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Integrating Accessibility into UI/UX Design: A Review of Evaluation Methods and Challenges

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Abstract – Digital accessibility has become non-negotiable for websites and applications used across the world from healthcare to education and public services. Despite having the right tools and standards in place, accessibility is often checked at a later stage leading to developer frustration, fragmented fixes, and a dissatisfied user experience for users with disabilities. Existing practices fail to bridge the gap between evaluated issues and implementation of those insights. To advance the current state of methodologies, this review evaluates recent publications, compares existing methodologies, and addresses the critical challenges and future opportunities facing the industry. A basic understanding of digital accessibility is provided, with a focus on the growing importance of developing inclusive digital platforms. It discusses why accessibility checkpoints should be considered during the transition between the design and development phases rather than being treated as a final checklist item. The selected studies collectively explore different accessibility evaluation methods, including automated tools, expert reviews and manual checks, but they are not integrating the findings into early stages of design and a part of development workflow. Through this, the review aims to present how these methods contribute to identifying accessibility barriers and supporting more inclusive user interaction and user experience design practices.

Keywords: UI/UX Design; Digital Accessibility; Accessibility Evaluation; User-Centered Design; Inclusive Design; WCAG Compliance

Introduction

Digital accessibility has become an important part of creating websites and applications that can be accessed by everyone, including people with disabilities. There are 1.3 billion people across the world who are living with some kind of disability according to The World Health Organization which represents nearly 16% of the global population. This highlights that accessibility principles should be considered as a daily practice in digital user experience and interaction (1-3). With rapid growth in internet usage across education, healthcare, and public services, ensuring that digital platforms remain accessible to diverse user groups has become increasingly important (3). While accessibility guidelines and tools are readily available, they are often applied late in the design process, making fixes harder and less effective. The vast majority of the web remains inaccessible to users with disabilities; notably, a large-scale analysis of 28 million pages by Lopes et al. revealed that a mere 3.89% complied with accessibility standards (4).

Study findings demonstrate the continuous gap between accessibility standards and their actual implementation across websites and applications. In multiple cases, accessibility checks focus only on identifying problems, without clearly explaining how designers and developers can address them in practice. The issue is particularly concerning, as studies observed that nearly 71% of users with disabilities leave a website immediately if they encounter accessibility barriers (1,4,6). This friction between standard checklists and actual development limits the meaningful inclusion of disabled users. In addition, many websites are still developed without fully considering diverse user needs, which often results in interfaces that create barriers for users with cognitive, visual, or motor impairments(5).Integrating accessibility early into digital interaction and experience design can decrease these issues and lead to more equitable digital experiences. Researchers have also emphasized that accessibility standards should be incorporated from the earliest stages of design and development so that inclusive design principles are embedded into the product rather than added as corrections later(7-8).By detecting issues earlier in the product lifecycle, automated evaluation tools can help designers and developers to create more inclusive experiences(9-10).This review brings together key research in this area by discussing research articles in the field to highlight current practices, challenges, and

opportunities for improving accessibility evaluation in design and development.

Methods

This study follows a comparative literature review approach to examine existing research on digital accessibility and its evaluation methods. Relevant research papers were identified through Google Scholar using keywords related to web accessibility, UI/UX design, and automated evaluation tools. The selection of studies was based on their relevance to accessibility evaluation, inclusion of different methodologies such as automated tools, manual assessments, and user-based evaluations, and their contribution to understanding accessibility within design and development workflows. The review is primarily based on previously published research, allowing for a comparative analysis of different approaches, findings, and limitations across studies. Through this method, the paper aims to identify common patterns, gaps, and emerging directions in accessibility evaluation practices.

Web accessibility

Web accessibility refers to the practice of designing and developing digital platforms so that people with disabilities can perceive, understand, navigate, and interact with digital content effectively. Inclusive design ensures that individuals with diverse abilities including those with visual, cognitive, motor, or hearing impairments. A digital platform is said to be accessible if users with disabilities can use it with the same effectiveness, security, and safety as non-disabled users (11-12). Accessibility also refers to the process of creating products, services, and digital environments that are usable by individuals with impairments, ensuring equal access to digital information and interactions (12). By infusing accessibility principles into design and development, digital platforms can provide a more inclusive and equitable user experience for everyone.

Importance of Web Accessibility

Web accessibility is important to ensure that digital platforms can be used by users with disabilities, allowing all users equal access to information, services, and online interactions. Building digital platforms with accessibility in mind makes the user experience fairer for everyone and user interaction smoother regardless of ability. Designing digital products involves several elements such as branding, color schemes, typography, readability, and ease of navigation. However, one of the most important considerations is ensuring that users with disabilities can access and interact with these products as effectively as other users, which reflects the core principle of inclusive and accessible design (12-13). Many users with impairments use digital platforms every day, but most of them are still hard to use and navigate due to incompatible interfaces developed without regard to human diversity. Poor design decisions can create accessibility hindrances, especially for users with cognitive or motor impairments, which may prevent them from effectively navigating or interacting with web content (5). To resolve these issues, designers and developers should include accessibility considerations throughout the product development lifecycle.

Automated Evaluation Tools for Accessibility

An automated accessibility evaluation tool is a software tool that automatically analyses websites or applications to identify potential accessibility issues by checking them against established accessibility standards and guidelines, such as Web Content Accessibility Guidelines (WCAG)(9). These tools play a crucial role in assessing the accessibility of websites and mobile applications. These tools give an initial check of digital platform's accessibility by auditing its elements to standard rules and guidelines. They help identify accessibility errors, warnings, and potential barriers, often suggesting descriptions and guidance to designers and developers in improving the accessibility of their interfaces (5).

Evaluation tools are particularly helpful in detecting many common accessibility problems related to compliance with guidelines such as WCAG. By highlighting problems that may affect diverse users, these tools not only help in identifying accessibility issues but also support the process of manual checks and raise awareness about accessibility requirements during the development process (11).

Past research shows that there are many tools available for checking accessibility on digital platforms. Researchers have mapped out nearly thirty such tools, including examples as A-Checker, Accessibility Check, Eva Access, Functional Accessibility Evaluator, Hera, Sortaper Site, TAW, Torquemada, Total Validator, and WAVE, which are available as online services, desktop applications, or browser extensions (2,10,14). Designers and developers use these evaluation tools to perform a preliminary check in the overall accessibility evaluation process.

Objective of the review

The objective of this review is to study selected research studies to understand the concept of accessibility in digital interfaces and highlight its importance in the design and development of

inclusive digital products. The review also explores the functional usage of automated evaluation tools, their accuracy in identifying issues, and how they help in fixing those issues. Accessibility standards and practices should ideally be considered from the early stages of product development as integrating accessibility later in the lifecycle often makes improvements more difficult and inefficient (15). However, despite the presence of established frameworks like WCAG, their practical implementation within real-world development cycles often remains fragmented (16). Through the analysis of the selected studies, this review also explores at which stage automated accessibility evaluation tools are commonly applied in the development process and how they help designers and developers in identifying accessibility issues during different phases of interface creation. Meeting diverse interaction needs for individuals with disabilities continues to be a significant barrier in the product lifecycle (14,17). Hence, this review seeks to understand how these tools can help bridge the gap between accessibility guidelines and functional design, enabling teams to create more inclusive digital experiences. This study systematically evaluates selected research papers' methodologies, challenges, limitations and future scope for improving the involvement of accessibility inclusion in the product development lifecycle by designers and developers.

Table 1. Literature review

Author(s), Year	Study Focus / Method	Key Findings	Remarks / Limitations
Letícia Seixas Pereira, Carlos Duarte, 2025(18)	Evaluating and monitoring digital accessibility from practitioner perspectives	Provides strong practitioner-led insights; highlights the gap between technical compliance and real user experience; emphasizes hybrid testing (automated, manual, and user testing); offers a global practitioner perspective; explores the potential and limits of AI in accessibility work	Cultural and regional bias due to varying accessibility regulations; AI discussion is largely exploratory; heavy reliance on self-reported practitioner experiences rather than direct usability testing outcomes
Paula Palomino et al., 2025(19)	Framework for transforming accessibility evaluations into implementable design and development fixes	Proposes a practical framework linking evaluation directly to implementation; effectively combines automated and manual accessibility evaluation; validated through real-world government educational platforms; suggests measurable usability improvements for users with disabilities	Framework testing limited to specific case studies; focuses only on government-based platforms; relies heavily on expert-led manual evaluations with limited participatory design involvement
Maya, 2023(22)	Exploration of accessibility challenges in digital user interfaces using user-centered approaches	Examines accessibility challenges in digital interfaces; highlights user-centered approaches to inclusive design; provides insights related to elderly users	Based on a small sample size (10 participants); limited generalizability; findings are context-specific to academic and small-scale projects; focuses mainly on web and interface-level accessibility

Carlos Duarte, 20229(15)	Rethinking digital accessibility evaluation beyond guidelines and automation	Critically examines WCAG-only compliance; emphasizes human-centered and contextual accessibility evaluation; highlights issues missed by automated tools; aligns accessibility with UX design processes; provides insights for designers, researchers, and policymakers	Largely conceptual with limited empirical validation; no large-scale user testing with people with disabilities; focuses mainly on web accessibility; limited technical implementation examples
Paula Palomino,2025 (19)	A Framework for Transforming Accessibility Evaluations into Implementable Fixes	The authors created a clear step-by-step way to turn accessibility test results into real fixes. They combined automated checks with expert reviews and then rewrote each problem as a task that designers or developers could actually act on.	The study focused on only two platforms, involved few users with disabilities, and did not track how well the fixes lasted over time.
Azrul hazri jantan, 2023(14)	UI/UX Fundamental Design for Mobile Application Prototype to Support Web Accessibility and Usability Acceptance	The mini review focuses on improving the identification and handling of web accessibility issues in real-world projects. The study emphasizes the need for clearer, more practical accessibility support.	The work is mainly based on analysis and discussion, not large-scale user testing. It does not measure long-term impact after accessibility changes are applied. Results may vary depending on team size, skills, and project context.
João Dias, Diana Carvalho, Tânia Rocha, João Barroso, 2022(9)	Automated Evaluation Tools for Web and Mobile Accessibility: proposal of a new adaptive interface tool	Compares multiple automated accessibility evaluation tools against WCAG criteria; shows that individual tools detect only a limited portion of accessibility issues; highlights the need for combining automated testing with manual verification; demonstrates accessibility gaps in a widely used public service website; proposes an adaptive interface	Automated tools provide incomplete coverage of accessibility guidelines; results are based on a single case study website which may limit generalizability; proposed adaptive tool remains conceptual and requires further validation through real-world implementation.

		concept to support more flexible accessibility evaluation.	
Shuyi Song, Jiajun Bu, Ye Wang, Zhi Yu, Andreas Artmeier, Lianjun Dai, 2018(6)	Web Accessibility Evaluation in a Crowdsourcing-Based System with Expertise-Based Decision Strategy	Introduces a crowdsourcing system to evaluate accessibility tasks using experts and non-experts; proposes Golden Set Strategy and Time-Based Golden Set Strategy to improve decision accuracy; shows improved reliability compared to majority voting; enables large-scale accessibility evaluation; reduces evaluation time while maintaining accuracy.	Relies on manual evaluation for complex checkpoints; dataset limited to Chinese websites; effectiveness depends on worker expertise and training.
Jinat Ara, Cecilia Sik-Lányi, Árpád Kelemen, Tibor Guzsvinecz, 2024(21)	An Inclusive Framework for Automated Web Content Accessibility Evaluation	Identifies major limitations in current accessibility testing tools; proposes a framework combining guideline selection, user and expert input, guideline simplification, automated testing, and issue visualization; improves clarity and effectiveness of accessibility evaluation results; helps developers understand accessibility evaluation processes; supports more reliable and fair automated accessibility assessment.	Framework mainly relies on WCAG guidelines; limited criteria derived from a small number of expert and user suggestions; requires strong programming and accessibility expertise for implementation.

Manca, Paternò, Santoro, Palumbo 2024 (24)	Web Accessibility Validation: Design Requirements for Next-Generation Automated Tools	Identifies limitations of existing accessibility validation tools and their lack of transparency. Proposes design requirements for next-generation accessibility validation tools. Introduces a modular validation architecture that can analyse dynamic web content. Supports both static validation and server-side rendering to improve evaluation accuracy. Initial usability testing with users provided positive feedback on the tool's usefulness and transparency.	Validation relies on a prototype tool and limited user testing. Evaluation was conducted with a small participant group. Some accessibility issues still require manual or expert evaluation beyond automated validation.

Thematic / Focused Sections

Key Developments and Comparative Analysis of Approaches

Letícia Seixas Pereira and Carlos Duarte,2025(18) conducted an online survey involving 27 accessibility practitioners from 16 countries to understand real-world accessibility practices. This was followed by in-depth interviews with six experienced professionals to gain deeper insight into everyday challenges. The authors examined training backgrounds, tools in use, testing approaches, and routine accessibility work. Survey and interview data were analyzed together to identify common patterns and recurring themes across professional experiences. Beyond outlining the study design, Pereira and Duarte,2025 detail how the survey captured self-reported practices rather than performance scores, with no numerical ranking of countries or tools used. Responses from the 27 practitioners show strong convergence across regions, particularly around insufficient formal training, heavy reliance on self-learning, and difficulty translating standards into daily work.

The mini review as written by Paula Palomino et al. 2025(19) introduces a practical framework that turns accessibility test results into clear, doable fixes. It focuses on making accessibility work usable for real design and development teams. The framework was tested on large public education platforms to show it works in practice. The authors combined automated checks with hands-on expert reviews to find accessibility problems. Each problem was linked to a clear user impact and then converted into specific tasks for designers or developers. These steps were tested and refined through real platform use and team feedback.

Zheng (20) outlines the types of color blindness and situates the issue within accessible UX design, before examining why accessibility is crucial for color blind users. Ara et al.2025 (21) made an inclusive framework for automated web content accessibility evaluation. They evaluated the effectiveness of the recently developed accessibility testing and evaluation systems/tools; determined the challenges and limitations of the current accessibility testing processes/methods; and presented an extensive accessibility testing framework considering a wide array of aspects to mitigate the investigated issues and improve the effectiveness of the accessibility testing results. Major emphasis was placed on text and non-text complexities with their examples, which may fail or pass for a user. Cozlov and Zadorojni [12]worked on a short discussion on inclusivity and accessibility in UX design. Jantan, Norowi, and Yazid, 2023(14). The research's main objective was to establish strong communication and support between the Universiti Putra Malaysia (UPM) and the MAB in the context of technological support in ICT to develop UI/UX fundamental design for a mobile application prototype to support web accessibility and usability acceptance.

The authors in Letícia Seixas Pereira and Carlos Duarte, 2025(18) do not provide country-wise quantitative comparisons, noting that regulatory contexts, budgets, and organizational scale differ widely, making direct comparison unreliable. Insights about national perspectives emerge mainly through interviews with practitioners from Australia, Croatia,

Estonia, Germany, India, and the Netherlands, who described similar struggles despite different legal frameworks. Higher-resourced contexts reported fewer compliance violations but still faced gaps between formal conformance and real user experience. Lower-resourced or smaller countries highlighted budget constraints and limited enforcement capacity as recurring barriers.

Recent research on digital accessibility evaluation has increasingly shifted from guideline-based compliance checks toward more integrated and practical approaches that support real design and development workflows. Earlier accessibility research primarily emphasized conformance with accessibility standards such as the WCAG guidelines, with automated tools used mainly to detect violations of these criteria. However, more recent studies demonstrate that accessibility evaluation is becoming more multidisciplinary, combining automated analysis, expert judgment, and user-centered evaluation to capture a broader range of usability barriers (3,9).

One important development in this area is the recognition that automated accessibility tools alone are insufficient for comprehensive accessibility assessment. Studies comparing multiple automated tools have shown that individual tools often detect only a subset of possible accessibility issues, meaning that relying on a single tool can lead to incomplete evaluation results(9). As a result, researchers increasingly recommend the combined use of several evaluation techniques, including automated testing, heuristic reviews, and testing with assistive technologies. This hybrid evaluation approach helps uncover issues that automated algorithms cannot easily detect, such as problems related to content clarity, navigation structure, or interaction design.

Another key development involves improving how accessibility evaluation results are communicated to development teams. Traditional evaluation tools often generate technical reports that highlight violations of accessibility guidelines but provide limited practical guidance for resolving them. To address this issue, several recent studies focus on translating accessibility findings into actionable design and development tasks. The framework proposed by Palomino et al.2025(19) is an example of this shift, as it attempts to bridge the gap between accessibility evaluation and implementation by linking detected issues directly to specific design modifications or development actions (19). By transforming accessibility problems into clearly defined tasks, such approaches make it easier for multidisciplinary teams to integrate accessibility improvements into their existing workflows.

Comparatively, other research focuses on expanding the technical capabilities of accessibility evaluation systems. For instance, Ara et al.2025(21) propose an inclusive evaluation framework that incorporates automated testing, expert feedback, and guideline simplification to improve the clarity and usability of accessibility evaluation results. Their approach emphasizes that accessibility testing should not only identify problems but also help developers understand the underlying causes of accessibility barriers. Similarly, studies exploring new validation architectures suggest that next-generation accessibility evaluation tools should be capable of analyzing dynamic web content and complex interactive interfaces, which are increasingly common in modern web applications (23).

Beyond tool development, recent research also emphasizes the importance of incorporating accessibility considerations into the early stages of the design process. Several studies highlight that accessibility problems often originate from design decisions rather than technical implementation alone(12,15). As a result, accessibility evaluation is gradually being repositioned as an activity that should occur throughout the entire design and development lifecycle rather than being performed only after a system has already been built.

When comparing these different approaches, three broad trends become evident. First, there is a clear shift from purely automated accessibility evaluation toward hybrid evaluation strategies that integrate automated tools with human expertise and user feedback. Second, research increasingly focuses on improving the usability and interpretability of accessibility evaluation results so that designers and developers can more easily implement necessary improvements. Third, accessibility evaluation is gradually being integrated earlier into the design process, reflecting a broader transition from reactive accessibility fixes to proactive inclusive design practices.

Current Challenges

In Letícia Seixas Pereira and Carlos Duarte,2025(18) across all regions, practitioners emphasized that automated tools are useful for detection but insufficient for context-dependent issues, especially on mobile platforms. The authors infer that accessibility challenges are structural and global rather than country-specific, reinforcing the need for shared, practitioner-informed evaluation approaches rather than localized scoring systems. The framework in Paula Palomino et al.2025(19)was tested on only two government platforms, so results may not cover all types of systems. Few users with disabilities participated in feedback, limiting lived-experience input. Long-term maintenance of fixes was not tracked.

Future research should explore ways to bring accessibility checks into the earliest stages of design, so potential issues are

identified while layouts, interactions, and content are still being planned. Improving automated tools to better reflect real user experiences will help designers and developers make more informed choices. Stronger collaboration between design and development teams, with a shared understanding of accessibility constraints, can reduce rework and delays. For the industry, this can lead to smoother workflows and more sustainable products. At a societal level, it encourages digital spaces that are inclusive by default rather than corrected after deployment. The study by Paula Palomino et al.2025(19])shows that accessibility improves when evaluations lead to clear, assigned actions. Combining tools with human judgment makes fixes more realistic and easier to implement. Accessibility needs to be built into everyday workflows, not treated as a final checklist.

Conclusion

This review shows that while accessibility guidelines and tools are readily available, they are often not used in ways that fit real design and development workflow. Across the reviewed studies, a common hindrance is that accessibility is still treated as a end checklist task rather than a core part of user experience design. These evaluation tools help identify problems, but they cannot fully capture real user experience or guide designers and developers on how to fix errors in practice. Studies also highlights gaps in training, communication, and collaboration between designers and developers, which further limits effective implementation. Overall, the findings suggest that accessibility works best when it is introduced early in the design process, supported by practical evaluation methods, and shared responsibility across teams, leading to more usable and inclusive digital products.

While automated accessibility tools can detect many structural accessibility issues, they cannot identify all barriers that users may encounter when interacting with digital interfaces. Many accessibility problems require human judgment, contextual understanding, and manual evaluation, specially when assessing usability and interaction with assistive technologies(3)(23). Therefore, effective accessibility evaluation often requires a combined approach of automated testing, manual inspection, and user-centered assessment methods to ensure that digital platforms provide inclusive and equitable experiences for all users(24).

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