications, mobile apps, online services, and any other digital mediums through which users interact with digital content. As the interconnection between digital and offline spaces strengthens with advancements such as digital twin and virtual technology, the perspective that dichotomizes the digital and physical worlds should be limited (Javaid et al., 2023). While the focus has primarily been on the web due to the dominance of web accessibility, previous bibliometric analyses suggest potential for contextual expansion.

Actionable objective Actionable objective refers to

specific actions or steps taken to achieve accessibility. The objective of digital accessibility can be categorized into three: first is removing existing barriers. Second is enabling the given function, and third step is providing a quality-based experience (effectiveness, efficiency, satisfaction). Barrier removal involves identifying and eliminating obstacles that prevent using digital technology. Barriers/obstacles has been characterized as “a failure mode” (Brajnik, 2006, p. 158) encompassing any technical, visual, social, cultural, or ethical issues that impede the desired outcome. Likewise, enabling involves implementing and facilitating access, approach, use, perception, understanding, navigation, interaction, uploading, and participation in digital activities. Providing usable information, services, and function allows users to initiate and terminate operations and complete tasks. Last is about providing quality experience which can be measured by effectiveness, efficiency, and satisfaction.

Desired outcome Desired outcome represents a broader, long-term goal of these actions, aiming to ensure fair and equal access to digital resources for all users. In terms of digital accessibility, it emphasizes a vision of equality, diversity, and inclusion in the digital space, ensuring fair and equitable access to digital resources and opportunities for participation for every individual. This vision aligns with Tim Berners-Lee’s idea of the universal value of the web, striving to make its benefits available to all (Rodríguez et al., 2017; WAI, 2024).

Table 3.

Coding framework (obtained via the iterative coding process)

Objective	Definition
Target	(1) All the users
	(2) Those with different levels and types of disabilities

	(3) Elderly (4) Socially and financially disadvantaged (5) Those in emerging countries (6) Those without available content, device, platform, network
Context	(1) Any digital spaces, platforms, services, contents, devices, where digital accessibility practices are implemented (i.e. web, game, film)
Actionable objective	(1) Removing barriers (2) Enabling and facilitating perceivability, operability, understandability, and robustness (3) Providing effective, efficient and satisfying experience
Desired outcome	(1) Equality of access and participation in the digital space (2) Support for diversity and inclusion (3) Independent living and full participation of all

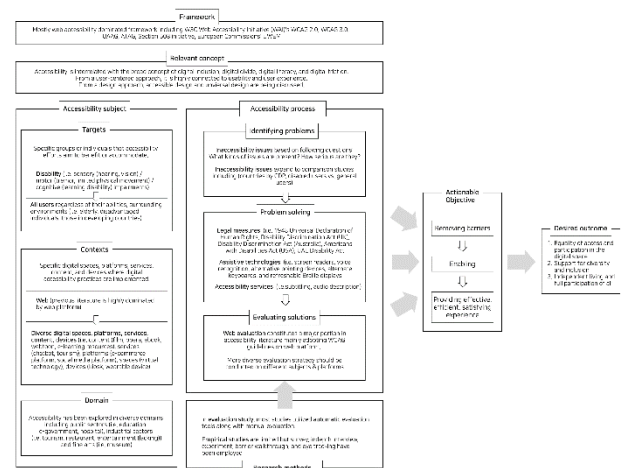
The final coding framework consists of 13 coding dimensions. This framework was used to code 70 quotations from 80 scholarly articles relevant to digital accessibility. Based on the collected definitions and coding procedure, this study presents the following definition of digital accessibility.

Digital accessibility is a process of removing barriers, enabling basic access/usage, and ensuring quality experiences across diverse digital software and hardware including content, platform, and network regardless of users' abilities, age, cultural backgrounds, or available technology, to achieve equality of access and participation while promoting diversity and inclusion.

To sum up, RQ 1 provides the overall

research trend of digital accessibility using bibliometric analysis with Bibliometrix and VOS viewer. It provides the quantitative research trend from 1996 to 2024, showing a growing focus on digital accessibility with increased funding, publications, and citations. Thematic analysis using collected author keywords further provides insight into how digital accessibility literature is shifting. Additionally, in RQ 2, the qualitative analysis of collected definitions offers a standardized understanding of digital accessibility, deepening insights from the general trend. Figure 10 summarizes the digital accessibility literature from the quantitative and qualitative results.

Figure 10
An overview of digital accessibility research in previous literature



5. Discussion

With a bibliometric analysis and SLR of collected articles on digital accessibility, this study initially attempts to explore the current research trend. Identifying how academic efforts on digital accessibility are established in terms of country, affiliation, authors, and keywords gives insight into the geographical and institutional distribution of research, key contributors and emerging themes and focal points that are shaping the discourse around digital accessibility. This provides a clear overview map as well as future agenda, providing a concrete guideline and direction for future research. Then, by manually collecting the

conceptual definitions of web accessibility, digital accessibility, and media accessibility, this study aims to provide definition fits to current digital context.

5.1 Implications

For academic implication, this study contributes to the literature by providing an overview of digital accessibility from 1996 to 2024. By identifying research trends and establishing a conceptual foundation through a review of 416 scholarly articles, the study provides what was already done and what should be done in accessibility domain. Plus, by employing a mixed-method approach using both qualitative and quantitative analyses, it ensures a well-rounded discussion, covering the topic from surface-level exploration to in-depth analysis. Based on the identified research trend, this study offers six possible future agendas. This includes *expansion to new media, niche targets, beyond evaluation, novel methodological approach, conceptual distinction, and active interdisciplinary collaboration*. Scholars are encouraged to broaden their scope to include new media such as mobile, virtual reality, and kiosk platforms, rather than focusing solely on web accessibility. Considering other potential marginalized groups in the digital accessibility domain is crucial for addressing current research gaps. Therefore, this study incorporates the concept of dynamic accessibility and further expands the discussion within the academic community. Also, the overview map (Figure 10) provides a practical guide for future researchers in specifying target audiences, context and domain, accessibility processes, objectives, and methodologies. This can serve as an initial action plan for initiating the next stage of digital accessibility research. Most importantly, this study views accessibility not as an isolated concept but in conjunction with the digital divide, digital inclusion, and disability models to address contextual changes effectively. It identifies three main trends in digital accessibility literature: conceptual diversification, target expansion, and progression from basic access to satisfactory usage.

These trends, along with other technological social movements, show how discussions on the digital divide and inclusion have evolved from the late 20th century to the early 21st century, offering important academic direction toward accessible and inclusive society.

This study has practical implications for users, legal practitioners, disability-related centers, and accessibility managers. For users, this study identifies research gaps, such as the lack of focus on individuals with cognitive disabilities and socially disadvantaged groups, expanding the potential targets of digital accessibility. It highlights marginalized subjects in academia and encourages future research on those groups, increasing the possible scope of beneficiaries. For legal practitioners, this study reveals marginalized subjects within academia, which can inform legal strategies and advocacy for these niche groups. Also, by offering a broad conceptual definition of digital accessibility, it can expand current web accessibility-related measures/acts to a broader scope. This comprehensive definition comprises target, context, objective, and outcome, allowing for its application across various contexts. For instance, practitioners focusing on kiosk accessibility for the elderly can adapt this definition to their needs, outlining the scope and aims of accessibility initiatives clearly. For disability-related centers and organizations, this review emphasizes the importance of active collaboration with academia. Despite its close ties to programming, design, and user study, current literature reveals limited practical solutions and interdisciplinary research. Disability-related centers often possess urgent needs and experiences, while academic institutions have resources to organize and solve problems. By leveraging each other's strengths, such collaboration can facilitate achieving actionable objectives and desired outcomes, highlighting the need for active partnerships with local academic and disability institutions. Lastly, for accessibility managers in industry sectors, this review helps locate necessary information for their specific services. It outlines

which subjects, processes, and objectives are relevant in their services to achieve digital accessibility, effectively addressing Environmental, social, and governance (ESG) within the corporate. As a practical guideline and broad direction for an inclusive society, accessibility managers can develop long-term plans while considering the current flow of digital divide, digital inclusion, and disability models.

For a follow-up study, it is recommended to explore the gap between academia and industry by further exploring the current accessibility discussion and feature from industrial report. Given the current isolation in accessibility literature from other relevant studies, this paper aims to act as a bridge, connecting diverse discussions within the domain of digital accessibility.

5.2 Limitations

This study is not without limitation. First, as the search query is limited to three key terms including web accessibility, digital accessibility, and media accessibility, this study may exclude specific content accessibility including game accessibility or e-book accessibility if the article does not include three terms within the title and keywords. During the bibliometric analysis conducted using Bibliometrix, it was found that 12.26% of the keyword data was missing, primarily due to authors not reporting keywords. As the thematic trends were mainly derived from the collected keywords, this missing data poses a limitation. Thirdly, this study did not conduct an inter-coder reliability test, as both data collection and analysis were carried out by a single author. However, to enhance the reliability of content analysis on the collected data, the study will recruit the intercoder to re-analyze the data. Lastly, the current study qualitatively analyzed 80 out of 416 collected articles. While this number is sufficient for a qualitative SLR, additional articles will be qualitatively examined during the re-analysis process to ensure a rich and exhaustive discussion on digital accessibility.

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Appendix A Top 10 landmark references (with high citations).

Rank	Author	Year	Title	Total Citations	TC per Year	Normalized TC
1	Lazar	2004	Improving web accessibility: a study of webmaster perceptions	220	10.48	3.4
2	Harper et al	2009	Toward a definition of visual complexity as an implicit measure of cognitive load.	85	5.31	4.55
3	Ahmi & Mohamad	2019	Bibliometric Analysis of Global Scientific Literature on Web Accessibility	78	13	6.27
4	Aizpurua et al	2016	Exploring the relationship between web accessibility and user experience☆	78	8.67	4.03
5	Schmetzke	2001	Web accessibility at university libraries and library schools	77	3.21	1.91
6	Kamoun & Almourad	2014	Accessibility as an integral factor in e-government web site evaluation: The case of Dubai e-government	66	6	4.04
7	Brophy & Craven	2007	Web Accessibility	65	3.61	2.3
8	Goodwin et al	2011	Global Web Accessibility Analysis of National Government Portals and Ministry Web Sites	60	4.29	2.92
9	Yesilada et al	2011	Exploring perceptions of web accessibility: a survey approach	59	5.9	4.01
10	Brajnik et al	2011	The Expertise Effect on Web Accessibility Evaluation Methods	56	4	2.73

Notes: As this data analysis is based on the combined data of SCOPUS and Web of Science bibliometric data, the number of citations may be varied depending on database.