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Examining the interrelationship between user experience design, accessibility, and real-world usability in inclusive digital products

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Abstract

Digital products increasingly mediate access to commerce, education, healthcare, and civic participation, yet many remain difficult or impossible for people with disabilities to use effectively. This paper examines the relationship between user experience (UX) design, accessibility, and real-world usability, arguing that the three function as interdependent and mutually reinforcing practices rather than sequential stages of product development. A conceptual framework is proposed in which accessibility serves as a structural foundation for usability, and usability serves as the observable outcome of well-integrated UX and accessibility practice. The paper then analyses how design decisions intended to enhance visual or interactive experience can unintentionally undermine accessibility, and how accessibility treated narrowly as legal compliance can fail to translate into genuinely usable experiences. Real-world cases, including litigation involving Target Corporation and Domino's Pizza, alongside Microsoft's Inclusive Design Toolkit and Xbox Adaptive Controller, illustrate both the costs of fragmented approaches and the benefits of integrated practice. The paper concludes that inclusive digital products emerge only when these three pillars are pursued as a single discipline.

Keywords: User Experience Design; Accessibility; Usability; Inclusive Design; Web Content Accessibility Guidelines (WCAG); User-Centered Design

1. Introduction

Digital products have moved from being optional conveniences to primary channels through which people shop, bank, learn, apply for jobs, and access government and healthcare services [1]. As this shift has accelerated, organizations have invested heavily in user experience (UX) design as a way of differentiating their products, with attention paid to visual polish, interaction flow, and emotional engagement. Much of this investment, however, has historically proceeded with only a narrow view of who the "user" actually is, often implicitly assuming a person without visual, motor, auditory, or cognitive impairment, using a stable internet connection on a full-sized screen. The result is a generation of digital products that may perform well in usability labs populated by able-bodied participants while remaining genuinely unusable, or entirely inaccessible, to a substantial portion of the population [2,3].

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Accessibility, when it is addressed at all, has often been treated as a separate workstream bolted onto a product near the end of development, framed primarily as a legal or compliance exercise rather than a design concern. This separation creates a structural problem: accessibility teams optimize for conformance with standards such as the Web Content Accessibility Guidelines (WCAG), while UX teams optimize for engagement metrics and visual appeal, and the two efforts rarely meet in a way that produces a product that is genuinely usable by a broad and diverse population in real-world conditions. The consequence is that organizations frequently achieve technical compliance without achieving usability, or achieve a polished user experience that excludes entire categories of users.

This paper examines the relationship between UX design, accessibility, and real-world usability in inclusive digital products, with the central argument that these three constructs are interdependent rather than sequential. The objectives of the discussion are threefold: first, to propose a conceptual framework that clarifies how UX design, accessibility, and usability relate to and depend upon one another; second, to analyze, through real-world cases, how this relationship plays out in practice, both where it has succeeded and where it has failed; and third, to draw out practical implications and recommendations for design practice.

This discussion is organized around three central themes: the impact of UX design decisions aimed at enhancing user engagement and aesthetic appeal on the accessibility of digital products; the role of accessibility as a fundamental prerequisite for usability in real-world contexts rather than as an isolated requirement; and the organizational and procedural barriers that prevent UX design, accessibility, and usability from being integrated as a unified discipline, often resulting in their treatment as competing priorities.

The significance of this discussion extends beyond compliance. The World Health Organization estimates that more than one billion people live with some form of disability, and that number grows substantially when temporary and situational impairments, such as a broken arm, a noisy environment, or a small mobile screen in bright sunlight, are taken into account[4]. Populations are also ageing in most major markets, meaning that visual, auditory, and motor limitations associated with age will affect an increasing share of users over time. Beyond the moral and legal case for inclusion, organizations that fail to integrate accessibility into UX practice expose themselves to litigation risk, reputational harm, and a shrinking addressable market[5,6].

The remainder of this paper proceeds as follows. It first introduces a conceptual framework that positions UX design, accessibility, and usability as overlapping rather than sequential concerns. It then analyses the relationship between the three pillars in greater depth, before turning to real-world cases that illustrate both alignment and misalignment in practice. The paper closes with a discussion of implications for design practice, followed by a conclusion and a set of recommendations.

2. Conceptual Framework

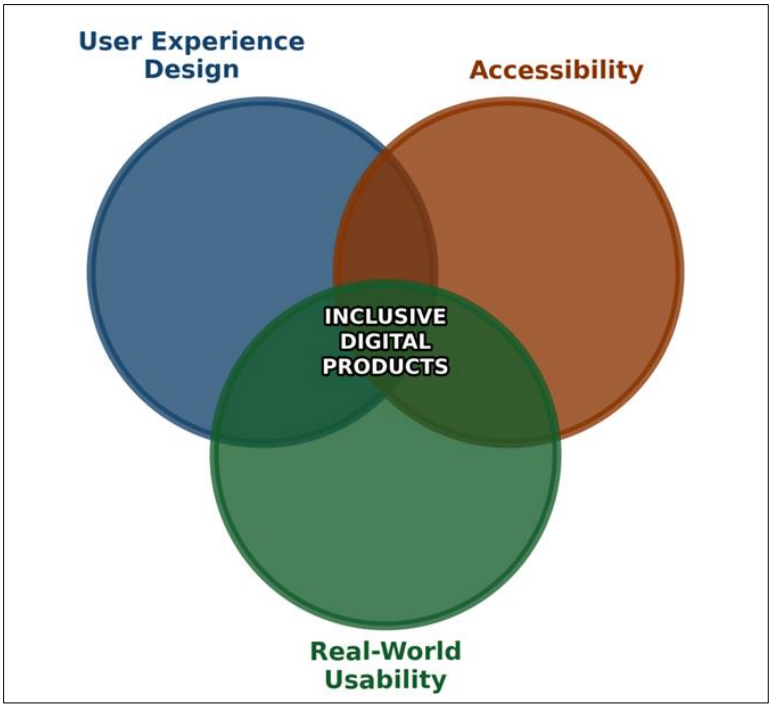
2.1. Defining the Three Pillars

UX Design, Accessibility, and UsabilityUser experience design refers to the holistic set of decisions, spanning visual design, information architecture, interaction patterns, content, and emotional tone, that shape how a person perceives and feels while using a digital product[7]. It is concerned not only with whether a task can be completed but with how the experience of completing it feels: efficient, frustrating, delightful, or confusing. Accessibility, by contrast, refers specifically to the practice of designing digital products so that people with disabilities, including visual, auditory, motor, speech, and cognitive impairments, can perceive, operate, and understand them[8]. It is most commonly operationalized through standards such as the Web Content Accessibility Guidelines, which organize requirements around four principles widely known by the acronym POUR: content must be Perceivable, Operable, Understandable, and Robust. Usability, finally, is typically defined, following the International Organization for Standardization, as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use. Of the three, usability is the most outcome-oriented: it is not a design discipline in itself but a measurable property that emerges from how well UX design and accessibility have been executed together.

2.2. The Proposed Relationship Model

Figure 1 illustrates the relationship proposed in this paper. Rather than positioning UX design, accessibility, and usability as three separate workstreams that converge only at the end of a product's development, the model treats them as overlapping domains whose intersection constitutes what this paper terms an inclusive digital product[9,10,].

A product that sits within the UX and accessibility overlap, but outside the usability domain, may be aesthetically considered and technically compliant with accessibility standards, yet still difficult to operate in practice, for instance, a screen-reader-compatible form that nonetheless takes an unreasonable number of steps to complete[11,12]. A product that sits within the UX and usability overlap but outside accessibility may test well with non-disabled users in a usability lab while excluding disabled users entirely. Only at the Centre, where all three domains overlap, does a product become genuinely inclusive[13].



Proposed relationship model showing UX design, accessibility, and usability as overlapping, mutually dependent domains [14].

Figure 1 Proposed Relationship Model

2.3. Why the Three Cannot Be Treated in Isolation

Treating UX design, accessibility, and usability as separate concerns, owned by separate teams and evaluated against separate metrics, produces exactly the kind of partial overlap described above[15,16]. A UX team measured solely on engagement metrics has little incentive to address accessibility, since assistive technology users are often a small fraction of analytics dashboards, not because they are a small fraction of the population, but because inaccessible products exclude them before they can be counted[17]. An accessibility team measured solely on WCAG compliance scores has little incentive to consider whether a technically compliant interface is genuinely pleasant or efficient to use. And a product organization that treats usability testing as a late-stage validation step, conducted only with readily available, typically non-disabled participants, will rarely surface the barriers that matter most to excluded users until after launch, when the cost of remediation is highest. The framework proposed here suggests that integration must happen earlier, at the level of design intent, rather than later, at the level of compliance review.

3. Examining the Interrelationship Between UX Design, Accessibility, and Usability

3.1. UX Design and Accessibility: Where They Reinforce and Where They Conflict

In many respects, good UX design and good accessibility practice point in the same direction. Clear typography, sufficient color contrast, generous touch targets, and predictable navigation patterns improve the experience for sighted, able-bodied users while simultaneously making a product easier to use for people with low vision, tremor, or cognitive load limitations[18]. This overlap is sometimes described, in the disability rights literature, through the idea of the curb-cut effect, named after kerb cuts originally installed for wheelchair users that turned out to benefit parents with strollers, travelers with luggage, and delivery workers alike. Captions added for deaf users similarly benefit viewers watching video in sound-sensitive environments or in a second language[19]. In other respects, however, UX design choices made in pursuit of visual minimalism or novelty can actively undermine accessibility. Design choices

such as navigation elements that rely solely on icons without accompanying text labels, typography with insufficient contrast ratios prioritised for visual minimalism, scroll interactions that lack clear structural anchors for non-visual navigation, and interactive components developed outside established semantic markup conventions represent a category of interface decisions that frequently perform adequately in controlled usability evaluations conducted with non-disabled participants, yet generate significant accessibility barriers that remain undetected by the development team responsible for their implementation [20,21].

3.2. Accessibility as a Precondition for Usability

A central argument of this paper is that accessibility should not be understood as a feature layered onto usability but as a precondition for it. Microsoft's Inclusive Design Toolkit captures this idea through its Persona Spectrum, which maps disability across a continuum of permanent, temporary, and situational limitations[22]. A person who has lost the use of one arm permanently, a person with a temporarily injured wrist, and a parent holding an infant while operating a phone with one hand all encounter the same interface barrier, even though only the first would traditionally be described as disabled[23,24]. Framed this way, accessibility barriers are usability barriers experienced by a larger and more fluid population than is typically assumed. A product that depends on precise, fine-motor gestures, perfect lighting conditions, or full auditory attention is not simply inaccessible to a defined minority; it is unusable in an entire range of everyday situational contexts that affect most users at some point[25,26].

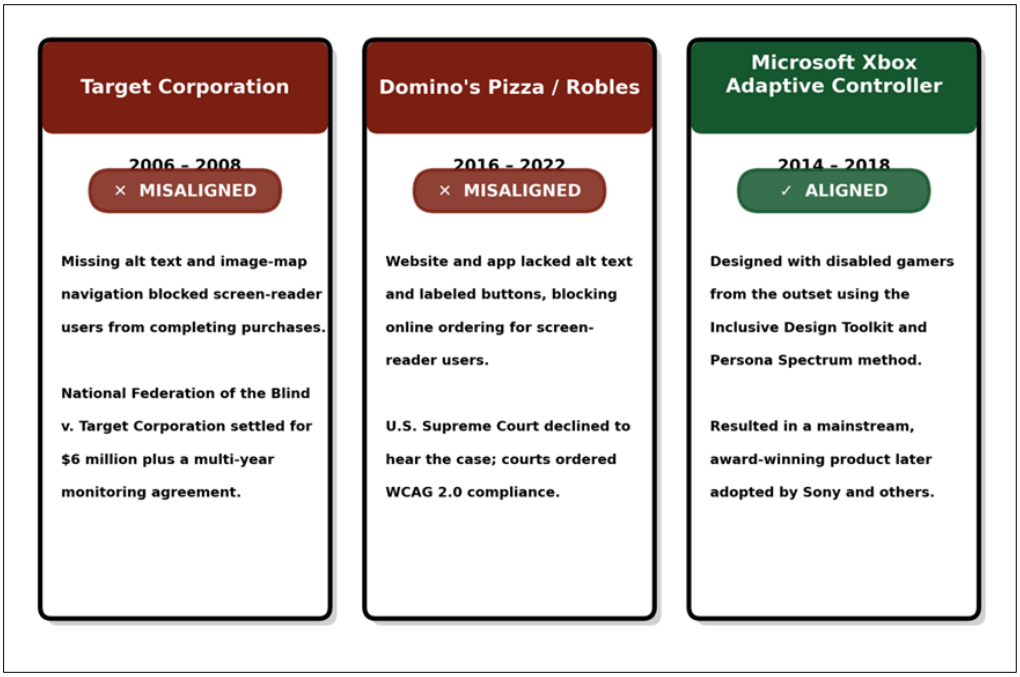
3.3. The Combined Effect on Inclusive Outcomes

When UX design and accessibility are pursued together rather than as competing priorities, the resulting usability gains tend to extend well beyond the population that accessibility standards were originally written to protect. Organizations that integrate accessibility into design practice from the outset typically report broader market reach, since the global population of people with disabilities, combined with ageing demographics in most major economies, represents a substantial and growing share of potential users[27]. They also typically report reduced legal exposure, since accessibility litigation under laws such as the Americans with Disabilities Act has increased steadily as courts have extended physical-accommodation principles to digital properties. Perhaps most importantly, they report a product development culture in which usability is evaluated against a genuinely representative range of users and contexts, rather than against a narrow band of conditions that happen to be convenient to test.

4. Empirical Evidence and Implementation Challenges

4.1. Cases Where the Three Pillars Worked Together

Microsoft's development of the Xbox Adaptive Controller, released in 2018, offers a widely cited example of UX design, accessibility, and usability being pursued as a single discipline rather than three separate concerns[28,29]. Rather than retrofitting an existing controller with accessibility features, Microsoft's design team worked directly with gamers who had limited mobility from the earliest stages of the project, using the Inclusive Design Toolkit and its Persona Spectrum method to understand how a single design decision could serve permanent, temporary, and situational needs simultaneously[30,31]. The result was a controller built around large programmable buttons and an extensive array of external ports, allowing it to connect to a wide range of third-party switches, joysticks, and mounts already used by the disabled gaming community, rather than attempting to anticipate every need in a single fixed device. Even the product's packaging was redesigned, with loop-based openings that could be operated using a mouth, foot, or wheelchair, after testing with users who could not rely on conventional hand dexterity. The controller went on to win mainstream design awards and influenced subsequent adaptive hardware from competitors, illustrating how a product designed for situational and permanent disability from the outset produced usability benefits that extended well beyond its original target users.



Comparison of three documented cases illustrating alignment and misalignment between UX design, accessibility, and usability[32].

Figure 2 Three Real-World Cases of Alignment and Misalignment

4.2. Cases Where They Failed to Align

Two well-documented legal cases illustrate the cost of treating accessibility as separate from UX design and usability. In 2006, the National Federation of the Blind, together with an individual plaintiff, filed suit against Target Corporation, alleging that Target.com could not be used by blind customers relying on screen-reading software[33]. Investigations during the litigation found that product images lacked alternative text, that navigation depended heavily on image maps without text equivalents, and that key purchase flows could not be completed using a keyboard alone, effectively excluding screen-reader users from the entire shopping experience[34]. The case proceeded as a class action and was settled in 2008 for six million dollars, alongside a multi-year agreement requiring Target to bring its site into compliance with accessibility guidelines and to submit to ongoing monitoring[35].

A decade later, a similar pattern played out in Robles v. Domino's Pizza LLC. Guillermo Robles, a blind customer, was unable to order a pizza through either Domino's website or its mobile app using his screen reader, citing missing alternative text and unlabeled interactive buttons that did not conform to platform accessibility guidelines. The case moved through the district court, the Ninth Circuit Court of Appeals, and ultimately to the United States Supreme Court, which declined to hear Domino's appeal in 2019, leaving in place a ruling that the Americans with Disabilities Act applies to websites and mobile applications connected to physical places of business. The litigation continued until 2022, when a district court ordered Domino's to bring its digital properties into compliance with WCAG 2.0. In both cases, the underlying design failures were technically modest, missing alternative text and inadequate keyboard operability, but the organizational failure to treat accessibility as integral to UX design resulted in years of litigation, direct financial cost, and reputational exposure[36,37].

4.3. Underlying Organizational and Process Barriers

The recurring pattern across cases of misalignment is not a lack of available accessibility knowledge but a structural failure to embed that knowledge into the design process at the point where decisions are actually made[38,39]. Accessibility audits conducted late in a product's lifecycle, often immediately before launch or only in response to a legal complaint, can identify violations but cannot easily undo design decisions, such as a reliance on image maps or custom components without semantic markup, that were made without accessibility in mind months earlier[40]. Design systems that do not bake accessible defaults into reusable components force every product team to solve the same accessibility problems independently, with inconsistent results[41,42]. Usability testing panels recruited through convenience sampling frequently exclude people who use screen readers, switch devices, or other assistive technology, meaning that the barriers most consequential to disabled users are the ones least likely to surface during testing. Finally, where accessibility is positioned organizationally as a legal or compliance function rather than a design function, it tends

to be measured by conformance checklists rather than by the lived experience of using the product, allowing technically compliant but genuinely unusable interfaces to pass review[43,44].

5. Discussion: Implications for Inclusive Design Practice

The relationship examined in this paper carries several implications for how digital products are designed and evaluated. First, accessibility cannot be effectively addressed as a downstream quality-assurance activity; it must be present at the point of ideation, where decisions about navigation structure, interaction patterns, and content hierarchy are first made, since these are precisely the decisions that are most costly to reverse later[45]. Second, organizations benefit from building accessibility into shared design systems and component libraries, so that individual designers and engineers are not required to solve the same accessibility problems repeatedly, and so that accessible patterns become the path of least resistance rather than an additional burden[46]. Third, usability research practices need to deliberately include participants with a range of permanent, temporary, and situational impairments, rather than treating accessibility testing as a separate, parallel process conducted only with assistive technology specialists[47]. Fourth, the cases examined in Section 4 suggest that the organizations most successful at integration are those that treat disabled users as co-designers and informants throughout the product lifecycle, rather than as a compliance audience consulted only after key decisions have already been made. Taken together, these implications point toward a shift in how design quality itself is defined: not as visual polish validated against a narrow set of users, but as real-world usability validated across the full range of human variation that any given product is likely to encounter.

6. Conclusion

This paper has argued that user experience design, accessibility, and real-world usability are best understood not as three separate stages of digital product development but as interdependent dimensions of a single design discipline. The conceptual framework proposed here positions accessibility as a structural precondition for usability rather than an optional enhancement, and positions usability itself as the observable outcome of how well UX design and accessibility have been integrated. The real-world cases examined, ranging from costly litigation against Target Corporation and Domino's Pizza to Microsoft's collaborative development of the Xbox Adaptive Controller, demonstrate that the cost of treating these three pillars separately is measured not only in legal exposure but in products that fail a substantial portion of their potential users. Where organizations have instead pursued UX design, accessibility, and usability as a unified practice, engaging disabled users directly throughout the design process, the resulting products have tended to perform better not only for disabled users but for the broader population encountering similar barriers in temporary or situational circumstances. Inclusive digital products, in other words, are not a specialized category distinct from well-designed products; they are simply what well-designed products look like when the full diversity of real-world users is taken seriously from the outset.

Recommendations

Embed accessibility at the point of ideation. Product and design teams should treat accessibility requirements as part of the initial brief for any new feature or product, alongside business goals and visual direction, rather than introducing them during a later compliance review. Decisions about navigation structure, content hierarchy, and interaction patterns should be evaluated against accessibility implications from the first wireframe onward, since these are the decisions most expensive to reverse once a product has shipped.

Invest in accessible design systems. Organizations should build accessibility into shared component libraries and design systems so that accessible patterns, such as properly labelled form fields, sufficient color contrast, and keyboard-operable interactive elements, become the default starting point for every team, rather than something each team must research and implement independently.

Recruit disabled users into core research and testing activities. Usability research panels should deliberately include participants who use screen readers, switch devices, voice control, and other assistive technologies as a standard part of every testing cycle, not as a separate accessibility-specific study conducted in isolation from mainstream UX research.

Measure usability outcomes across diverse user groups rather than conformance checklists alone. While WCAG conformance remains an important baseline, organizations should track task completion, efficiency, and satisfaction metrics broken out by user group, including disabled and situationally impaired users, to capture whether technical compliance is translating into genuine usability.

Establish shared accountability across design, engineering, and product leadership. Responsibility for accessibility and inclusive usability should not sit solely within a legal or compliance function. Cross-functional ownership, with design, engineering, product management, and leadership all holding some measure of accountability for inclusive outcomes, is more likely to produce the kind of early, integrated decision-making that the cases in this paper suggest is necessary.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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