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## Usability and Accessibility Analysis of Durham University Online Web System (DUO)

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### ABSTRACT

This paper seeks to investigate the usability and accessibility of the Durham University Online Web System (DUO) which is an implementation of the Blackboard software. This study is concerned with the DUO system based on the WCAG 2.0 guidelines under the broad themes of accessibility and usability. DUO is measured for robustness, permeability, operability, and understandability to measure conformance. The Blackboard software company claimed that its systems followed the WCAG 2.0 standards with a conformance level of AA. The goal of this study is to test how the DUO system is perceived by Durham University students and also its claims of adherence to the WCAG 2.0 standards. It is not the goal of this study to test whether DUO conforms to the AA rating claimed by Blackboard.

**Keywords:** LMS, DUO, Usability, Accessibility, WCAG 2.0 standards

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#### Journal Reference Format:

Suleiman, R.N., Atiku, A.U. & Aliyu, M.M. (2023): Usability and Accessibility Analysis of Durham University Online Web System (DUO). Journal of Behavioural Informatics, Digital Humanities and Development Research. Vol. 9. No. 2, Pp 1-8. Available online at <https://www.isteams.net/behavioralinformaticsjournal>. dx.doi.org/10.22624/AIMS/BHI/V9N2P1

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### I. INTRODUCTION

A system is accessible when someone with a disability may use it while usability is a qualitative attribute for accessing how easy it is to use a system [1], [2]. It is pertinent to point out that accessibility and usability studies especially for users with disability are still evolving fields [1]. The World Wide Web Consortium (W3C) has come up with a standard set of guidelines termed the Web Content Accessibility Guidelines (WCAG 2.0) as part of the W3C's Web Accessibility Initiative (WAI) to cater for the needs of people with disabilities [3].

The Durham University Online (DUO) System, which is a customised version of the Blackboard Learning Management System (LMS) tailored for Durham University will be investigated, based on its accessibility and usability features. The suitability of the current approach used in the DUO System development concerning its accommodation for users with motor/physical, visual and cognitive impairments will also be investigated.

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## 2. RELATED ARTICLES

The study of usability and accessibility of Learning Management Systems have been carried out over the past three decades either as comparative studies or analysis of single systems [4] [5] [6] [7]. Some studies looked at open source solutions like Moodle [8], others evaluated Google Classroom [9]. This has included study of remote laboratory systems or integration remote laboratory systems to Learning Management systems [10]. “Culturability” - how students’ culture affects usability was explored in [11]. A similar study to ours included cybersecurity concerns to address achieving a safe online education environment for students [12]. Another study explored the challenges of using LMS during the covid-19 pandemic [13].

Ubiquitous computing techniques like including eye tracking technology to evaluate usability was carried out in [14]. Universal framework in designing requirements approach for building e-learning systems where user feedback is hard to access was proposed in [15]. Some researchers focused on adoption problems in developing countries [16]. Putting students responsible for choosing how materials on LMS are organised favoured a time based approach for organising course content [17]. Previous exposure to acceptance helps with adoption [18]. Some studies looked at attitudes of teachers towards LMS [19]. The impact of LMS on student performance was evaluated in [20]. All these research fall under some category of usability research. Different researchers have come up with the taxonomy of usability and accessibility research [21].

However, broadly speaking accessibility and usability research can be categorised into the following:

### **Accessible User Interfaces**

This research area covers assistive technologies such as screen readers, alternative input devices and voice recognition systems. Other studies that involve multiple modes of interaction such as speech, gestures, and touch by users with disability are termed multimodal interfaces. Alternative output modalities like haptic feedback, sonification or tactiles displays have also been employed to help users with visual and hearing impairments. Adaptive interfaces research have also been used to match user characteristics and preferences based cognitive, motor and sensory abilities.

### **User Experience and Interaction Design**

In the user experience research sub-category research is divided into user-centred design, interaction techniques, user experience evaluation, and information architecture and navigation. When a study involves users with disability throughout the design process it is referred to as user-centred design. Research in interaction techniques focus on new approaches or input methods that contribute to enhancing usability and accessibility for users with disabilities. In some cases research is limited to assessing metrics and research methods for user experience evaluation in individuals with disability. When research focuses on techniques for organising and structuring information to improve accessibility and ease of use such as hierarchical menus, search interface and navigation aids it is referred to as information architecture and navigation research.

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## **Cognitive and Perceptual Factors**

Cognitive and perceptual factors research branches into cognitive methods, and visual perception and memory and learning research. The development of cognitive models and their application to understand the interaction cognitive-impaired users have with the system is classified as cognitive models research. Some other studies look at how visual attention and perceptual processes impact the usability and accessibility of interfaces. Memory and learning research investigates interfaces that support memory and learning processes for users with cognitive impairments

## **Web Accessibility**

Closely related to our paper is the web accessibility research area. Our paper tests the DUO system against the Web Content Accessibility Guidelines (WCAG 2.0). It also incorporated the use of web accessibility evaluation tool research area: validator for checking HTML/XHTML. Our research has not covered the mobile and web accessibility research area that is concerned with building mobile-first LMS systems.

## **Inclusive Technologies and Digital Inclusion**

Emerging research fields in accessibility and usability involves technology for ageing population and inclusive design for marginalised. Research involving design and usability for over 65 year adults to support an improved quality of life and independent living refers to the former. The latter is concerned with keeping in cognisance the accessibility and usability needs of individuals from marginalised communities: low literacy, low income individuals, and individuals with limited technology resources such as low internet bandwidth.

## **2.1 Review Of Accessibility And Usability Features Of The Duo System**

The DUO System is the primary and sometimes secondary communication platform for the exchange of information between academic staff, non-academic staff and students. It also has features that allow access to the library, file storage and so many other auxiliary services like paying charges accrued on overdue loans from the library or even filling out surveys. The DUO System has significantly followed the WCAG 2.0 standards with the conformance level of AA on accessibility/usability for users with visual impairment, motor/physical, and cognitive impairment [22].

## **Accessibility**

### **Understanding WCAG Guidelines**

The goal of WCAG guidelines is to help developers, designers and others to understand how to create and also measure accessible websites, applications, browsers, and other web tools. There are other guidelines related to WCAG like the Authoring Tool Accessibility Guidelines (ATAG), and User Agent Accessibility Guidelines (UAAG) guidelines but it is not the goal of this article to point to the relationships. A full description of understanding the aforementioned guidelines and their success criterion can be found on their respective websites (WACG). DUO System examination for accessibility based on the following guidelines from WCAG 2.0:

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**Perceivable:** Non-text contents have text alternatives. Users can also invoke a view that shows main content only and it has a very distinct separation between background contents and foreground contents. It also provides different colour schemes and allows toggling of the font size.

**Operable:** All interface elements are keyboard accessible and navigable, no time-based media, time-outs (logs off) only after a long period of inactivity, and no seizing content.

**Understandable:** Vocabulary used, and results of actions do not deviate from normal learning scenarios. It averagely helps users avoid mistakes by using input assistance.

**Robust:** The screen-magnifiers/screen-reader can interoperate with every aspect of the web content.

### **Usability**

DUO System examination for usability based on the following adapted guidelines from [1]

#### **2.2 Web Usability Criteria**

**Learnability:** Users with little web experience can quickly learn how to use the system whether when looking for information or trying to use functionality because standard web practice has been adapted.

**Efficiency:** On average users accomplish the online tasks quickly with little cognitive effort after learning how to use the website as all texts and button labels are in simple plain English and commands suggest the results of actions to be taken.

**Errors:** Apart from allowing a no-file submission, the DUO System has very good error prevention. In the case that an instructor has only allowed single submission, the user can't upload the correct file in place of a no-file submission made. Errors are flagged, and selectors (e.g. drop-down box) were used to avoid error occurrences.

**Satisfaction:** Most users are satisfied with using the system as shown in the reviews carried out on the DUO System [22].

**Memorability:** Returning users do not have to learn how to use the system, the DUO System uses standard web practices, which aids recognition, and in essence requires little or no memorability.

#### **2.3 Principles of Good Design**

**Visibility:** Some of the crucial tasks like checking grades and uploaded contents have alternative action paths to accomplish, and also make use of tab pointers and breadcrumbs [23].

**Good mappings:** The system made very good use of metaphors as in the case of the log-off button, which is the conventional on/off button found on electronic devices [1], [23].

**Feedback:** The DUO System gave good feedback in almost all instances, especially through the use of status icons or colour-coded task completion flags [1], [23].

#### **Golden Rules of Interface Design**

**Consistency:** There is average consistency on the DUO System as some pages have different layouts, different secondary navigation, and a balance of information [1], [24].

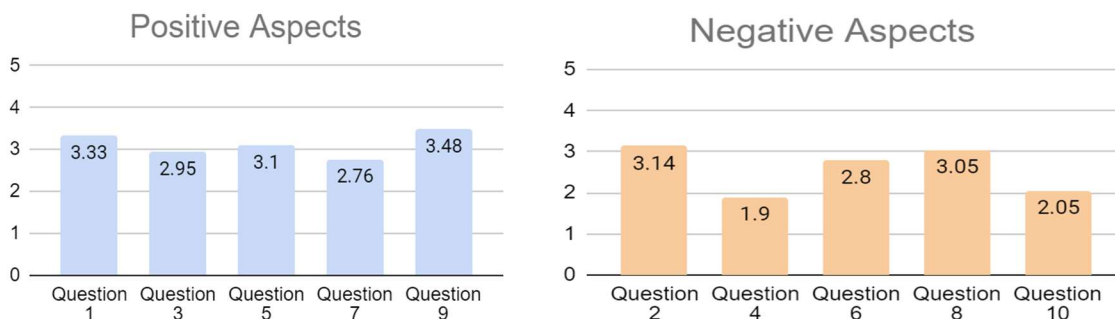
**Working memory load:** Although the DUO System is balanced in terms of information presentation, the main page found after login intends to bombard especially new users with a lot of information [1], [24].

### 3. ANALYSIS OF FINDINGS

Although the DUO System has level AA conformance to the WCAG 2.0 guidelines for accessibility and usability [22], extant literature claims that conforming to guidelines is just one side of the problem in making content accessible to especially blind users that are arising from the confusion regarding the understanding of these guidelines and sometimes the inability for the guidelines to be measured effectively [25]. The confusion is mainly because accessibility and usability are still an evolving field and most coders are not very familiar with the concept and especially how to measure it.

Another issue is that existing literature has shown that the approach used for the development of most LMS like the DUO System is not very efficient for solving the problems of users with disability[1], [26]. A more task-oriented approach might be a better option as it does a very good job of preventing cognitive overload, especially for users with dyslexia and low vision or total blindness [27]. It also limits movement that might be needed to accomplish a task thereby helping users with motor/physical impairments.

A survey (adapted from Brooke, System Usability Survey) carried out on the student users of the DUO system suggest that users without disabilities thought the system was quite usable (with a SUS score of 54.2), and existing literature has shown that if a system is useful to users without disability it solves at least half the problem of the users with disability [25]. The charts in figure 1 shows the average scores of the SUS survey questions. Users found it usable based on the relatively high scores of the positive aspects of the system. However, two aspects on the negative side also have high scores. They are questions two and eight, which has to do with how complex and cumbersome the system is respectively. Also running the DUO System through the W3C markup validation service for checking HTML/XHTML[28], validation/parsing errors revealed only 6 Errors, and 3 warning(s).



**Fig. 1: Outcome of System Usability Survey**

#### 3.1 Suggested Improvements for the Duo System

- A more vivid task-oriented approach should be used for users with a disability, and the DUO should be redesigned in such a way that a user can select whether they have a disability or not at logon.
- If a user has a disability then a different interface should be provided which helps the user navigate the DUO System based on the task they want to perform rather than be presented with the current system that requires navigation based on the university learning environment that the DUO simulates.
- Two kinds of back buttons should be added, a “Previous Page Button” that takes a user to the previous page visited and a “Back Button” that takes the user one level up down the current selection they have made.
- No Menu should be allowed to have more than two depth levels. All pages should have suggestive titles, and inline validations should also be implored.
- No-file submission should not be allowed especially for blind users. A file must be selected before the submission is completed message can be displayed.

#### **4. CONCLUSION**

Generally, the DUO System is quite accessible given the nature of the learning environment it is mimicking and the issues associated with exactly predicting the accessibility and usability needs of people with disability. As the field of usability and accessibility for users with disability matures DUO can be made a perfect System with minimal improvement.



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