Chapter

A Conceptual Model for Conformance with Accessible Gamification

Keyonda Smith

Abstract

There currently remains limited Gamification awareness and training for developers on WCAG conformance. Studies indicate an increased interest from developers to raise their acceptance, awareness, and technical abilities for designing accessible digital products. This article explores and presents a conceptual module to improve web developers' capabilities and knowledge of accessible digital design. By leveraging the standards put forth by WCAG 2.0, developers can create accessible content for users who identify with various forms of abilities. Four primary principles comprise WCAG 2.0 and 12 standards, and 12 standards deliver fundamental objectives as best practices for developers. These guidelines were employed for gaming content design and development, permitting users to regulate reality and Gamification associations whereas immersing in the game. The goal is to apply diverse processes for each stage of the game to allow challenges and motivation for users to determine novel processes while understanding the guidelines. Assistive Technology was used to navigate each stage. To suit independence or self-reliance, the conceptual model supports players' personalization while completing the game activities. Likewise, employing complex, advanced, and reward dashboards satisfies the proficiency component, and social network communications to other players provide the opportunity for interconnectedness. The conceptual model presented in this paper underpins Gamification and the potential to incorporate evidence-based accessibility principles developed by W3C. The previous examinations focused on instruments (e.g., software, feature, components) to achieve WCAG conformance. This examination presents a distinction from prior studies as this conceptual model recognizes consciousness and self-determination as the initial starting point.

Keywords: Gamification, accessibility, eLearning, ADA, disability

1. Introduction

The expansion of accessible e-learning and its components presents challenges and barriers recognized by the World Wide Consortium (W3C) and similar compliance organizations. A recent Centers for Disease Control and Prevention (CDC) [1] study results suggested that over 60 million adults live within the United States and identify as possessing a disability. These results indicate that most adults in the United States seeking higher education may experience barriers and challenges when presented with digital learning tasks. Sallafranque-St-Louis & Normand [2] research revealed that approximately 25 percent of disabled adults lacked access to

the Internet, compared to over 10 percent of non-disabled adults. This disproportion for Internet access demonstrates an essential disadvantage, particularly when considering age.

Additionally, these statistics forecast an increase as people are living longer. The lack of accessibility provisions validates a significant digital gap for adults that identify with a disability. Even though there are continuous improvements, less than 20 percent of public websites conform to the World Wide Consortium (W3C) Web Content Accessibility Guidelines (WCAG) 2.0/2.1 guidelines [3]. This statistic suggests insufficient compliance for most web developers' inability to comply with the guidelines. The Americans with Disabilities Act (ADA) necessitates specific public and private entities to ensure published web content is accessible for those who identify with various levels of blindness, deafness, dexterity abilities, cognition, or using assistive technology. However, there is a continued overall deficiency of consciousness regarding accessibility resources such as training and developers' incentive to practice accessible design.

Moreover, Dror et al. [4] argue that the most recent global pandemic exposed how assistive device and technology marketplaces remain disjointed and largely cost-prohibitive, resulting in digital products lacking compliance to accommodate all users. These issues demonstrate the critical state of accessibility and developers' capacity to implement and assimilate accessible features for digital products. Considering that accessible and compliant digital products increase the UX (UX) by over 30 percent [5], verify positive returns when integrating content that meets accessibility standards and guidelines. To improve user results, engagement, and the general experience, developers incorporate Gamification features within digital products. Nacke & Deterding [6] defines Gamification as employing 'game design elements in a non-game context.' As research increases and practice improves, there remains scant guidance on the appropriate design and implementation of accessible digital gamification elements using game design elements (e.g., leaderboards, points, progression indicators, leaderboards). Organizations and institutions generally leverage Gamification to enhance learning, provide training, increase employee enrichment and inspiration, and research projected its growth to over $19.4 billion by 2023 [7].

There currently remains limited Gamification awareness, and training [8], for developers on WCAG conformance. Studies indicate an increased interest from developers to raise their acceptance, awareness, and technical abilities for designing accessible digital products. This article explores and presents an engaging resolution to improve web developers' capabilities and knowledge of accessible digital design.

2. The literature

2.1 Accessibility background

Developers employ various conventions to mitigate accessibility issues. As an endeavor to commiserate and perceive users' requirements, this proposal suggests the deployment of avatars. Zhang et al. [9] examined the adoption of sensible methods to further this concept. Their research focused on implementing accessibility and its corresponding users to navigate a Gamified platform named '**CoMove.**' CoMove is a virtual living space atmosphere for players who identify with differing cognitive abilities. Coincidentally, researchers continue to explore mechanized online accessibility review tools [10, 11] without requiring user intervention that measures accessibility using WCAG standards and guidelines. Automated tools lack complete compatibility with current WCAG standards and with constraints to only evaluating select elements.

In contrast, current tools often present limitations, steep learning curves, and often require clarification, resulting in issues and non-compliance. Undeniably, research has demonstrated that the current standards present as vague, abstruse, and unnecessarily challenging to decipher. There is a deficient examination to refine the convoluted and arduous process to mitigate digital products when leveraging WCAG standards. The effort to improve digital accessibility centers on employing approaches and procedures that consolidate the recommended standards; yet, these tactics fail to confront encouragement and absence of consciousness by developers', which present various barriers and challenges.

2.2 Gamification and eLearning

Usability and UX act as essential characters concerning the quality of ubiquitous access to digital materials. Several models underpin how UX, internally and externally, supports motivation and inspiration when conducting specific activities. However, Wigfield's [12] examination of the Expectancy Value Theory of Motivation (EVTM) published results grounded on acknowledging that inborn inspiration is most desirable due to leveraging three central rational requirements - aptitude, self-sufficiency, and empathy. When satisfied, the user expresses increased satisfaction and inspiration. The examination of Gamification advantages meant to engage users is not novel. Further exploration has indicated that Gamification aids in self-efficacy, empathy, compassion, and engagement. Research also indicated that Gamification enhanced stimulation.

In practice, there are a few instances of this hypothesis. For example, to help individuals become familiar with another dialect, the software Duolingo utilized Gamification. Microsoft [13] integrated and introduced Gamification to nearly 1,000 employees to enhance its Windows interpretation program, where they completed over 25,000 assignments. This strategy exhibited that their employees completed assignments over 130 percent more rapidly than the benchmark group. These results concluded an over 60 percent increase in participation when engaging with Gamification. Online training also demonstrated increased participation in course activities when employing Gamification by over 60 percent.

Prior research purported that boundaries exist when comparing an assignment to reality [14, 15]. A more prominent construct among the present reality situation and a gamified task may improve UX and satisfaction. However, it may conceivably increase challenges and difficulty for accomplishing the coarse learning objectives. Games with realistic scenarios present fewer challenges when working towards accomplishing the course objective, yet the user experiences, engagement, and commitment may decline. Nakamura et al. [16] assessed Gamification and the UX's viability in learning management systems by measuring UX and usability. Their research introduced several models applied to appraise knowledge attainment and learning conditions.

In this article, the author furthers this exploration by constructing a scheme outlining realistic Gamification components to increase accessibility consciousness and improve acceptance of WCAG's accessibility standards.

3. Aligning WCAG principles and Gamified solutions

As a methodology, Gamification demands the development of a practical solution centered on the foundations of Gamification. The standards put forth by WCAG 2.0 provides a conduit for developers to create accessible content that is and increasingly available for users who identify with various forms of abilities. Four

primary principles comprise WCAG 2.0 and 12 standards. The 12 standards deliver fundamental objectives as best practices for developers. In the context of this article, the standards are central to achieving accessibility.

This scheme intends to employ gaming content design and development, permitting users to regulate reality and Gamification associations whereas immersing in the game. The game entails various stages, individually plotting to each of the WCAG standards. The goal is to apply diverse processes for each stage to allow challenges and motivation for users to determine novel processes while understanding the guidelines. Assistive Technology observes and aids users as they navigate each stage. Assistive Technology is acting as the sole and primary guide. Assistive Technology provides motivation and clarity on comprehending strategy and design in numerous stages.

The projected plotting among how the game operates and WCAG 2.1 consists of the below criteria.

a. Perceivable - WCAG explains the perceivable principle as ensuring the content and interface presents intuitively**.** Additionally, this principle encompasses four standards, plotted against how the game operates for the users (Accessibility Principles [17]).

- *Alternative Text:* Present all non-text content to users with text alternatives. This standard maps to the '**Facebook® Live Trivia'** game, where users are positioned in a dark room viewing an unclear picture. The Assistive Robot will explain what is on the image, and the player transcribes the explanations in the image 'ALT tag' to move forward.

- *Synchronization:* Time-based media, or synchronization, contains characteristics that allow corresponding alternatives (e.g., Audio or Video content). This corresponding measurement tool is the '**Facebook® Live Trivia'** game, which contains ambiguous videos. By viewing this multimedia in a noisy and loud environment, Assistive Technology then connects the text and player to complete the 'ALT Text' and obtain information from the video that provides access to the next stage.

- *Flexible:* Create various content types (e.g., more straightforward layout) without losing information or structure. The game **'Braid'** aligns with the 'Flexibility' standard. Braid is a puzzle game where the user receives tasks to open three doors in a specific sequence, using two keys. The first key in the cadence is the most difficult. However, users have access to a rewinding feature, which allows the user to reverse any mistakes.

- *Differentiate:* Create a simple, user-friendly experience that distinguishes the foreground content from the background. The **'Sift Heads Cartels'** game measures and links to the 'Differentiate' standard. The user identifies a unique target in a mass of targets. All targets are homogenous and require filtering to allow visualization. Alternatively, other features require fine-tuning by the user, such as audio.

b. Operable – WCAG outlines the 'Operable' principle to comprise of four standards and posits that the user interface, its elements, and navigation are generally operational (Accessibility Principles [17]).

- *Focus:* Keyboard focus and usability connect to the '**Discovery! A Seek and Find Adventure**' game, whereby players accept a duty to restore a keyboard

to submit the security information. To accomplish this particular task, the player must discover the misplaced keys. The assistive technology recommends applying keyboard shortcuts. The game consists of specific zones that disallow keyboards and mice, challenges expected for the player to conquer.

- *Efforts:* Users are allowed adequate time and effort to consume the content. Adequate time links to the '**Defenders 2: Tower Defense CCG**' game. In this game, players must terminate a specific number of opponents within the predetermined time allowed. To win the assistive technology is required to guide them by helping them lengthen the permitted time.

- *Flashing:* By evaluating the **'Cyberpunk 2077'** game and its potential seizure-causing elements, players may further understand this phenomenon. The game features a highlighted attribute called "braindance." Braindance initiates with sequential blinking lights, similar to those employed by professional neurologists to induce seizures during diagnostic sessions. Although computer device solutions potentially decrease the likelihood of seizures for those who identify as epileptic, there are no native or inherent in-game settings to control this.

- *Manipulation:* Afford methods to assist users with maneuvering and navigation for players when locating game materials or features and allow independent regulation of their location within the game. Navigation corresponds with the '**Discovery! A Seek and Find Adventure**,' which initiates with the player experiencing various spaces and rooms. For players to move on and accomplish each activity, they must post or access (download) a file. The assistive technology provides suggestions and recommendations to assist players in locating the home screen, identifying page headings, and accessing breadcrumb tracking links.

c. Understandable – WCAG describes three fundamental standards that define the 'Understandable' principle when considering and planning game development and its accompanying user interface or platform (Accessibility Principles [17]).

- *Comprehensive*: To understand the game material and its contents, it must sustain readability. This standard correlates with the **'7 Little Words**' game, which requires the player to locate the URL to alter the instructions' language.

- *Intuitive:* The game pages and screens must operate intuitively and expectedly. The 'Intuitive' standard connects with the **'Escape the Crate'** game. The game initiates with the player situated in a room that is locked. The exit has a dashboard located adjacently. First, there is a code which the player needs to locate. Conversely, the entry field requires unlocking to allow the play to input the secret code. Lastly, a submission control containing the appropriate tag is required to enter the secret code.

- *Form Entry Ability*: Assistive Technology seeks to aid players in preventing and adjusting errors. The game '**2 For 2: Connect The Numbers**' corresponds with this standard. For this game, players receive instructions to match to solve for the sum of those numbers. This task involves the player associating

where the player needs to connect verifications, proof, and tags to specific areas to advance to the next phase.

d. Robust – WCAG summarizes one essential standard to define the 'Robust' principle. This classification characterizes the game materials as consistent for translation by assistive technology and the most ubiquitous group of individuals (Accessibility Principles [17]).

- Congruency – This standard aligns with the '**Metro Exodus**' game. In this game, players must unlock an electric door. However, the power supply is not functioning. Therefore, the player's task is to repair the component. The assistive technology software does not recognize this screen and lacks any notification to the player. If the player somehow realizes this error, they can remediate this by repairing user identification labels or tags to allow the assistive technology to recognize what is occurring on the screen and the required next steps.

3.1 Gamification tools, features, and measure

Lastly, the final phase entails the incorporation of Gamification technology. A study conducted by van Roy & Zaman [18] acknowledged several Gamification features and their correlation to EVTM.

Correspondingly, to suit independence or self-reliance, the conceptual model supports *players' personalization* while completing the game activities. Likewise, employing *complex, advanced, and reward dashboards* satisfies the proficiency component, and *social network communications to other players* provide the opportunity for interconnectedness **Figure 1**.

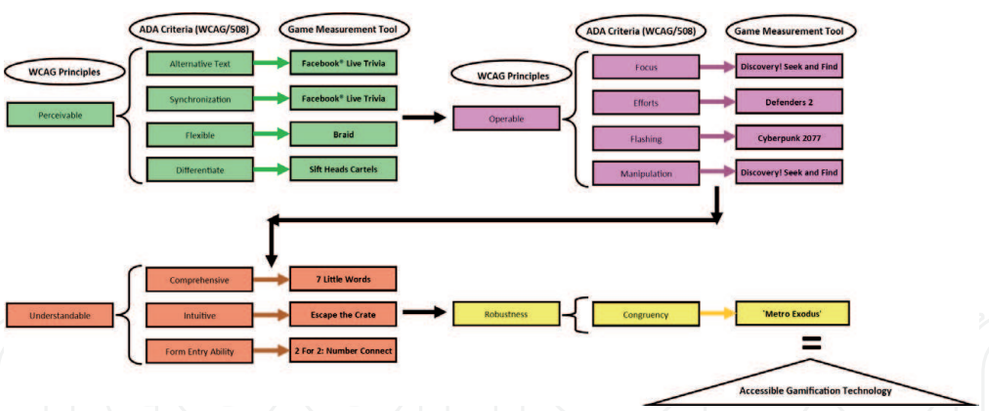

Figure 1.
The conceptual model.

4. Discussion

The conceptual model presented in this paper underpins Gamification and the potential to incorporate evidence-based accessibility principles developed by W3C. The previous examinations focused on instruments (e.g., software, feature, components) to achieve WCAG conformance. This examination presents a distinction from prior studies as this conceptual model recognizes consciousness and self-determination as the initial starting point.

Section 508 of the Rehabilitation Act of 1973, amended in 1998, mandates federal agencies to comply with providing accessible information technology to people with disabilities. This mandate comprises both employees and the public. Section

508 underwent a significant revision in 2017 and commissioned that by January 2018, all federal and contracted service providers conform to WCAG 2.0 A/AA. Therefore, this conceptual model reinforces and supports Gamification and gamified learning equity for active participation and engagement to increase WCAG 2.0/2.1 knowledge. The prediction based on this remedy is a treatment for future accessibility in a digital environment. It is recommended to researchers to examine further an exhaustive treatment for accessibility in conjunction with developers. Moreover, researchers should further review the Unified Theory of Acceptance and Use of Technology (UTAUT) and its relationship to M-learning -Usability and User Experience Encountered in Mobile Educational Context (MUUX-E).

Author details

Keyonda Smith
Trident @ American InterContinental University, Fairfax, VA, USA

*Address all correspondence to: kmsmithphd@gmail.com

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