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Accessibility in e-government portals: a systematic mapping study

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ABSTRACT

In recent years, several researchers have investigated the challenges of accessibility in e-government portals and have contributed to many proposals for improvements. However, no comprehensive review has been conducted on this topic. This study aimed to survey and synthesize the published work on the accessibility of e-government portals for people with disabilities. We carried out a review using a systematic mapping study (SMS) to compile previous findings and provide comprehensive state-of-the-art. The SMS collected studies published between January 2000 and March 2025 were identified using an automated search in five known databases. In total, 112 primary studies were selected. The results showed a notable increase in interest and research activities related to accessibility in e-government portals. Journals are the most widely used publication channel; studies have mainly focused on evaluation research and show a commitment to inclusivity. "AChecker" and "Wave validator" are the most used accessibility evaluation tools. The findings also identified various accessibility guidelines, with the most frequently referenced being the web content accessibility guidelines (WCAG). Based on this study, several key implications emerge for researchers, and addressing them would be beneficial for researchers to advance e-government website accessibility in a meaningful way.

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1. INTRODUCTION

The growth and wide use of the Internet have made the web an important channel of information and services provided to citizens using e-government portals or websites. Thus, regardless of citizens' disabilities, it is essential that equal access be guaranteed by these portals for all [1]. E-government is defined by the United Nations (UN) as "the use of information and communication technologies (ICTs) to deliver government services more effectively and efficiently to citizens and businesses. It is the application of ICT in government operations, achieving public ends by digital means" [2]. The aim is to enhance communication and interactions between governments and their citizens by providing online services that are usable, readable, and equally accessible on various devices at any time and location [3]. E-government portals have become even more essential during the COVID-19 pandemic as many nations have been forced to move their operations and services online to limit the spread of the pandemic. Notably, the World Health Organization (WHO) published a recent study in 2023 affirming that accessibility barriers disproportionately affect the estimated 16% of the global population, over 1,3 billion people, who live with

some form of disability [4]. Citizens with disabilities or with impairments or special needs or other accessibility requirements may encounter additional obstacles in obtaining essential information and services online, thus emphasizing the need for accessible e-government services [5] designed to accommodate all citizens, regardless of their abilities or disabilities.

The UN defines Accessibility as "a fundamental principle ensuring equal access and inclusion for all individuals. Removing barriers to facilities, services, and information is essential for the full and effective participation of persons with disabilities in society" [6]. The idea of accessible design guarantees "direct access (*i.e.*, unassisted) as well as indirect access compatibility with a person's assistive technology, such as computer screen readers" [3]. Furthermore, according to the web content accessibility guidelines (WCAG), "Web accessibility means that websites, tools, and technologies are designed and developed so that people with disabilities can use them. More specifically, people can perceive, understand, navigate, and interact with the Web and contribute to it." [5]. Therefore, accessibility is crucial in enabling individuals with disabilities, such as those with "visual, hearing, cognitive, and physical impairments" [5] to access, comprehend, navigate, and interact with digital content in the same way as people without disabilities. Moreover, the UN stated that aging populations, projected to reach nearly 2.1 billion by 2050, face rising disability rates (over 46% of those aged 60 and older), driven by accumulated health risks, necessitating integrated policies to address aging and disability synergistically [7]. Hence, accessibility has become an important aspect that governments should not neglect when designing electronic portals to facilitate access to provided services. In this context, "Although WCAG 2.0 has been proposed to ensure that all online resources/services are accessible to persons with disabilities, several researchers have noted that most remain inaccessible" [8].

While many related initiatives are being taken across the world in many countries, literature reviews related to e-government accessibility for people with disabilities in particular are currently scarce. Although some accessibility reviews have been published, only one study [8] has focused on the accessibility of e-government services for people with disabilities, published in 2021, identified a set of 42 studies collected between 2010 and 2020. The result analysis provided some insights concerning accessibility factors, design, assistive technologies usability, and the evaluation of e-government portals. The authors performed this literature analysis using a traditional methodology approach, without using a rigorous approach such as that proposed by Kitchenham's guidelines for conducting systematic reviews, using the example of a systematic mapping study (SMS) [9]. Furthermore, given the relevance of e-government, Human-Computer Interaction becomes important since it focuses on the design and evaluation of interactive computing systems for human use, taking into account user experience, usability, cognitive and physical limitations, and accessibility concerns [10]. Therefore, this paper examines the researchers' efforts to enhance accessibility for people with disabilities in e-government portals through SMS, aiming to summarize and synthesize existing research, as well as provide suggestions for future researchers. This study analyzes and discusses five mapping questions (MQs) related to publication years, sources and channels, contribution types, disability types, and accessibility tools and guidelines used over the years in the selected studies. To this end, a set of 112 primary studies was selected from January 2000 to March 2025 based on five digital databases to provide answers to the MQs. The output of this study offers valuable insights to researchers exploring this interdisciplinary topic, especially within the fields of web accessibility and HCI, as well as to government entities aiming to develop or enhance the accessibility of their portals, ultimately facilitating more equitable access to online public services for individuals with disabilities.

This paper is structured as follows. Section 2 presents a summary of related work. Section 3 presents the research method adopted to carry out the mapping study, and section 4 presents the results and discussion, as well as provides implications for researchers and threats to the validity of this study. Finally, section 5 presents the conclusion of this work.

2. RELATED WORK

Various studies have been published on accessibility in e-government portals in different countries, such as for Jordan [11], for Latin America [12], and for Ecuador [13]. Furthermore, some review studies have also been published, where the summarized context is presented in Table 1 in terms of purpose, type of review systematic literature review (SLR), Preferred reporting items for systematic reviews and meta-analyses (PRISMA), and systematic review (SR), period of collection, number of studies, and year of publication.

From Table 1, it can be observed that related work comprises a variety of review studies that investigated different aspects of web accessibility using various research methods, including traditional reviews, Kitchenham guidelines for SLR, PRISMA for SR, or inspired by SLR (by using some steps). The selected reviews looked into digital accessibility, accessibility assessment methods, web accessibility metrics, accessibility for people with disabilities, telerehabilitation platforms, etc. In addition, some studies have focused on accessibility to university websites, e-government services, or web applications for a specific

country or region, or broadly. Furthermore, the studies addressed a wide range of research questions or aspects concerning methods, techniques, domains, disability types, trends, metrics, guidelines, laws, standards, evaluations, assistive technologies, cognitive impairment, countries, tools, and so on. However, to date, no SMS has been carried out with a focus on this topic. Hence, an SMS was conducted in this study to collect, summarize, and synthesize published work on the accessibility of persons with disabilities in e-government portals.

Table 1. Summarized context of related work on accessibility in e-government portals

Study ID	Purpose	Type of review	Period	# Studies	Year of Publication
[14]	Study e-government services evaluation	Inspired SLR	2006-2016	90	2017
[15]	Explore accessibility in Saudi websites	Inspired SLR	2009-2017	15	2017
[16]	Investigate accessibility methods	SLR	2015-2018	20	2019
[17]	Telerehabilitation platforms	PRISMA SR	1990-2019	37	2019
[18]	Digital accessibility topics	Inspired SLR	2000-2021	204	2021
[19]	E-gov web app evaluation methods	SLR	2015-2019	36	2021
[8]	Disabled persons' accessibility	Literature analysis	2010-2020	42	2021
[1]	University websites accessibility	SLR	2002-2021	42	2021
[20]	Web accessibility metrics	SLR	2008-2022	30	2022
[21]	Cognitive impairment accessibility	PRISMA SR	2006-2021	45	2022

3. RESEARCH METHOD

For this SMS, we adopted a rigorous and transparent method proposed in [22] and [23]. Figure 1 summarizes the steps followed, which are: The specification of the research questions, the definition of the search strategy, the selection of studies, the extraction of data, and the analysis of results.

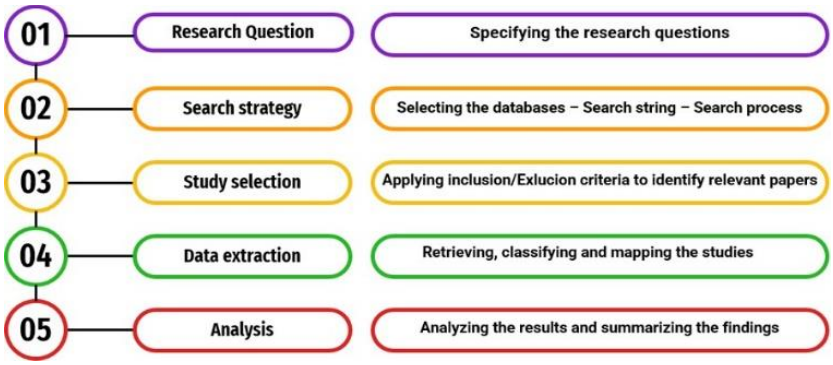

Figure 1. SMS selection process steps

3.1. Mapping questions

We established five mapping questions (MQs) to conduct this mapping study. Table 2 lists these MQs along with their respective motivations. The questions cover publication trends, research contributions, disability types, evaluation tools, and accessibility guidelines relevant to e-government portals.

Table 1. Mapping questions (MQs)

ID	Mapping Questions	Motivation
MQ1	Which publications, years, channels, and sources were the targets for selected studies?	To examine the years, the channels, as well as the target sources of publications of the selected studies.
MQ2	What types of research contributions were conducted in the selected studies?	To explore the types of research contributions made in the selected studies.
MQ3	Which types of disabilities were discussed in the selected studies?	To identify the various types of disabilities addressed in the selected studies.
MQ4	What tools were utilized to evaluate accessibility in the selected studies?	To determine the tools employed for assessing accessibility in e-government portals, and to understand how the usage of these tools has evolved over time across the selected studies.
MQ5	Which accessibility guidelines were referenced in the selected studies?	To investigate the accessibility guidelines applied to government portals for disabled citizens, and to examine how the adoption of these guidelines has changed over the years.

3.2. Search strategy

The search strategy consisted of three main steps: selection of the electronic database, establishment of the search string, and execution of the search process.

Step 1: Selection of the electronic databases. The IEEExplorer, ACM Digital Library, SpringerLink, and Science Direct databases were selected for this SMS. Google Scholar was also used for literature searches due to its ability to explore various digital databases. The motivation behind the selection of these databases was their wide range of credible peer-reviewed sources on topics related to computer science, information technology, and electronic government. These databases provide access to a large collection of academic journals, theses, and conferences using advanced search capabilities that allow the filtering of results based on a list of criteria, such as publication year, keywords, and authors. Furthermore, they are up-to-date, an important element in ensuring that our search is up-to-date and relevant.

Step 2: Establishment of the search string. Developing an effective search string involves several steps [15]: the first step involves defining key search terms that are aligned with the mapping questions. Subsequently, it is imperative to broaden the search scope by incorporating synonyms and alternative spellings for each primary term, thereby improving the relevance of outcomes. The Boolean operator "OR" is employed for each key term to concatenate all the identified synonyms and alternative terms and thus ensure the retrieval of studies containing any of the specified terms. The Boolean operator "AND" is used to connect all the main terms in the search string and, as a result, guarantees that the retrieved studies encompass all the defined key terms. Based on these steps, the resulting search string for the SMS is formulated as follows: *"(accessibility OR barrier* OR disab* OR impairment OR handicap* OR special need*) AND (e-Government OR electronic government OR e-gov OR e-service OR electronic service) AND (portal OR website OR site OR software OR technique OR application OR system) AND (requirement* OR guideline OR standard OR law OR rule)*".

Step 3: Conducting the search process. A two-round search process was performed from January 2000 to March 2025 to retrieve the candidate studies. For the automatic, a predefined search string is employed to conduct searches across the five chosen databases and retrieve potential studies. For the manual (known by reference checking): To identify more studies relevant to this topic, references of the studies were checked to ensure that the search encompassed all studies relevant to accessibility on e-government websites. Throughout the search, we observed that the search string was too long for some electronic databases. To address this limitation, we adapted the search string according to the electronic databases used. This involved splitting the entire search string, conducting the search, and manually combining the results. Two authors performed the search process, while the remaining authors checked the relevance of the retained candidate studies.

3.2.1. Study selection

The purpose of this step is to select candidate studies to be included in order to address the MQs. To achieve this, each of the selected candidate studies was evaluated using established inclusion and exclusion criteria. It should be noted that a study was accepted if all the inclusion criteria were met and rejected if only one exclusion criterion was applicable. The inclusion criteria (ICs) are as follows:

- (IC1): Studies specifically pertinent to the accessibility of e-government portals.
- (IC2): Studies on impairments or people with disabilities.

The exclusion criteria (ECs) are:

- (EC1): Studies on accessibility in contexts other than e-government portals.
- (EC2): Studies published before 2000.
- (EC3): Studies not available in full text.
- (EC4): Studies not in English.
- (EC5): Duplicate study.

In this case, one study is considered to be more complete. Two independent authors performed this process to obtain reliable results based on the study's titles, abstracts, and keywords. In case of any disagreement, a meeting was held where the two authors discussed the context of their choice (*i.e.*, included or excluded); if needed, the full paper text was analyzed and discussed until reaching an agreement.

3.2.2. Data extraction form

For every selected study, a dataset was compiled using a data extraction form designed to address predefined MQs.

a. ID of the study: Title of the study. The database from which the study was selected. The extractor's name.

b. MQ1: Publication years. Publications sources. Publications channels (*i.e.*, conferences, journals, chapters, books, workshops, and theses).
c. MQ2: Contribution research types can be classified as solution proposal, evaluation research, and comparison research, following the systematic mapping guidelines [23].
d. MQ3: Disability types can be classified into the following categories [24]:
   – "Visual, Physical, Cognitive and neurological, Auditory and speech."
   – Other: "Any other type of health condition that can be an obstacle for the users to use the portal, such as situational limitations or temporary disabilities, such as a broken arm or lost glasses."
   – People with disabilities (PWD): We added this category, which concerns studies that did not specify the disability type and addressed PWD in general.
e. MQ4: Accessibility tools used over the years for evaluation purposes or conformity to laws or standards can be classified as: Software (any software or web solution, such as the tools provided in [25]), or Technique (any technique or method used, such as Nielsen's Checklist [26]).
f. MQ5: Accessibility guidelines adopted in the selected studies and their usage over the years. Examples of these guidelines are legal requirements that mandate accessibility compliance and ensure equal access to digital content and services [27]. Specific requirements or regulations must be followed to achieve accessibility compliance [28]. Recommendations and best practices for designing and developing accessible content [29].

4. RESULTS ANALYSIS

This section presents the main results of the mapping study. It includes answers to the five mapping questions, along with an analysis of the findings. The results are also illustrated using figures and tables to show key trends and observations.

4.1. Mapping results

This section summarizes the study selection results and responds to each MQs. The study selection results are summarized in Figure 2. An initial set of 6,183 studies was retrieved after applying the search string to five databases. From this pool, 142 candidate studies related to the scope of this SMS emerged based on the titles, abstracts, and keywords. A total of 90 studies were included from the application of ICs and ECs, as reflected in the negative adjustments of a total of 52 studies discarded. Reference checking resulted in the addition of 22 relevant studies; all found in the Google Scholar database. The final selection resulted in 112 studies aligned with this study's scope.

Database	ACM	Springer	IEEExplorer	Science Direct	Google Scholar	Total
Retrieved Studies	2748	122	106	107	3100	6183
Candidate Studies	25	19	33	16	49	142
Excluded Studies	-13	-3	-16	-1	-19	-52
Included Studies	12	16	17	15	30	90
Reference Checking	00	00	00	00	+22	+22
Selected Studies	**12**	**16**	**17**	**15**	**52**	**112**

Figure 2. Study selection results

4.1.1. Publication years, channels, and sources

The analysis of the selected studies in this SMS reveals a dynamic trend over the years (MQ1). As can be observed in Table 3, in the early 2000s, interest in the accessibility of e-government websites started modestly. The first published study was in 2002, followed by two studies in 2003. Subsequently, there was a steady, small increase or decrease in the number of publications during the first decade. Since 2012, there has been a significant surge in publications, reflecting a substantial increase in attention to accessibility in e-government. The peaks were reached in 2013 with eight studies, and in 2016 and 2020 with 12 and 10 studies, respectively. For 2021, 2022, and 2023, there was a decline in the number of studies, with two, three, and four studies, respectively. Finally, in 2024 and 2025, only one study was selected each year. The decrease in the number of studies may be attributed to our data collection, which only spans until March

2025, and thus does not encompass the entirety of the year. In addition, it is worth noting that the publication process or some studies often extends beyond the data collection period, contributing to the observed lag in their availability.

The sources of the selected studies fell into two main channels: Journals and Conferences. Journals are the predominant accounting for 65 studies, which indicates a significant emphasis on publishing research in peer-reviewed academic journals. Conferences comprised 47 studies, offering researchers an opportunity to present their findings and participate in the discussions.

Table 3. Selected studies per publication year (MQ1)

Publication year	ID Studies	Publication year	ID Studies
2002	[30], [31]	2014	[32]
2003	[33]–[38]	2015	[39]–[42]
2004	[43]–[46]	2016	[47]–[51]
2005	[52]–[58]	2017	[59]–[64]
2006	[65]–[67]	2018	[11], [68]–[72]
2007	[73]–[77]	2019	[15], [78]–[82]
2008	----------	2020	[83]–[87]
2009	[5], [88]–[90]	2021	[12], [91], [92]
2010	[27], [93]–[95]	2022	[96]–[101]
2011	[28], [102]–[106]	2023	[10], [107]–[111]
2012	[112]–[120]	2024	[13], [29], [121], [122]
2013	[30], [31]	2025	[123], [124]

Table 4 summarizes the publication sources with their corresponding rankings and number of studies. These rankings help provide an assessment of the significance and quality of conferences and journals in computing disciplines. Journal ranking was provided by the Scimago Journal Ranking (SJR), which classifies journals using four quartiles (Q1 to Q4). Conference rankings are provided by Computing Research and Education (CORE), in which conferences are classified into different categories (A, B, C). As can be observed, "Universal Access in the Information Society" emerged as the most frequently used journal, holding a Q2 ranking and contributing 12% of the 112 selected studies. "Government Information Quarterly" follows closely as a Q1 ranking and 10% of all the selected studies, highlighting its prominence in the field. Among the conferences, the "International Conference on Theory and Practice of Electronic Governance" (ICEGOV) stands out at the top of the conference with an "A" ranking, followed by the "International Conference on eDemocracy & eGovernment" with a "B" ranking, representing respectively 5% and 2% of the selected studies. The utilization of these decent publication sources underscores confidence in the relevance of the selected studies to this SMS scope.

Table 4. Examples of used publication sources (MQ1)

Publication source	Ranking	Studies	# of Studies
Universal Access in the Information Society: International Journal	Q2	[1], [3], [5], [62], [68], [78], [85], [86], [96], [121], [88], [105], [123], [125]	14
Government Information Quarterly: International journal	Q1	[27], [30], [31], [33], [39], [63], [113]	11
International Conference on Theory and Practice of Electronic Governance	A	[53], [93], [102], [103]	6
International Conference on eDemocracy & eGovernment	B	[50], [79], [92], [65], [100]	3
Journal of Government Information	Q3	[12], [13], [80]	2
Brazilian Symposium on Information Systems	B	[32], [34]	2

4.1.2. Contribution research types (MQ2)

Figure 3 presents the identified contribution research types of the selected studies (MQ2): comparison research, evaluation research, and solution proposal (see Section 4.4 for their descriptions). It should be noted that study [89] presented both an evaluation and a solution proposal. Furthermore, evaluation research emerged as the most prevalent type of contribution, occurring 95 times. This high frequency underscores the need to evaluate the accessibility of e-government portals and websites. Solution proposals accounted for 12 studies, in which the authors investigated new aspects related to accessibility. Comparison research was the least frequently encountered contribution type, appearing in only six studies.

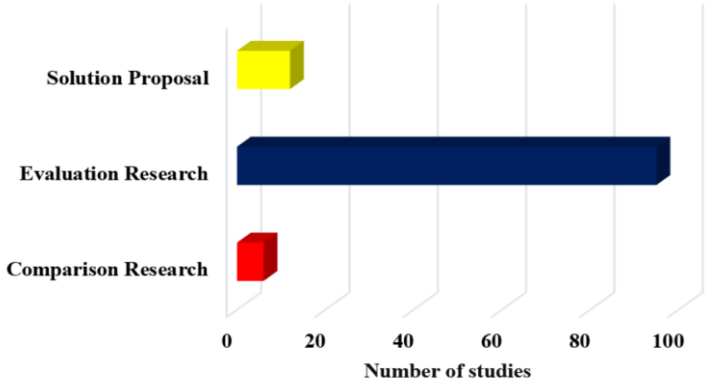

Figure 3. Contribution research types of the selected studies (MQ2)

4.1.3. Disability types (MQ3)

Figure 4 presents a summary of the main disability types addressed in the selected studies (MQ3) along with the corresponding occurrences. It is noteworthy that a single study may address multiple types of disabilities, and the occurrences reflect the number of times each disability is addressed across all the studies. In general, 37% of the studies focused on disability and lacked a specific focus on particular types of disability. One study [36] emphasized the importance of developers addressing a diverse range of disabilities individually. It highlighted that users with different disabilities (such as cognitive, visual, hearing loss, and motor disabilities) have distinct needs and manners when interacting with web content. Visual disability constitutes a substantial focus, with 19% of the studies focusing on this area. This emphasis is justified given the heightened challenges faced by blind and visually impaired (BVI) users in web-based interactions compared with sighted individuals. Cognitive disability was the most diverse, but only 12% of the selected studies. This disability encompasses a broad spectrum of individuals, varying significantly due to the inclusion of individuals with general processing difficulties such as mental retardation and brain injury [36]. Although there has been considerable effort in recent years to understand how people with perceptual and motor impairments use computers, research on users with cognitive impairments is relatively new and limited [36]. Auditory and Speech disabilities, with 12% of the selected studies, demonstrate a commitment to ensuring that information and communication are accessible to individuals who are deaf or hard of hearing, as well as to those with speech impairments. This finding highlights the importance of inclusive communication methods. Physical disability, in 13% of the selected studies, indicates a commitment to making physical environments, products, and technologies accessible to individuals with mobility limitations. Finally, 7% of the selected studies encompassed disabilities that may not fit into the previously mentioned categories, such as broken arms, as stated in a previous study [117].

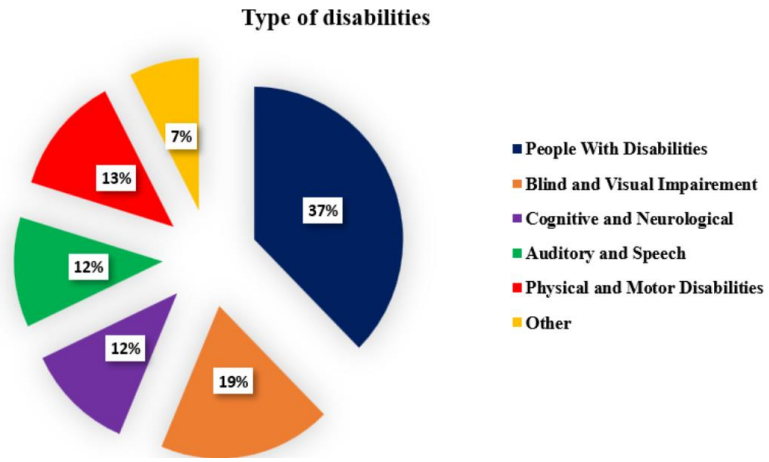

Figure 4. Type of disabilities discussed in the selected studies (MQ3)

4.1.4. Accessibility evaluation tools (MQ4)

A set of 43 tools was employed in the 112 selected studies to assess accessibility in e-government portals (MQ4), marking the first-ever utilization of accessibility tools in literature dating back to 2002. Each tool exhibited varying frequency of use. It is important to recognize that a tool may be utilized across multiple studies; thus, it is counted for each use, and a single study may employ multiple tools simultaneously. The most frequently used evaluation tools (i.e., those used more than five times), among them, "AChecker" and "Wave Validator" stand out with the highest usage count of 25 each. "Bobby" follows with 17 uses. "TAW" tool with 15 uses. These evaluation tools are prominent choices for accessibility evaluation on e-government websites [80], indicating their established reputation and effectiveness in this domain. Figure 5 provides more insights into the most-used accessibility evaluation tools over the years. For instance, the "AChecker" tool usage started in 2011 and increased steadily with a significant peak in 2014, 2017, and 2019 (with 3, 4, and 5 uses respectively). The "Wave Validator" usage started in 2005 and had occasional increases over the years, peaking in 2016 and 2020 with 3 and 4 uses, respectively. To summarize, the "AChecker" and "Wave Validator" tools have been a consistent choice over the years, while other tools, such as "Bobby" and "TAW" have seen a decline in usage. Variations in tool usage underscore the dynamic nature of the field, which is influenced by the evolving features, standards, and user preferences. Users can choose tools based on specific functionalities or changing requirements over time.

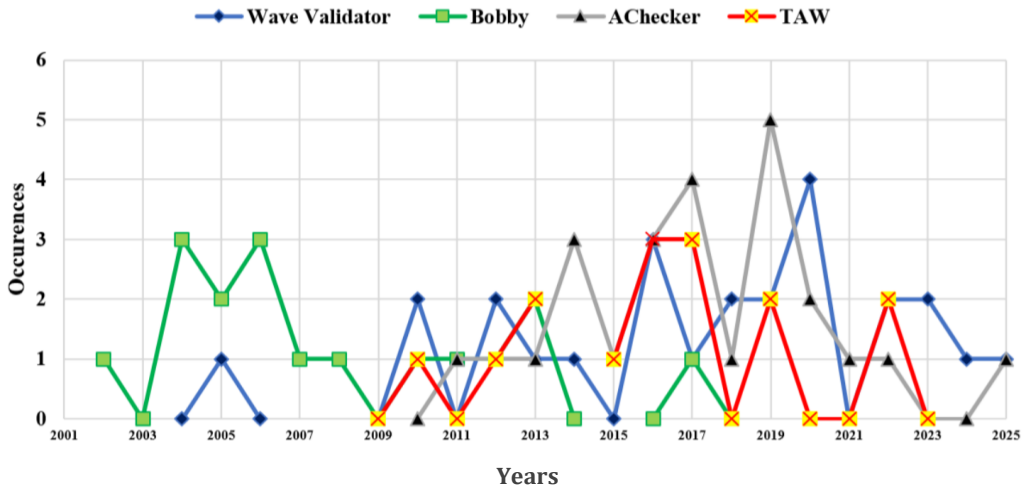

Figure 5. Occurrence of most used evaluation tools in the selected studies over time (MQ4)

4.1.5. Accessibility guidelines (MQ5)

Figure 6 provides a chronological overview of the accessibility guidelines adopted in the 92 selected studies that mentioned the guidelines used (MQ5). A total of six different guidelines were identified across the selected studies. WCAG and its versions, developed by the World Wide Web Consortium (W3C) to ensure accessible web content for individuals with disabilities, was the most frequently referenced guideline, appearing 101 times across 84 studies. The Section 508 standard, a U.S. federal law requiring federal agencies to ensure that their electronic and information technology is accessible to individuals with disabilities [123], was cited 11 times in 11 studies. Brazil's Electronic Government Accessibility Model (E-MAG), introduced in 2004 and based on WCAG principles [81], was used in six studies. The Guidelines for Indian Government Websites (GIGW), which combine the WCAG 2.0 and ISO 23026 standards to define lifecycle requirements for websites [3], were adopted three times in two studies. South Korea's Korean Web Content Accessibility Guidelines (KWCAG), designed to promote universal access to information, appeared in two studies [67], while Japan's Japanese Industrial Standard (JIS X 8341) is a set of standards for web accessibility in Japan [126]. This guideline was adopted in only one study.

The trends illustrated in Figure 6 reveal that WCAG has experienced an intermittent but generally growing adoption over time, with notable peaks in 2013 (nine instances), 2016 (11 instances), and 2020 (nine instances). In contrast, KWCAG, GIGW, E-MAG, and Section 508 saw sporadic use, and JIS X 8341 appeared only once, in 2006. These findings indicate a dynamic and evolving pattern in the adoption of accessibility standards.

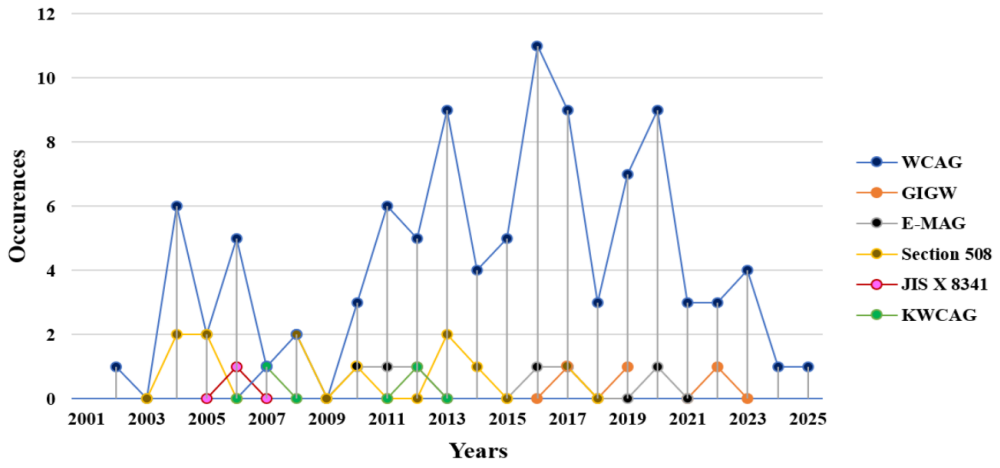

Figure 6. Usage of guidelines in the selected studies over time (MQ5)

5. RESULTS DISCUSSION

Publication years, channels, and sources (MQ1): The trend in the accessibility of e-government portals does not strictly follow an increasing trajectory in Table 3. However, this remains a compelling and noteworthy issue. Although the number of publications has steadily increased over the years, a particularly significant surge has been observed recently. Furthermore, recent years (2023–2025) show four studies in 2023, one in 2024, and one in 2025 (as of March 2025), totaling six studies over this period. This lower-than-expected output may reflect delays in publication indexing and incomplete data for 2025 (still ongoing). Furthermore, the reviewed studies were published through two major channels: Journals and Conferences. Journals, with a majority of 65 studies at conferences, contributed 47 studies to the scholarly discourse. Furthermore, the findings highlight the significance and quality of publication sources used in the selected studies in Table 4, with rankings provided by SJR and CORE, such as the "Universal Access in the Information Society" and the "Government Information Quarterly." In terms of conferences, the "International Conference on Theory and Practice of Electronic Governance" stands out as the top conference, the "International Conference on eDemocracy eGovernment" and the "Brazilian Symposium on Information Systems." These findings underscore the relevance and credibility of the selected studies within the scope of this SMS.

5.1. Contribution research types (MQ2)

The analysis indicated that a significant portion of the studies primarily concentrated on evaluation research, with comparatively fewer studies focusing on solution proposals and comparison research in Figure 3. A similar trend was observed in prior literature, where evaluation dominated over innovation [1]. While evaluation is essential for benchmarking, the scarcity of solution-oriented studies may hinder practical advancements. Nonetheless, it is important to recognize that each of these contribution types holds significance in furthering our understanding of accessibility in e-government. They collectively contribute to ongoing efforts to identify strategies to enhance website accessibility and ensure digital inclusion for all users. Given the relatively low frequency of solution proposals, it is recommended that researchers and governments prioritize collaborative efforts to develop and test innovative solutions, such as artificial intelligence (AI) driven accessibility checkers or adaptive interfaces tailored to diverse user needs.

5.2. Disability types (MQ3)

The findings summarize the diversity of disability types addressed in the selected studies see in Figure 4. A striking finding was that 37% of studies did not specify disability types, opting instead for a generalized approach to accessibility. While this reflects a broad commitment to inclusivity, it risks overlooking the nuanced requirements of specific user groups. For example, visual impairments (19% of studies) received considerable attention, likely due to the direct impact of screen readers and alt-text compliance. In contrast, cognitive disabilities (12%) were underrepresented, despite their complexity and diversity (*e.g.*, dyslexia). This mirrors findings from [16], where 80% of studies similarly lacked specificity, potentially leading to homogenized solutions that inadequately address the spectrum of disability needs. Therefore, researchers are invited to recognize the diverse nature of disabilities by highlighting the importance of addressing the needs of specific groups individually. Future research should adopt a segmented approach, prioritize underrepresented disabilities and involving end-users in co-design processes to ensure solutions address real-world challenges.

5.3. Accessibility evaluation tools (MQ4)

E-government accessibility studies rely heavily on established tools, with "AChecker" and "Wave Validator" (used in 25 studies each) being the most frequent choices, followed by Bobby, see Figure 5. These tools prioritize automated checks against WCAG standards but require human judgment to interpret nuanced results. This aligns with the findings of study [1], which identified the same tools as dominant in university website evaluations, and study [19], which noted their prevalence in e-government assessments. While tools like "TAW" remain relevant, others, such as "Bobby" and "Cynthia Says" have declined in use over time, reflecting shifts in tool capabilities and guideline updates (e.g., WCAG 2.2). Despite the growing variety of tools (43 identified in this study), researchers and practitioners favor a narrow set of trusted options, as seen in [16] and [20]. Less common tools like "DaSilva" or "EvalAccess" are rarely adopted, even for specific needs. To address this limitation, future evaluations should combine established tools (for reliability) with specialized alternatives (*e.g.*, "W3C Validator" for markup compliance) to ensure comprehensive assessments. Additionally, developing an integrated tool that merges automated efficiency with adaptive features for diverse disabilities (*e.g.*, cognitive impairments) could bridge gaps identified in studies like [21]. Such innovation would reduce reliance on fragmented methods and improve alignment with real-world user needs.

5.4. Accessibility guidelines (MQ5)

The analysis of e-government portals across studies reveals a detailed picture of accessibility guidelines. Among these, WCAG usage was predominant, with 101 occurrences, indicating its foundational role. Section 508, mentioned 11 times, emphasizes accessibility mandates for US federal agencies. These findings are further substantiated by results from prior systematic reviews [1], [19] where the most frequently employed standards were also WCAG and Section 508. This alignment across both e-government and academic web domains points out the global recognition and institutional reliance on WCAG as the principal framework for accessibility compliance. E-MAG, referenced six times, aligns closely with WCAG principles, reflecting Brazil's standards. Lesser uses were found for GIGW, KWCAG, and JIS X 8341. Furthermore, by examining the evolving landscape in Figure 6, a trend towards WCAG is clear, alongside the integration of country-specific guidelines from India, Korea, and Japan. This reflects a nuanced approach that considers both the global and regional standards. This study highlights the dynamic commitment to web accessibility by adapting to evolving regulations and standards in the e-government domain. These findings underscore the dominance of WCAG and highlight the global importance of standards such as Section 508 and E-MAG. Recommendations include continued emphasis on WCAG compliance, greater exploration of emerging standards, and the necessity for countries to develop their own accessibility standards or laws tailored to their specificities, ensuring more effective enhancement of accessibility.

6. THREATS TO VALIDITY

This systematic mapping study was designed to comprehensively examine accessibility in e-government portals. Nonetheless, several validity threats were identified and addressed, inspired by studies [21], [47], [127]. Construct validity concerns the alignment between research questions, methods, and objectives; possible ambiguity in accessibility terminology was mitigated by designing broad search strings and applying precise inclusion and exclusion criteria, followed by reference checking to ensure that all relevant studies were captured, thereby maintaining consistency and coverage across databases. Internal validity, which relates to the reliability of data extraction and analysis, was strengthened through a rigorous process based on Kitchenham's guidelines, where two authors independently extracted data, compared results, and resolved disagreements by consensus; transparent documentation and multiple review round further enhanced the accuracy and objectivity of findings. Regarding external validity, which involves the generalizability of results, the findings were derived from peer-reviewed studies on e-government accessibility, with data extracted as published to preserve impartiality; although regional and temporal coverage may limit generalization, the use of several databases reduced this effect. Finally, conclusion validity, addressing the soundness of interpretations drawn from the data, was supported by limiting the corpus to published studies to strengthen reliability, while standardized extraction forms and cross-verification among authors reinforced confidence in the conclusions.

7. CONCLUSION

This paper presents the results of a mapping study conducted to analyze existing research efforts on accessibility in e-government portals for disabled people. The purpose was to investigate the accessibility aspects adopted in e-government portals to identify the achievements of researchers in this context, identify

gaps, and provide future directions for improvement purposes. To this end, an SMS was conducted to examine the findings of 116 primary studies on accessibility in e-government portals, systematically selected from the period January 2000 to March 2025, across five digital databases. The extracted data are displayed in tables and graphs to enable a detailed analysis of the results with respect to the five established MQs. The analysis encompasses various aspects, including the number of publications over the years, sources and channels, types of contributions, types of disabilities, evaluation tools used for accessibility assessments, and accessibility guidelines employed in the selected studies.

The key findings of this mapping study indicate that the accessibility trend on e-government websites shows fluctuations, with a recent surge in publications. The studies have been published in journals (65) and conferences (47). Studies mainly focus on evaluation research, with fewer on solutions and comparisons. Studies show commitment to inclusivity, but 37% lack a specific focus on particular disabilities. Visual impairments received significant attention (19%), while cognitive disabilities (12%) required more comprehensive research and tailored solutions. Accessibility evaluations in e-government portals used 43 tools, with "AChecker" and "Wave Validator" being the most frequently employed. The findings highlight various accessibility guidelines, with WCAG being the most often referenced.

The findings from this systematic mapping study provide a critical foundation for guiding future research on the accessibility of e-government portals. While the current body of literature is rich in evaluation-focused studies, significant gaps remain, particularly in the development of innovative and user-centered solutions tailored to diverse disabilities. These gaps underscore the need for a shift in research priorities toward more practical, inclusive, and technology-driven approaches. Building on these implications, future work should explore the integration of AI and other emerging technologies to foster innovation in accessibility. AI can enable the automatic identification and remediation of accessibility issues, adapt interfaces based on users' needs, and support intelligent content personalization for users with diverse abilities. Additionally, research should explore co-design approaches that engage people with disabilities throughout the development lifecycle, ensuring solutions are not only technically compliant but also genuinely inclusive. This direction promises to address existing research gaps, bridge the divide between evaluation and implementation, and make a meaningful contribution to the realization of accessible and equitable e-government services.

The implications for researchers seeking to advance this field include encouraging solution-driven research to address the current lack of innovative accessibility interventions, expanding focus to underrepresented disabilities such as cognitive, speech, and neurological impairments, and complementing automated testing with human-centered evaluations, including expert reviews and user testing with people with disabilities. Additionally, it is important to investigate emerging and localized accessibility standards in addition to WCAG to align with diverse contexts and evolving technologies.

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