E-learning accessibility in higher education - developing accessibility hub for University of Edinburgh students and staff

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Abstract

The number of higher education students in the UK has been growing significantly in recent years and with that grows the number of students with disabilities. Legislation is improved with each year to ensure accessible digital and education experience to all students with disabilities, however there are still many barriers that they face every day. On the other hand, university staff needs precise guidelines and information on how they can support such students and make their study materials accessible to them.

This work focuses on determining these specific barriers that students and staff of University of Edinburgh face as well as on discovering the way to design an online "accessible hub" platform for UoE community. Through user-centred approach to design, the requirements for the tool are gathered through the review of relevant literature and interviews with experts and students with disabilities. A low-fidelty prototype is proposed and evaluated with users and experts, followed by implementing it as a high-fidelity prototype. The empirical data from the final evaluation show that the proposed system is an effective tool suitable to its target audience, allowing them to access relevant accessibility guidelines, support and contact options in an easy and intuitive way.

Research Ethics Approval

This project obtained approval from the Informatics Research Ethics committee.
Ethics application number: 272316
Date when approval was obtained: 2023-12-06
The participants' information sheet and a consent form are included in the appendix.

Declaration

I declare that this thesis was composed by myself, that the work contained herein is my own except where explicitly stated otherwise in the text, and that this work has not been submitted for any other degree or professional qualification except as specified.

(*Julia Iwańczuk*)

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I dedicate this work to all Eastern European women in this world.

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Chapter 1

Introduction

1.1 Digital accessibility in Higher Education

Disability encompasses a range of impairments affecting mobility, senses, cognition, and mental health. While physical disabilities may limit mobility, sensory disabilities may impact sight or hearing. Acording to WHO, 1 in 6 of us experiences significant disability [1]. Accessibility ensures that products, services and environments are designed with the goal of being usable by people with disabilities [8]. In recent years, there has been a growing recognition of the importance of accessibility across various domains, with significant changes made in legislation such as Equality Act 2010 [7] in the UK or European Disability Strategy for 2010-2020 in the European Union, digital content guidelines (e.x. WCAG - the Web Content Accessibility Guidelines), and university computing curricula [35]. According to Ladner (2016) [35], the topic of accessibility has become more *"mainstream"* in recent years. However, studies show that the adoption of digital accessibility practices is currently still limited in scope, due to lack of awareness, training and relevant resources, among others [51].
It is evident that students with disabilities face additional challenges, including higher rates of mental health conditions [31] and feelings of disconnection from university communities [26]. Around two-thirds of students struggling with mental health have considered dropping out of their studies [26]. This means that providing high quality higher education for everyone is a matter of not only creating accessible materials but also providing such students with appropriate support, as well as creating inclusive and well-informed communities at the universities.
In the field of higher education more and more digital tools are available and used every year, benefiting both teaching staff and the students [50]. While studies show that the attitudes of members of teaching staff are usually positive towards accommodating their students' accessibility needs, students with disabilities may be partially or fully excluded from their courses. This disconnect is often attributed to educators' insufficient knowledge of relevant legislation, guidelines, and support mechanisms [21]. Thus, this dissertation aims to bridge the gap between positive attitudes towards accessibility and the practical implementation of inclusive practices in higher education. Since university staff play a crucial role in ensuring accessible digital learning materials [21], the specific guidelines they are provided with have to be universal across the same organisation

and come from estimable and up-to-date resources. One of the main problems is that a lot of recommendations available do not offer direct support to the teaching staff and learning content creators and instead they generally focus on technical aspects intended at web-designers [24], which suggests that both guidelines for creating online platforms and guidelines describing content creation have to be context-specific.

1.2 Aims and research questions

The main goal of this research is to explore how an online platform can be designed for students and staff of The University of Edinburgh, that would act as a hub for relevant accessibility guidelines, accessible e-learning materials, relevant learning-enhancing tools, and information about community and support. The web-based and web-enhanced tools and courses have proven to increase the chances of people with disabilities to gain degrees in higher education, although there are still many challenges these materials and platforms have that need to be resolved in order to provide fully equal access to education for everyone [53]. Moreover, studies show that both users with and without disabilities can benefit from typical accessibility measures applied in the technology they use [25]. The sense of belonging to a community in the academic context is crucial for student performance and persistence [54], but students with disabilities can get easily overwhelmed when looking for appropriate resources [20]. Therefore, the following research questions are addressed to help build a platform incorporating resources for both students with disabilities and staff working with them:

- **RQ1:** What are the main difficulties that higher education students and university staff find in creating and accessing accessible e-learning materials and spaces?
- **RQ2:** What is the best way to design an online platform for university students and staff that serves as an accessibility hub?
- **RQ3:** To what extent is the created website usable and what is its impact on students with disabilities and university staff, in terms of appropriateness, effectiveness and ease of use?

1.3 Structure

This work consists of seven chapters, with the following themes and aims:
Chapter 1 - Introduction
This chapter aims to introduce the concept of accessibility and digital accessibility in higher education, along with a brief description of current challenges faced by students and university staff. Furthermore, the aims of the research are stated followed by three research questions.
Chapter 2 - Literature review
This chapter aims to present a brief review of relevant literature and statistics on the current situation of students with disabilities in higher education, accessibility legislation in the United Kingdom, and challenges with accessing and creating appropriate resources faced by higher education students and teaching staff. The chapter also explains most

common terms used throughout this work and describes categories of students with disabilities that are referred to in the future.
This chapter partially answers **RQ 1:** What are the main difficulties that higher education students and university staff find in creating and accessing accessible e-learning materials and spaces?

Chapter 3 - Requirements gathering
This chapter explains the process of gathering requirements for the digital platform described in later parts of this work. It first describes the process of interviewing experts in the field of teaching and/or accessibility and students with disabilities. Then it describes relevant existing accessibility guidelines and at the end the requirements for the system are presented and justified.
This chapter partially answers **RQ 1:** What are the main difficulties that higher education students and university staff find in creating and accessing accessible e-learning materials and spaces? and **RQ 2:** What is the best way to design an online platform for university students and staff that serves as an accessibility hub?

Chapter 4 - Low-fidelity prototype
This chapter describes the main features of a prototype of the platform built in Figma [2] as well as the evaluation of these design choices through cognitive walk-through and evaluation with students and staff.

Chapter 5 - High-fidelity prototype
This chapter describes the changes in previous design as well as technical solutions to create a high fidelity prototype of the platform. It introduces its features and their justifications.

Chapter 6 - High-fidelity prototype evaluation
This chapter provides a detailed description of the high-fidelity prototype evaluation with students, teaching staff and experts in the field. It also provides discussion based on the evaluation findings.
This chapter answers **RQ 2:**What is the best way to design an online platform for university students and staff that serves as an accessibility hub? and **RQ 3:** To what extent is the created website usable and what is its impact on students with disabilities and university staff, in terms of appropriateness, effectiveness and ease of use?

Chapter 7 - Conclusions and recommendations for future work
This chapter answers the initial three research questions based on the results presented in the previous chapters, the conclusions and limitations of the work are presented and recommendations for future work are described.

Chapter 2

Literature review

*This chapter discusses the prevalence and categories of students with disabilities in higher education in the UK, analyses the barriers the staff and students face, discusses the accessibility legislation, and presents the methodology used for this work. The chapter partially answers **RQ1**.*

2.1 Students with disabilities in Higher Education in UK

2.1.1 Prevalence

The population of higher education students in the UK has been growing significantly in recent years and with that grows the number of students with disabilities [13]. However, while the statistics show a 24% increase in the total number of students enrolled in higher education between academic years 2013/2014 and 2021/2022, the number of students reporting their disability status as 'Known disability' has almost doubled in size (97% increase) in that time. This phenomenon is not only present in British education, as studies from countries like USA[49] and Australia[33] show similar statistics. Reasons for such growth include a higher diagnosis rate in society, specific accessibility laws and resulting accommodations provided by the universities as well as increased public awareness of learning disabilities and positive trends in identifying them and supporting affected individuals.

Current statistics indicate that out of 415,950 UK-domiciled students with disabilities enrolled in British Higher Education in 2021/22, 134,320 of them reported having been diagnosed with (or identified with) a specific learning difficulty such as dyslexia, dyspraxia, or AD(H)D, which makes around 32% of this community[12]. Another 119,480 mentioned a mental health condition (such as depression, schizophrenia, or anxiety disorder). A notable drop is present in numbers for students with physical disabilities, with around 3,700 blind or visually impaired students, 6,980 Deaf or hearing impaired students, and 8,900 students with physical or mobility issues. It's important to note that many studies focus on these groups individually, overlooking multiple disabilities. Nearly 14% of UK students with disabilities report being affected by two or more conditions, underscoring the need for policymakers, educators, and the

IT sector to develop inclusive solutions that address a wide range of needs to ensure equal access to academic resources.

2.1.2 Categories and definitions

In this work, disabilities are defined as *"long-term physical, mental, intellectual, or sensory impairments that which in interaction with various barriers may hinder full participation in society"*, as outlined by the United Nations General Assembly [15]. Most universities will have a disabilities services office or a disabilities advisor for their students, and on top of that, they will provide their teachers with guidelines for making their courses' content accessible for every student [52]. After reviewing such guidelines of a few UK universities [6][5][4] along with the accessibility guidelines created by the UK Government and the already mentioned statistics [12], one can observe a trend of categorising such guidelines into specific sections, each based on a separate recognised disability. The categories considered and discussed in this work were established based on the accessibility recommendations from UK Government's 'Accessibility in Government' blog [45], web accessibility guidelines published by W3C WAI [10], Higher Education Statistics Agency [13] and student support guidelines published by University of Edinburgh [5]. These categories are:

Physical and Motor Disabilities - include individuals with weakness and limitations of muscular control, limitations of sensation, joint disorders, pain that impedes movement, and missing limbs. Users with physical disbailities may prefer to use specialised hardware and/or software, such as specially designed input hardware replacing traditional keyboard and mouse, eye-tracking and speech recognition programs etc.

Auditory Disabilities - include individuals experiencing moderate to substantial hearing loss in one or both ears. Such individuals may use terms 'Deaf' or 'Hard of hearing' that they identify with. Many of them may use sign language particular to their region, phonetic language, or a combination of both. They may or may not choose to use hearing aids available on the market.

Visual Disabilities - include individuals with mild to complete vision loss in one or both eyes, lack or reduced sensitivity to different colours, or increased sensitivity to brightness. Perception of colours and brightness does not necessarily correlate with impaired vision quality.

Autism Spectrum Conditions - include individuals experiencing issues with dealing with social communication and interaction, and/or restricted interests and habits and/or sensitivity to some outer stimuli like light or sound. It is important to notice that each individual on autism spectrum can experience mentioned symptoms differently, from moderate to significant levels, and do not have experience them at equal intensity. ASD is considered to be a type of neurodiversity.

Attention Deficit Disorders (ADD or ADHD) - include individuals experiencing difficulties focusing on single tasks, for longer time, without being easily distracted. Like ASD, ADHD is a type of neurodiversity and some of their symptoms may overlap.

Specific Learning Differences - include individuals experiencing difficulties processing specific information during learning process. These can include, but are not limited to dyslexia, dyscalculia and dyspraxia.

2.2 Legislation

2.2.1 Accessibility accommodations in higher education

The main legal basis for any accessibility-related accommodations and support can be found in the Equality Act 2010 [7], which says that you are disabled if *"you have a physical or mental impairment that has a 'substantial' and 'long-term' negative effect on your ability to do normal daily activities."*. The legislation specifies disability as one of the protected characteristics, against which it prohibits discrimination in sectors such as education, work, services etc. Following this law, it is illegal for a public school (including higher education) to discriminate a student based on their disability status, both directly and indirectly. Indirect discrimination can mean providing documentation like study materials or forms in only one, inaccessible format. Education providers must make 'reasonable adjustments' in order to ensure that no students are discriminated on this basis, and, depending on the specific situation, this can mean providing additional materials, teaching support, interpreters, etc. Moreover, all higher education institutions in the UK should have a person in charge of disability issues.

2.2.2 Digital accessibility

The Public Sector Bodies (Websites and Mobile Applications) Accessibility Regulations 2018 [9] mandate that all public sector websites and apps in the UK comply with WCAG 2.2 [37] accessibility standards and publish accessibility statements. These regulations cover intranets and extranets as well. While some institutions may be exempt, most should make reasonable adjustments to their content. Failure to comply constitutes a violation of the Equality Act 2010 [7]. WCAG 2.2 is the most recent (as for December 2023) version of international guidelines aiming to provide a single shared standard for creating accessible web content, and provides guidelines for creating accessible web content, organized into four categories: perceivable, operable, understandable, and robust. Public universities and colleges fall under this legislation and must ensure their websites, services, and materials are accessible.

2.3 Challenges with accessing and creating resources

Course organisers and teaching staff
A study run by Sanderson et al [48] showed that very few members of academic staff are aware of universal design guidelines, accessibility accommodations and legislation. They showed that many of them lack sufficient understanding of assistive technologies and digital barriers that students with disabilities may encounter. Although aware of the physical aspects of these limitations (usually related to the architecture of the study spaces), their understanding of digital barriers and terminology is limited. Even though the staff shows a positive attitude towards providing accessible resources and learning more about it [21], their theoretical knowledge surpasses their practical expertise [48]. Langørgen [36] showed that the main barriers that staff usually faces are time constraints, unclear outcome measures to evaluate the students, insufficient support and lack of sufficient knowledge.

Students with visual disabilities

Most of the challenges with accessing digital study materials and information by visually impaired students come from their limited perception of visual information, which makes resources in textual and graphic formats inaccessible for them. Amin [14] mentions that the accessibility-related challenges that higher education students with visual impairment face are, among others, difficulty accessing information, materials (especially in a book format), online systems, and university infrastructure (including accessing specific spaces on campus). The focus on supporting students with visual disabilities is more general and it lacks an understanding of actual barriers to accessing online systems, as their usability remains a challenge for this group [47].

Students with auditory disabilities

Wajdi et al [55] have established that a major limitation for Deaf and Hard of Hearing students is lack of equipment such as hearing aids and lack of stable internet connection (especially since the move to online learning since the start of the Covid-19 pandemic). When it comes to accessibility of the learning materials, the biggest problem seems to be the limited access to captioning, speech-to-text alternatives, and unclear audio or unnecessary background noise. Deaf students may prefer sign language over phonic languages [41] (for example BSL over English), and that may make it more difficult for them to understand materials written in complex English, and they may require assistance of note-takers, interpreters and/or speech-to-text systems.

Attention Deficit Disorders

Emmers et al [27] show that students with ADHD may be at a higher risk for experiencing learning disabilities and psychiatric disorders, hence care should be taken to provide them with effective support. Such students usually struggle with core study techniques such as task prioritisation, attention and . Moreover, Barkley [17] suggested that some of their poor executive functions like emotion regulation and working memory may be caused by ”inability to inhibit actions as well as emotions”. Although the specific barriers in accessing educational materials and spaces by students with ADHD differ depending on each person, Emmers et al [27] showed that following the principles of Universal Design for Learning can support teachers with designing their materials for students with ADHD. Sarid et al [39] argued the importance of support provided to students with ADHD during sudden changes such as move to online learning.

Autism Spectrum Conditions

Adams et al [23] established that although online environments, used more and more often in higher education, may provide flexibility for students on the autism spectrum, they may also create many barriers, such as too many functionalities in one place, confusing phrasing or lack of needed explanations. Adults on the spectrum are prone to mental health related issues such as anxiety and depression [29] and may struggle with social interaction, which may impact their abilities to perform well at group work tasks and overall integration with the university community.

Specific Learning Difficulties

Although the term SLD addresses many conditions, almost 80% of them are related to difficulties with text processing and reading [34]. Kohli et al [34] mentions that conditions such as dyslexia affect short-term memory and reading fluency, suggesting that students with dyslexia may perform equally well as other students, but may require more support and time. Other LDs such as dyscalculia and dysgraphia affect students

required to follow multi-step processes, mixing upper and lower-case fonts, etc. Pino et al proved that some user-centred design practices can benefit higher education students with dyslexia and improve their overall learning experience [43].

Physical Impairments and Mobility Issues

With regards to the barriers in accessing e-learning materials that students with physical disabilities face, Kent [32] points out inflexible time limits, pdf and PowerPoint materials not adjusted to assistive technologies and lack of configuration of screen readers with online chat rooms. Other barriers stem from lack of appropriate controls on the websites, too complicated routes taking long time and cognitive effort, and inaccessible communication systems between students and university.

2.4 Motivation

The background research performed in this chapter shows a high prevalence of students with disabilities in higher education (HE), as well as the current legislation related to accessibility in HE. However, it was also shown how different groups of students with disabilities may still face various barriers related to accessing resources, support and digital study materials, which may impact their future studies and overall educational experience. Although multiple resources are made available at the Univeristy of Edinburgh website, there is not a single point where students and university staff can access guidelines, support resources and general information related to accessibility. Hence, this work aims to research the topic of barriers in accessing e-learning materials and spaces by university students and staff, and to then create an online platform acting as an ”accessibility hub” for the community of University of Edinburgh. Students with disabilities often use digital technology to help them overcome accessibility issues, and in many instances find the online aspect of higher education beneficial in completing their studies [46]. Strategies to support students with disabilities should have a diverse approach due to the heterogeneous nature of this community [46], hence the work is not limited to one particular subgroup of disabilities, and it aims to use principles of universal design and accessibility to make the tool usable for all members of University of Edinburgh community.

2.5 Methodology

This work assumes User-Centred Design as its main approach to design. User-Centred Design (UCD) was first introduced in 1986 by Norman and Draper in their book ’User-Centered System Design: New Perspectives on Human-Computer Interaction’ [42]. They introduced the idea of system design being informed by potential users’ interests and needs with usability playing the central role. Norman has further developed this idea in his later books and introduced many core principles of UCD that are followed by field professionals to this day[11]. The methodology of this work is majorly inspired by Jokela’s ’Method-Independent Process Model of User-Centred Design’ [30]. Jokela introduces six processes working iteratively, whose timelines intertwine in order to provide full and ongoing assessment of UCD methods used throughout the research. These processes are 1) Identification of User Groups; 2) Context of Use of User Group ‘N’; 3) User

Requirements; 4) User Task Design; 5) Produce User Interaction Designs; 6)Usability Evaluation.

Due to the time constraints and scope of the project, the work follows a limited number of outcomes described in Jokela's article. The phases were:

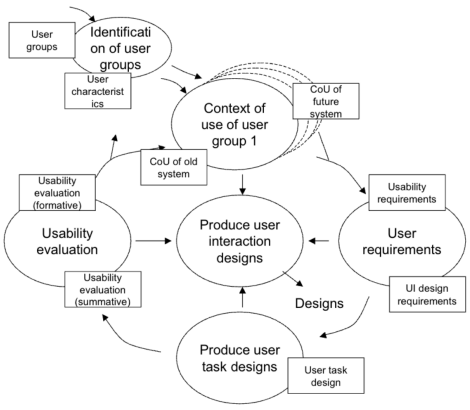


Figure 2.1: Jokela's Method-independent Process Model of User Centered Design [30]

Requirements gathering: The purpose of this stage was to uncover the barriers and needs related to accessible education and disability support that students and staff of University of Edinburgh (UoE) may face. This involved reviewing literature related to accessibility legislation and barriers in accessible education, as well as reviewing relevant guidelines and conducting semi-structured interviews to gather empirical data that would inform next stages. The initial set of requirements for the tool's design was created.This phase is contained in Jokela's first three processes and is described in Chapters 2 and 3.

Low-fidelity prototype: The purpose of this stage was to design a low-fidelity prototype of an accessibility hub for the students and staff of UoE in Figma [2], based on the requirements discovered in the previous stage. Formative evaluation of the prototype was run by experts through a cognitive walkthrough and through task-based evaluation with students and university teachers. A set of redesign recommendations was created to inform the final implementation. This phase is contained in Jokela's fourth and fifth processes and is described in Chapter 4.

High-fidelity prototype: The purpose of this stage was to redesign and implement a high-fidelity prototype of the tool as a website built using React.js [3]. This phase is contained in Jokela's fifth process and is described in Chapter 5.

Final evaluation: The purpose of this stage was to perform final evaluation of the prototype with experts (through cooperative evaluation) and potential users. Qualitative data was gathered through think aloud technique and semi-structured interviews, while quantitative data was gathered through SUS questionnaire. Final conclusions were drawn and recommendation for future extensions were described. This follows Jokela's sixth process and is described in Chapter 6.

Chapter 3

Requirements gathering

*This chapter discusses the requirements gathering stage. It describes the interviews run with staff and students with disabilities, the followed guidelines, and presents initial requirements for the design. The chapter answers **RQ1** and partially **RQ2**.*

3.1 Interviews

3.1.1 Aims

The main aim of the interviews was to uncover potential users' requirements and gather ideas for system functionalities. This would inform the next stage - building a low-fidelity prototype. The aims were to identify: 1) The current level of support students with disabilites and university staff get from the University of Edinburgh; 2) Challenges that students with disabilities may encounter in accessing higher education online; 3) Challenges that university staff faces in providing accessible teaching materials and support; 4) The level of access to guidelines, support, and communities related to accessibility for university students and staff;

3.1.2 Participants

The participants of interviews were recruited through friends and acquaintances of the researchers, and consisted of: 1) higher education students with disabilities (S); 2) higher education teachers (T); 3) other members of staff and/or experts in the field of accessible education (O). Table 3.1 presents participants in each category. To ensure anonymity, each participant was assigned a number (P1, P2, P3, P4, P5 and P6).

3.1.3 Procedure

Each interview was held either online (using MS Teams) or in-person, at the participant's convenience, and consisted of two people - the researcher (author of this work) and one participant at a time. Before the interview, each participant was informed of the nature and aims of the study, was familiarised with the participant information sheet (Appendix A) and consent form (Appendix B), and obtained copies of both of

Participant Number	Group	Role
P1	S	part-time online masters student with a physical disability
P2	S	university applicant with ADHD returning to education
P3	T	university lecturer, course organiser past personal tutor and expert in HCI and software engineering
P4	T	university lecturer in machine learning and course organiser
P5	T	support teacher working with blind students in upper secondary education
P6	O	Assistant Director at the Disability and Learning Service at University of Edinburgh

Table 3.1: Interview participants

these documents via email before the interview. Each interview lasted between 30 and 60 minutes. Depending on the group they belong to (as mentioned in 3.1.2), the participants were asked questions revolving around the topic of accessibility in education and their experience with it. Main questions can be found in Appendix C. Due to the semi-structured nature of the interview, the follow-up questions depended on each participant's situation and their answers. The participants were encouraged to share their experience and opinions due to the conversation's inherent flexibility and its authentic and semi-formal atmosphere. This environment fostered a sense of natural discourse, encouraging individuals to contribute openly and comfortably. Due to the sensitive nature of some questions, the participants were informed that they were under no obligation to respond if they chose not to do so. The interview questions, although flexible, were grouped into three stages:

1. Experience: The participants were asked about their experience in: navigating student life as a person with disabilities (students), considering accessibility in their work as a course organiser (teachers), or working in direct contact with students with disabilities and providing support (other). This was to get to know the participant's background better and give them an opportunity to set the tone of the rest of the conversation. The questions were intentionally of a light and broad nature to alleviate any initial apprehension or intimidation that participants might feel at the beginning of the interview.

2. Barriers: The interview proceeded with questions regarding barriers in: accessing e-learning materials, getting support from the university and contacting relevant members of staff (students), finding relevant accessibility guidelines and other resources, and implementing relevant measures to their materials (teachers), or providing relevant support to students with disabilities and understanding their barriers and requests. The participants were asked follow-up questions based on examples they brought into the conversation or to find out specific details of the systems they work in.

3. Wishes: The finish the interview, all participants were asked about what they wish

the University could do better to support their requests and/or roles. This was to help the researcher prioritise the ideas for system functionalities gathered in previous questions.

3.1.4 Data Collection and Analysis

The voice recordings were made using a phone. Afterwards, they were transcribed and the original recordings were deleted. Participant's names were anonymised. The transcriptions along with the researcher's notes taken during the interviews were analysed using thematic analysis, as it is considered to be an effective method of identifying, analysing, and interpreting qualitative data that is structured by topic [19]. It aims to group the data by similar ideas, patterns, and topics. Thematic analysis is a flexible framework particularly suitable for exploratory research. The themes resulting from the thematic analysis of the collected data are presented in the next section.

3.1.5 Results

After the thematic analysis of the collected data, the following themes were identified:
Time: Time was one of the most commonly mentioned topics in interviews with participants from all three categories. P1 mentioned that due to her disability she needs more time to complete some tasks and that sometimes *"you have to stretch and squeeze time from your sleep time"*. P2 mentioned he usually needed more time to complete some assignments, but due to no support from their college in the past, *"I was getting lower mark, even though I knew I could do better."*. P6 mentioned that students visiting the University Disability and Learning Service often ask for the deadline extensions for their courseworks and time adjustments for their exams, however in several cases they *"don't have enough information or apply too late for the service to accommodate that"*. Moreover, P1 mentioned being tired of having to find and fill in forms, saying *"I try to take a look and I totally give up on that."* and *"My fear is that I don't have that amount of time that involves in all the conversation back and forth."*.
Materials: When asked about the quality of received study materials, P2 has mentioned there were several times when *"there was just so much text I couldn't focus for longer"*. P1 has mentioned that many times she can't understand what is said on the recording and *"The transcript that is loaded sometimes (...) doesn't capture the speaker in a proper way"*.. P1 has also mentioned some materials she has obtained from course organisers had relevant accessibility measures applied, but the course organisers are not uniform with their attitude and guidelines they follow. P5 has mentioned that many of her students have to rely on alternative forms of original materials due to their vision impairments and that in many cases she has to adjust the materials first. Both P3 and P4 said they understand why they have to make their materials accessible, but P4 said he feels his creativity in creating them is limited and added *"if you start focusing on those [guidelines], you're not going to do a good lecture"*, while P3 said *"if something more related to material would come up then that would be very time consuming."*.
Guidelines: With regards to what guidelines there are available for university staff, P6 was happy about the amount and quality of the guidelines available on the University's website. However, both P3 and P4 expressed dissatisfaction in the amount of practical

knowledge they can find: P3 said she usually has to *"spend a lot of time looking for guidelines, checking if they had not been updated and then deciding which rules to apply"*. P4 mentioned that he can't fully adjust his materials *"because I don't have, for example, a complete list of requirements that I can just tick through"*. P3, P4 and P6 all said they have not been given clear and uniform guidelines from the education organisations they work for.

Support: The interviews also served purpose of finding out how easy it is to find support for both students and staff. P2 mentioned that one of the things he is looking at when he researches the universities to apply to is *"if I'm not going to waste my time there with no support"*. P6 said that while the University Disability and Learning Service has experienced a *"significant increase in the number of students seeking help over the years"*, they have been hiring more staff and providing various training opportunities for the university staff. P1 mentioned it is sometimes difficult for her to find relevant information about what kind of forms and documents she has to fill in to get proper support from the university and that she thinks it is *"a waste of time"*. This has affected her choice of courses several times. P3 said she knows how to support students because she *"used to be the teaching support staff trainer"*, but it takes a long time and effort, especially with finding and recommending support resources to students.

3.2 Guidelines

In order to design a tool that effectively centralises key accessibility resources and technologies for students and members of staff of University of Edinburgh, three types of guidelines were considered:

Human-Computer Interaction Design Principles Due to the web-based nature of the tool, relevant guidelines related to user interface design were gathered to ensure usability of the website and user's positive experience. A popular evaluation choice in the field of Human-Computer Interaction are Jakob Nielsen's ten usability heursitics [40]. However, since their publication, Nielsen's heuristics have been studied, evaluated and developed to accommodate the ever-changing academic knowledge of usability heuristics and ergonomic criteria - two popular and intertwining forms of design knowledge [44]. One proposed solution that combines these two areas and at the same time extends the popular and well-respected Nielsen's set is a "Revised Set of Usability Heuristics for the Evaluation of Interactive Systems" developed by Pribeanu [44]. The author has grouped the fourteen rules into four categories: user guidance, user effort, user control and freedom, and user support. The heuristics were used to inform the design of the tool, their full list can be found in Appendix D. For the rest of this work, where relevant, they will be referred to using their numbers (as in the list) - e.g. Pr-1.

Accessible web design guidelines On top of the usability and ergonomics heuristics, a set of of principles related to accessible web design was developed, to ensure that all published content is easy to navigate and access for all users. The set called WCAG (Web Content Accessibility Guidelines) developed by W3C was used, as it is one of the most recognized regulations for evaluating web content accessibility [22]. It acts as an international standard and is being constantly developed by W3C experts in accessibility in cooperation with international individuals and organizations. The guidelines are grouped into four categories: perceivable, operable, understandable, and robust. Each

guideline is accompanied by relevant success criteria. The version used in this work is WCAG 2.2. The list of relevant guidelines can be found in Appendix E. For the rest of this work, where relevant, they will be referred to using their numbers (as in the list) - e.g. WCAG-1.4.1.

Accessible materials creation guidelines In addition to the aforementioned two sets of guidelines, the interview stage discovered a need for guidelines for designing accessible study materials and content. In contrary to the WCAG guidelines, the guidelines in this section have to describe good practices in creating the content of study materials, not the structure of the website or a mobile app. The final set relevant to this project was developed based on an article published by UK Government's Accessibility team called "Dos and don'ts on designing for accessibility" [45], and "Accessibility guidelines for the development of Learning Objects" collected by de Macedo and Ulbricht [24]. These guidelines (Appendix F)act primarily as a basis for the content of the Guidelines Checklist functionality and inform the system's general design. Where relevant, these guidelines will be referred to using their numbers (as in the list) - e.g. M-22.

3.3 Requirements for the system

Following the thematic analysis of the interview data and reviewing the mentioned guidelines, the following design requirements for the system were established.

	Requirement (the tool should...)	**Relevance**
1.	provide access to relevant guidelines on creating accessible materials	P3, P4, P6
2.	the tool should provide a simple way of checking accessibility of provided materials	P2,P3,P5
3.	provide a quick access to the most important support resources	P1,P2,P3, Pr-7, WCAG 2.4
4.	contain information in plain English	M-1,Pr-6, WCAG 3.1
5.	allow full control for users navigating through keyboard and/or screen reader	P1,P5, Pr-9, Pr-10, WCAG 2.1, WCAG 2.4
6.	follow a simple, linear, logical layout	M-2, M-3, M-8,Pr-3, Pr-7, Pr-4, Pr-5 WCAG 1.4
7.	inform the user about what steps to expect after clicking on a link, option or button	P1, M-15,Pr-12, WCAG 3.2
8.	give user an overview of possible actions	Pr-1 ,Pr-12, WCAG 3.2
9.	provide a quick way of generating content of typical messages	P1
10.	be easy to customise visually	P2,P5,M-5,M-11,Pr-9, Pr-10, Pr-11, WCAG 1.3

Table 3.2: Initial requirements

Chapter 4

Low-fidelity prototype

*This chapter presents the low-fidelity prototype of the tool created in Figma and discusses its formative evaluation with experts and users. Recommendations for redesign are presented. This chapter partially answers **RQ2**.*

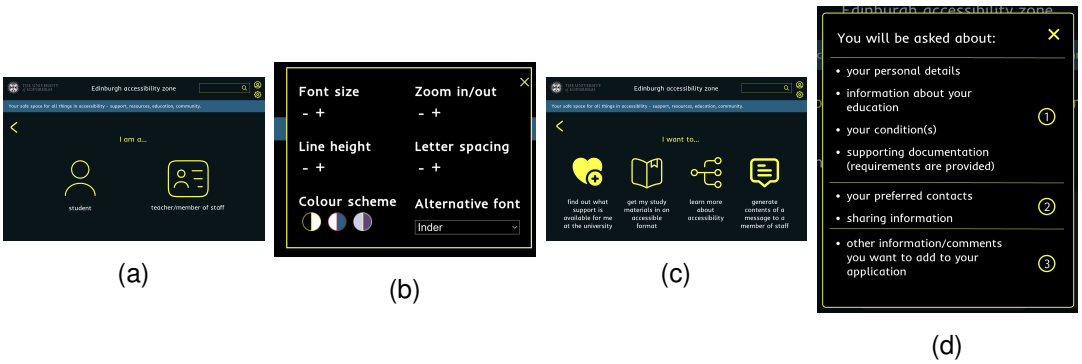
4.1 Prototype description

After gathering initial requirements through a relevant literature review, and conducting interviews with potential users and experts, a low-fidelity prototype of a web application was created using Figma [2]. Figma is a popular web tool used for interface design, that gained its popularity due to the amount and variability of features and enabling design of complex interaction flows. The intention behind creating a low-fidelity prototype was to enable formative evaluation of the usability of the tool through a cognitive walkthrough with experts and task-based thinking-aloud protocol followed by a short interview with users. The design of all screens is available in Appendix G

Tool's intention: A web application was chosen as an appropriate tool to design in order to meet the gathered requirements. Its online nature makes it easy to access and share, and at the same time it allows for a lot of flexibility when it comes to design and accessibility configurations of the browsers and machines (Requirement 10). The tool aims to centralise the most important resources for students with disabilities and members of faculty at the University of Edinburgh. It contains information about available support, accessible materials guidelines, disability awareness, as well as an option to upload such materials and generate contents of an email using generative AI (Requirements 1, 2, 3, 9 ,10).

Two modes: The users have the option to use one of two modes: Student or Teacher (Figure 4.1a). This solution limits the number of options available for the user in the next steps, which decreases the possibility of confusion and ensures a minimalist design (Requirement 6). The icons are supposed to help quick recognition, especially for users interacting with the system on a regular basis.

Accessibility settings: In the top right corner of the interface there are accessibility settings present at all times (Figure 4.1b). This solution was used to follow the requirement of customisability of the tool and the requirements for allowing user to change



(a) (b) (c) (d)

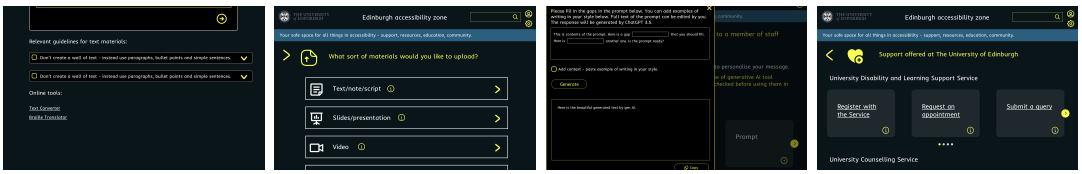
Figure 4.1: LFP screens: two modes, accessibility settings, four options, information map.

the size of the font and screen while maintaining content readability (Requirement 10). The settings allow for altering: font size, screen zoom, line spacing, letter spacing, colour scheme (three options), and font type. The default interface settings follow the standard requirements of accessibility guidelines for content size and style, and the default colour scheme maintains high contrast with three simple colours: black (background), white (main text), yellow (accent). The two other colour schemes are: (1.) white (background), dark blue (main text), dark pink (accent) for users preferring light mode, and (2.) light purple (background), dark purple (main text) and light olive green (accent) for users preferring 'calming', light colour scheme.

Four main options:the initial prototype assumed four options to choose from for users of both modes (Figure 4.1c). The student mode presented the user with: (1.) Support available, (2.) Study materials in accessible format, (3.) Learn more about accessibility, and (4.) Generate contents of a message to a member of staff. The staff mode presented the user with: (1.) Support available, (2.) Upload study materials, (3.) Learn more about accessibility, (4.) Manage my courses. Each option was presented in a form of a simple icon accompanied by text with the option's name. After choosing one of the options by clicking on it, the user is presented with another screen with relevant options and instructions.

Information maps: In order to ensure the predictability of user's choices and give users an overview of specific functionality, the concept of information maps was introduced and added to the system (Figure 4.1d) (Reuirement 7). An information map is a simple pop-up window with information describing what would happen next after the user chooses a specific option. If choosing an option is followed by multiple steps, the user is informed of each of them. An information map opens by clicking on an information button next to the relevant option. To prevent distraction, the rest of the page forms a background by changing its brightness to 50% of the original one. The map's content follows a simple, bulleted and vertical structure using plain English language, in order to convey messages quickly and effectively. The map can be closed at any time by clicking 'x' or any place outside of the map. The maps were introduced by the following system functionalities: material uploading (different map for each material type), support links, 'learn more' links, and generative AI options.

Guidelines checklists: To solve one of the main problems recognised during the requirements gathering stage (multiple accessibility guidelines scattered around the



(a) (b) (c) (d)

Figure 4.2: LFP screens: guidelines checklist, materials uploading, messages generation, support resources.

internet and staff's confusion around them) the guidelines checklist functionality was added (Figure 4.2a) (Requirements 1, 2). The main goal for it was to provide brief descriptions of key guidelines relevant to specific types of materials (text, video, slides, picture, audio). The user can expand each point to learn more about common methods of applying the rule, and how does applying the rule benefit certain users. The functionality of the checklist lets the user mark their progress and it improves the decision making process.

Materials uploading: Along with the guidelines checklist, the users in the teacher mode are prompted to follow next steps, allowing them to upload the material to the platform (Figure 4.2b). The steps were separated into a few consecutive screens and can be opened after clicking on an arrow icon pointing to the right, in order to prevent cognitive overload. The user can first upload their material for overview (like mentioned in previous point - 'Guideline checklists'), and access the checklist of guidelines and links to online tools. Then, in the next step they can add a description and an alternative format. Next screens prompts them to choose to create a new or already existing unit and the option to link current material to the past ones. At the end they are able to choose the unit title and successfully submit it. For video materials, the user has also an option to add subtitles and transcript, and for audio they can add transcript too. The screen for these options is one of the steps in the submission process.

Generative AI integration in messages: The option to generate contents of a message was introduced to support students with mobility and cognitive impairments, that may spend a lot of time and effort to write the whole email themselves (Requirement 9). The functionality is present in the student mode as one of four options. After opening the option, the user can see a range of various prompts representing requests to write a specific email. The prompts are grouped by categories of requests and are presented as tiles in an interactive carousel. After opening a prompt, the user is presented with an editable prompt, where they can add details (Figure 4.2c). Below is a checkbox to choose if the user wishes to add an example of their previous messages, so that the style of a new message can match the style of the old ones. The message is generated by ChatGPT 3.5. and the user can copy its contents.

Support and learning resources: To address the issue of difficulty in finding support offered at the university and knowledge resources on accessibility, the 'Find Support Offered at University' and 'Learn More About Accessibility' options were added both to the student and staff mode (Figure 4.2d) (Requirement 3). Both screens share similar layout pattern, to decrease cognitive overload of the user. Both screens present the user with links to relevant resources grouped into various categories. Links in each category are presented as separate tiles in an interactive carousel, with an 'i' icon underneath

each link, representing an option to open an information map.

4.2 Prototype evaluation

To identify usability and content-related issues with the low-fidelity prototype, two rounds of evaluation were conducted. The first iteration included a cognitive walk-through with two experts in Human-Computer Interaction (HCI) and front-end design and development, and the second iteration involved students with disabilities and two university teachers, who acted as both potential users and experts in HCI.

4.2.1 Cognitive walkthrough

The first iteration of prototype evaluation consisted of a cognitive walkthrough run by two fellow student researchers with experience in human-computer interaction and front-end design and development. A cognitive walkthrough is a structured evaluation method to test usability of a product [38]. Unlike other methods, it considers not only the usability of the tool, but also the cognitive activities of users, such as goals and knowledge. The evaluators, who are not users, use the interface to perform tasks that a typical system's user would need to accomplish. The actions and responses of the interface are evaluated according to the user's goals and knowledge through responses to relevant questions that measure the differences between user's expectations and the use reality.

Aims: The aims of this cognitive walkthrough were to (1.) identify possible usability issues in the design; (2.) evaluate the cognitive workload expected from the users; (3.) determine the best way to present resources in the system; (4.) gather feedback on the overall design.

Participants: The experts were two fellow students experienced in HCI and front-end development. Table 4.1 sums up their characteristics.

Procedure: The meeting was conducted in person during one session. The participants

Participant number	Role
E1	Masters Computer Science student and Software Engineer, with experience in human-computer interaction, front-end web and app design and development
E2	Bachelors Computer Science and Mathematics student and Software Engineer at the University's Information Services Group, experienced in web development, computer science ethics and education

Table 4.1: Cognitive Walkthrough experts

were familiarised with the Participants Information Sheet prior to the study, and gave their written and oral consent. The session was audio-recorded, and then transcribed. The researcher was also taking notes. The experts were presented with a range of tasks to perform on the interactive low-fidelity prototype, steps to complete them, and four questions related to the usability of the tool. They were free to discuss their opinion and encouraged to share both positive and negative aspects of the interface. The

questions for each task were taken from a paper ”Cognitive Walktrough for the Web” by Blackmon, Polson, et al.(2002) [18], and are: *Q1. Will the user try and achieve the right outcome?*, *Q2. Will the user notice that the correct action is available to them?*, *Q3. Will the user associate the correct action with the outcome they expect to achieve?*, *Q4. If the correct action is performed, will the user see that progress is being made towards their intended outcome?*.
The given tasks along with the steps necessary to perform them are included in Appendix H
Results: The results of the cognitive walkthrough are presented in Table 4.2. The main areas for improvement were identified as: (1.) Wording of the main options' titles; (2.) Choice of icon for ”learn more”; (3.) Separating materials guidelines from uploading; and are further described in Table 4.4. These recommendations are further referenced by the number identifying the cognitive walkthrough task through which they were discovered, e.x. CW-1 for experts' recommendations from task 1.

4.2.2 Evaluation with students and university staff

The prototype was then evaluated with potential users and experts, in order to check whether considerations from the cognitive walkthrough would hold with real users and to identify new areas for development.
Aims: The aims of this part of evaluation were to: (1.) evaluate the level of appropriateness of the current design for target population; (2.) determine the categories of resources to include on the website; (3.) identify the most and least useful options for students and staff; (4.) identify possible usability issues in the design.
Participants: As the tool's intended audience are both students and university staff, two members of each group (four in total) were invited for on-on-one evaluation sessions. Two faculty members had also experience in human-computer interaction and were counted as potential users and experts. Only P1 and P3 have taken part in the previous stage of the study (requirements gathering interviews), so the sample was balanced. Table 4.3 sums up the characteristics of the participants.
Procedure: The evaluation sessions were carried out in-person, separately with each participant. The sessions were audio-recorded and later transcribed by the researcher. Task-based evaluation was chosen as an appropriate method to conduct the study, as it let the researcher test specific parts of the system and gather feedback on them. The participants were encouraged to employ a 'Think Aloud' technique when they perform the tasks. Think Aloud protocol focuses on participants verabalising their thoughts and is a popular usability evaluation technique due to its low cost and the fact that it doesn't require many participants, much training and much analysis [28]. The users were asked to perform given tasks on a user interface prototype (without being given the correct steps) and to say their thoughts aloud. The task-based analysis was followed by a short semi-structured interview, to get a deeper understanding of some points raised in the previous part and get overall feedback on the presented tool. The tasks and questions for this part can be found in Appendix H
Data and analysis: The audio recordings were transcribed by the researcher and were analysed along with the notes. Thematic analysis was chosen as an appropriate method

Task	**Answers to questions 1-4**	**Experts justification**
1	*Q1:* Yes *Q2:* Yes *Q3:* Yes *Q4:* Yes	The user has to follow a simple route to find the link. The 'support' icon is relevant and easy to associate with the option. The user is always informed about which section they're in.
2	*Q1:* Yes *Q2:* Maybe *Q3:* Maybe *Q4:* Yes	The user can easily find 'messages' icon and associate it with the option. The carousel tiles take a lot of space and user may not know about other options below. The user may expect to write their own prompt instead of filling it in.
3	*Q1:* Yes *Q2:* Yes *Q3:* Yes *Q4:* Yes	The 'upload materials' icon is easy to find and so are the following icons for different materials. If the user chooses to click on the 'i' icon, they will read about the steps, but they can also open the screen for the material and click through the arrows.
4	*Q1:* Yes *Q2:* Yes *Q3:* Yes *Q4:* Yes	The 'upload materials' and 'video' icon are clear to the user. The user can use the information map if they want to know what will happen. The consecutive steps let user know the progress and complete the step if the action at a time.
5	*Q1:* Yes *Q2:* Yes *Q3:* Maybe *Q4:* Yes	The user will find the option, the icon has a very clear meaning. The user may be confused, and expect to have their materials changed to accessible formats instead of just finding what has been uploaded. The layout shows clearly what courses are available.
6	*Q1:* Yes *Q2:* Maybe *Q3:* Yes *Q4:* Yes	The user will expect to find such information under topic 'learn more about accessibility', but they may find the icon confusing. The titles identifying carousels are appropriate and the tiles are intuitive to navigate.
7	*Q1:* Maybe *Q2:* Maybe *Q3:* No *Q4:* Yes	The user may be confused about where to start, as there is no clear option to check guidelines. The user is expected to click on the uploading button, which may be their choice only after excluding other options. After they get to the next screen, it's easy to see the guidelines and check their contents.

Table 4.2: Cognitive walkthrough results

Participant number	Group	Role
P1	S	university applicant with ADHD returning to education
P2	S	Bachelor's Computer Science and Mathematics Student identifying as colorblind
P3	T	university lecturer, course organiser, past personal tutor and expert in HCI and software engineering
P4	T	university tutor, course organiser and expert in computer science ethics and robotics

Table 4.3: Participants of low-fidelity prototype evaluation

of evaluating the collected data and declarative approach was used - the themes for the analysis were established based on the tasks to be completed by the participants and aims of this part of study.

Results: The following themes were expanded during the analysis:

Finding support and accessibility information: All four participants had no problem with tasks related to finding links to specific support places. P3 mentioned that *"It makes sense (...) you have them split into sections."*, but she found the tiles *"quite big"*. P2 said he would use it often as it's *"nice that everything is in one place."*. The participants pointed out they have all experienced issues in finding links to support resources in the past, and that the problem is wide-spread across the university, especially among students with disabilities, who may need to use specific services offered by the university more often. When it comes to the visual identification, P3 said she felt *"supported"* and *"protected"* when she saw the icons used in this section.

Uploading and managing materials: Both P3 and P4, when prompted to upload a video material, narrowed down their choices to two options: 'managing materials' and 'uploading materials', and found it confusing. P4 said *"I was going to say manage my course and units, but there's also an upload my course material (...) so one of these two."*. There was also confusion about radio-type buttons for choosing a video format, with concerns being *"That also reads to me as not selected."*. Some wording was confusing, as P4 said *"I'm not clear what a unit is."*. P3 mentioned she would like to have *"some shortcuts from withing the courses(...) to add materials."*. Both P3 and P4, who are members of faculty, said they already have to upload their materials to other platforms, and that having another hub would require *"a lot of time and effort"* and it would require additional levels of security.

Guidelines checklists: In contrary to the functionality to upload materials, P3 and P4 both had a positive reaction to the checklist functionality, and mentioned they would use it more often than the option to upload materials - *"I imagine I would be more likely to use this as a check at some stage."*, said P4. He also said he would *"add a link to some*

relevant study" to add more context to the guidelines. Both participants stressed the importance of having relevant and up-to-date guidelines, especially for less experienced members of faculty. P3 found the guidelines *"extremely useful"* and she said she would *"probably start adding materials (...) by starting from this tool."*, while P4 pointed out how much easier his workflow would be, when he said *"I would do this processing in one sitting, update the materials as a result and then put them wherever I put my materials."*. Again, the main idea of the tool, that is centralisation, was mentioned, when P3 said she likes *"everything in one place"*.

Information maps: With regards to the information maps, appearing on the screen after clicking an "i" icon, both experts (P3 and P4) found the idea *"very good"* and *"very helpful"*, but they both pointed out that although *"They don't occupy much space"*, the researcher should be careful about making them accessible for users with mobility difficulties. P1 and P2 had no issues with finding information through the use of maps and when asked about how useful it would be for them in the future, P2 said he finds it *"very useful, because sometimes you don't know where you'll end up"*. P3 added that she usually uses *"these kinds of things"* pointing out the appropriateness of the solution.

Generating messages: When asked to generate contents of a message using the prototype of the interface, no participants had any difficulties with it, as they mentioned that the option is *"labeled very clearly with text and icon"*. When asked about how often they would use it, P1 said it's a good idea, because *"sometimes I overthink the tone and message too much"* and that it would be good to *"have something to even compare to"*, while P2 said that even though he wouldn't use it often, he sees *"why someone else may use it"*. Both P3 and P4 expressed interest in this option and recommended making sure that the user is aware that it's AI, but P3 also added she notices *"more and more students using Chat GPT"* and that there's no reason to *"fight it"*. The categories of prompts were clear and understandable to all participants, and P1 said that *"it's good you can add more prompts in the future"*.

Tool's appropriateness: When it comes to the general feedback about the tool, all four participants were enthusiastic about the idea of it and expressed their willingness to use it. P3 said *"it's good to have everything in one place, because I don't have time."* and added that there are many ways to integrate it with other tools in the future. From the perspective of students, P1 said he would find it *"useful to know what options are available to me"*. P4 stressed that this tool should make it clear to the user, what they can expect under every option, and that support should be moved to the left, so that it's *"easier to find"*. All users enjoyed the idea of customisation settings in the top right corner and they all ensured that having various customisation options will make it more friendly to users with different disabilities. It can be therefore reasoned, that the tool is appropriate for both students and university staff.

Graphical design: With regards to the iconography used, P4 said *"Yeah, these icons are clear."* and *"That seems like a good choice of icon to me."* when asked about the "learn more" option. When it comes to the options presented, P4 found the ordering *"a bit strange"*. Overall the flow of going through the system was clear to all participants, and P4 added that the design feels *"clean, in the sense that there's not a lot of complexity to it."*. Both experts and students mentioned that they don't like complex interfaces

No	Recommendation	Source	Justification
1.	Decrease the size of carousel tiles and option icons	P3	Too big tiles and icons can limit space for other content, so minimising them would make the design more clear.
2.	Remove the upload functionality	CW-5 P3, P4	The uploading functionality would not be used often due to platform duplication, and the teachers prefer to use only checklist.
3.	Add study links to the guidelines in checklists	P3	The links add more context and explanation of the rule.
4.	Display message prompts in an editable text field.	P1, CW-2	It gives the user more control over the prompt, while still having the option to stay with the original prompt.
5.	Change the wording of options in both modes	CW-2 CW-7, P4	The option to check guidelines checklist should be identifiable more directly. User should know exactly what to expect in the messages option.
6.	Change the icon for learn more	CW-6	The icon has to clearly indicate the availability of knowledge resources

Table 4.4: Recommendations for design improvements

and recommended to keep this design, as it would be easy to navigate by people with different disabilities, while P4 expressed that he likes that *"It's not overburdening me with options."*. P3 added that she likes big icons *"which can be helpful for people who have a mobility difficulty"*, but she mentioned she still found them *"too big"*. When asked about the colour palette, P2 said it is *"very clear"* and "readable" for him, as he has experience difficulties in distinguishing colors on websites in the past, and P3 pointed out that black background is *"very easy to read"*, and that she uses *"a night mode (...) because it's better for the eyes."*.

4.2.3 Impact on the design

Overall, the idea of the presented tool was welcomed by experts, students, and members of faculty, who participated in the evaluation studies. All participants were very enthusiastic about the idea of having *"one accessibility hub for everything I may need"*, as P1 said. Although the tool was found to be generally usable and accessible, a few points were made about some issues that the users had while navigating through the interface. The feedback about the tool obtained through the cognitive walkthrough and task-based evaluation with participants allowed the researcher to list recommendations for design improvements that were then employed in the following stages of system re-design. Table 4.4 contains all gathered recommendations and their impact on the tool's design.

Chapter 5

High-fidelity prototype

*This chapter presents the high-fidelity prototype of the tool created in React.js. Technical and design decisions are discussed. This chapter partially answers **RQ2**.*

5.1 Technical decisions

The decision was made to develop the system as a web application, as it would be form that is easy to share, access through different browsers and platforms, customise through browser and system configurations, and it is a form already friendly for most students and members of staff at the university.

Implementation framework: The system was implemented using React.js [3], which is a popular and open-source JavaScript library used for building user-interfaces. The code developed in React.js is based on components, which are reusable block of code, that are easy to integrate with each other. The library reinforces the idea of using semantic HTML that enables seamless integration with assistive technologies and accessibility features such as keyboard navigation, and hence is one of the foundational concepts of accessibility in web technology. Moreover, React's flexibility and scalability make future development of the application easier. The system can be continuously improved and expanded due to its easy maintenance and update integration, without compromising its accessibility or performance. Overall, React.js provides a solid foundation for creating accessible web applications that can evolve according to the needs of its users over time.

Accessibility measures applied: In order to ensure accessibility and customisability of the website, various technical solutions were employed. These were inspired by the initial requirements for the system, accessibility guidelines mentioned in Chapter 3 and the results of formative evaluation. In order to ensure integration with voice over technologies, all visual content was accompanied by descriptive alternative text, as an ”alt” tag in the React or HTML components. Next, the keyboard navigation was ensured by adding a focus to all interactive elements. The focus frame was changed from a default to thick and visible one (2px, red), so that every user can see the object that has current focus frame on it. Another design choice was to employ single font throughout the website to allow users to adjust the font size and style according to their

preferences using their browser configuration. This ensures readability for users with visual impairments and provides a consistent experience across different devices and platforms. A limited colour palette was used to minimise cognitive overload of the user. The colours maintained high contrast between text and its background (at least 7:1 for normal size text and 4.5:1 for large text [37]) and visual elements and their background (at least 3:1 [37]). Finally, proper semantic HTML markup was utilised, including increasing headings order and proper naming, to provide a clear structure and make navigation for assistive technologies, such as screen readers, more seamless.

Accessibility configurations on website: Another technological challenge was to employ a range of accessibility setting options, that every user can access from the level of the website. This was reasoned to be an optimal solution for users who may not be familiar or comfortable with changing configurations inbuilt in their browsers. The website maintained integration with the browser, so that users choosing the browser settings instead of settings embedded on the website, can also be supported. The choice of settings was based on the WCAG accessibility guidelines [37]. Quantitative options include: font size, letter space, line space and zooming in and out, while qualitative options include change of colour scheme and font style. These were implemented through the use of props (special arguments passed in React.js components [3]), a few simple functions, CSS sheets and useState hooks (a way to preserve specific values between different React components). The colour schemes were chosen to be black-white-yellow (black background, white main text, yellow accents) and cream-black-turquoise (cream background, black main text, turquoise accents). The third colours scheme was chosen to be light purple-dark purple-yellow (light purple background, dark purple main text, yellow accents) as a third option acting solely as a comparison for the final evaluation.

Generative AI integration: To develop the student generate an email, the implementation required strategic prompt engineering and integration of the system with a separately hosted generative artificial intelligence platform. For this case, ChatGpt 3.5 was chosen, as it is a wide-known advanced natural language processing model available online. Due to its separately hosted nature, scalability of the system is ensured, allowing for future extensions and development of the system. Integrating the website with ChatGPT 3.5 allows the user to generate a coherent email content tailored to a chosen prompt and contextual input. The strategic prompt engineering involved: (1.) creating prompts that accurately convey the desired request for email's content to the language model; (2.) creating editable text fields for the prompt (filled in with the prompt text by default) and past messages of the user that provide context for the style of the message (empty by default); (3.) forming the final prompt passed as an argument to the language model, which included putting together contents of two text fields with additional phrases conditioned on the availability of the text in the second field. The prompt was then passed to ChatGpt 3.5 through the use of openai API, using a specifically generated secret key.

External hosting: Since the tool's final form is a website, also recognised as a web app, its contents had to be hosted online for the users to access it easily and quickly. Netlify was used as a platform to host the system, as it allows hosting of dynamic and interactive websites enabling their full original functionality. It also allows secure hosting of projects stored on GitHub, a popular version control online platform, that was chosen for this project. hyperref

5.2 Prototype description

The high fidelity prototype was implemented as an online hosted web application, available at https://edinburghaccessibilityhub.netlify.app/. All screens from the website are available in Appendix I. The original concept of an accessibility hub remained, while some changes were made based on the recommendations described in Section 4.2.3. The biggest change involved removing the uploading materials functionality, as the formative evaluation has proven it to be obsolete due to platform duplication and unnecessary complexity and confusion it was adding to other functionalities, such as checking guidelines. Other changes involved reordering some components, changing wording of some titles and short descriptions, and a few visual improvements, all as described before. This allowed for improved usability and visual appealing of the tool, and it enabled the researcher to focus on detailed implementation of other functionalities, such as generative AI integration and guidelines checklists. The final prototype included changed textual placeholders to give users an idea of what the final resources would look like.

Main menu: The first screen that the user sees after opening the web application is a simple combination of two modes represented by both icons and text, to allow recognition rather than recall and decrease cognitive workload on the user [44]. The options represent a student mode and a staff mode and the user can proceed with either, to uncover options for the specified audience. The size of icons was decreased, as per recommendation obtained during formative evaluation (Recommendation 1).

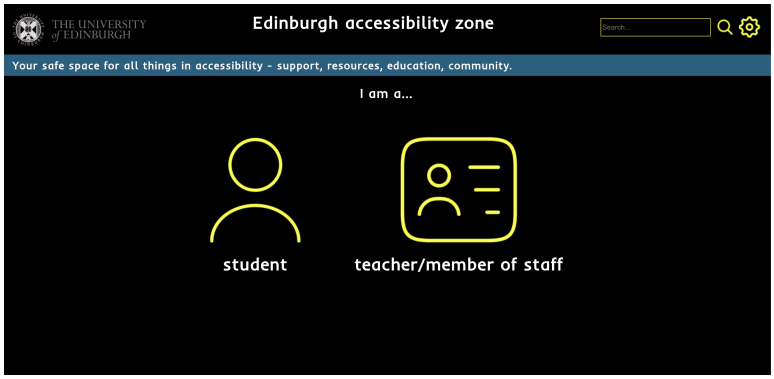


Figure 5.1: Main menu with two modes: student and member of staff.

Student options: After opening student mode, the user is presented with three options (Figure 5.2). A simple design was intended to again decrease the cognitive overload. The options were renamed, to include shorter, but more direct titles (Recommendation 5), and the size of the icons representing them was slightly decreased (Recommendation 1). The icon for ”learn more” option was also changed, as per suggestion in the formative evaluation (Recommendation 6), to comply with the sixth heuristic of Pribeanu [44]. The user can choose from one of three options: generate a message, find support, and learn more, all phrased in a way to finish the sentence ”I want to...” at the top-left of the screen. The screen follows the main style of the colour scheme and icon type and layout as other screens in the web app, to comply with the Consistency heuristic [44].

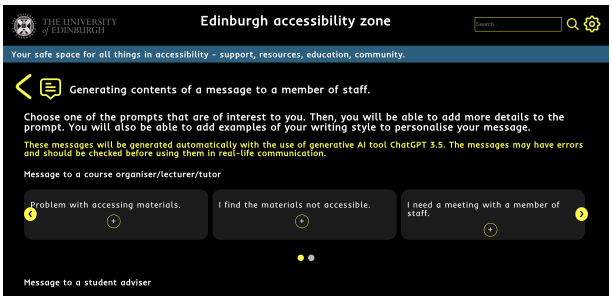
Staff options: Similarly to the student options, the options for staff are presented in the same style and order (Pribeanu’s Consistency heuristic [44]) (Figure 5.3). The only

Figure 5.2: Options in the student mode.

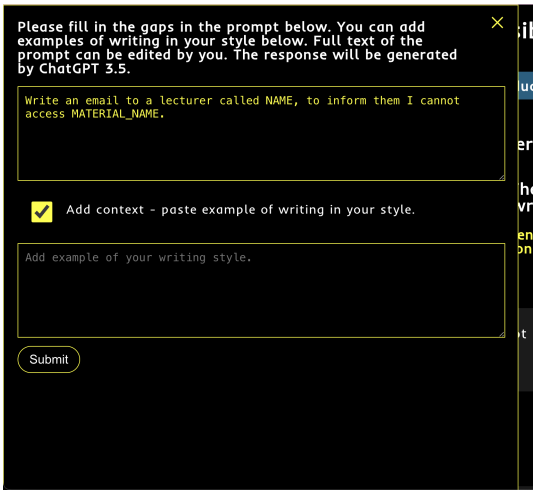
difference is the ”check my materials with guidelines” option replacing ”generate a message” in the student mode. Just like the options screen in the student mode, the staff mode presents all possible options in a clear, simple and linear layout (Requirements 6 and 8). The wording of the first option was changed from ”upload my course materials and make them accessible” to ”check my materials with guidelines”, as the functionality behind the option was changed and the results of the formative evaluation suggested to clarify the wording (Recommendations 2 and 5, Requirement 4).

Figure 5.3: Options in the staff mode.

Messages generation: One of the options available in the student mode is to ”generate contents of a message” (Requirement 9). Here, the user is presented with a few horizontal carousels containing tiles with available situations. The carousels are grouped according to different topics of messages (Figure **??**). After clicking on one of the tiles, a side window is opened to reveal the automatically generated prompt (description of a request passed to ChatGpt). The user has an option to check a checkbox in order to add an example of some past messages written in their style. If the text is pasted into this field (the field appears after the option is checked on), the program changes the passed prompt internally with specific phrases added, to make the input into the language model more accurate. Both text fields (initially generated prompt and past messages) are editable (Recommendation 4), to give user full control and flexibility (Pribeanu’s ninth and tenth heuristics). After clicking the ”submit” button, contents of a message generated by ChatGpt 3.5 appear below and the user has an option to copy it.
Guidelines checklist: Following the feedback from formative evaluation, the option to



(a) Main screen of the ”generate a message” option with available prompts.



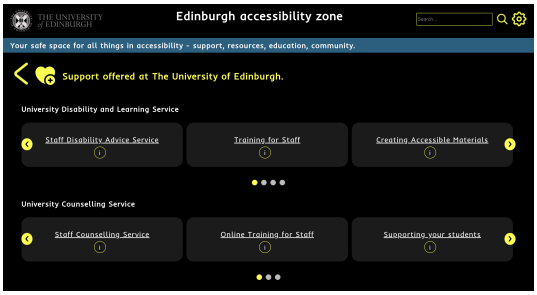
(b) Side window opening after a prompt is chosen.

Figure 5.4: Screens for generating contents of a message.

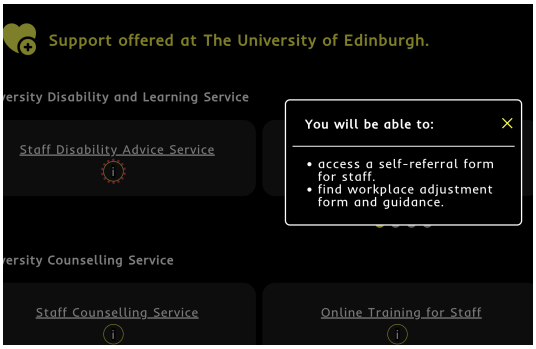
upload and check materials was transformed into ”check my materials with guidelines” (Recommendation 2 and 5). After navigating to this screen, the user can choose one of the types of materials (text, slides, video, picture, audio) and, in the new screen, upload their file for overview and access an interactive set of guidelines (Requirements 1 and 2). This set contains guidelines describing how to create accessible study materials for students, and is inspired by guidelines mentioned in Section 3.2, under ”Accessible materials creation guidelines”. This was implemented in a checklist form, to give the user overview of possible actions and freedom of choice - they can follow the guidelines they want since the list serves as their private check only. The tiles with guidelines were implemented in a way that lets the user extend each guideline, to obtain further information such as examples of implementing a guideline or a link to a related study (Recommendation 3). Below the interactive checklist there are also available links to various online tools, that can help the user change the original format of a chosen document.

Support resources: In order to fulfil Requirement 3 (provide a quick access to the most important support resources), both modes (student and staff) have an option to find relevant support resources (Figure **??**). The icon representing the option maintained the same as in the low-fiedlity prototype, due to very positive feedback it received during formative evaluation. After opening the option, the user is presented with a set of carousels following style very similar to the one in other screens (generate a message, learn more) to maintain consistency (Pribeanu’s fifth heuristic [44] and WCAG 3.2.3 and 3.2.4 [37]). The tiles in the carousels contain links to the relevant webpages including information about specific support resource, such as support phone numbers, support policies or forms. Every tile contains an ”i” icon as well, that represents an information map after clicking on the icon. The information map is a short overlayed piece of information designed specifically for this system (Requirements 7 and 8). Information maps contain short information about what the user will be able to access after following the link and, if needed, what they should have prepared. This minimises the cognitive

overload related to accessing multiple resources and different websites (Pribeanu's third, sixth and twelfth heuristics) and was proven to be supportive to the user during formative evaluation. The size of tiles was decreased, following Recommendation 1.



(a) Main screen for the staff support options.



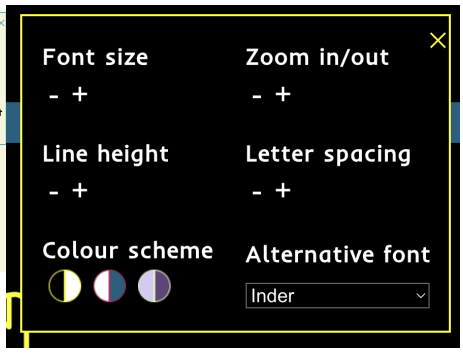
(b) Information map in the support screen.

Figure 5.5: Support options for staff.

Learning resources: Similarly to the support resources, the user can also navigate to a screen containing resources about accessibility. This option is called "learn more" in both modes (student and staff) and has a different icon (book), which is more representative of learning resources than the icon used in the low-fidelity prototype (Recommendation 6). The carousels maintained the same style as in support resources Pribeanu's fifth heuristic) and all tiles also consist of a link to an external website and a dedicated information map. The sources were grouped into categories, that are represented by each carousel.

Accessibility settings: Finally, the accessibility settings are available on every screen in the top right corner under a well-known "settings" icon (Figure **??**). They allow the user to customise the visual aspect of the page freely and are fully operable by both mouse and keyboard input (Requirements 5, 8 and 11). Even though the user is able to adjust the settings according to their preference, the default version of the website already holds enough contrast ratio between the colours and has a font size big enough (WCAG 1.4 [37]).

(a) Main screen with changed font style, font size, increased letter spacing and changed colour scheme.



(b) Accessibility settings window.

Figure 5.6: Accessibility settings.

Chapter 6

High-fidelity prototype evaluation

*This chapter discusses final evaluation of the tool with experts and users and answers **RQ2** and **RQ3**.*

6.1 Evaluation with experts

To determine whether the proposed tool was appropriate and accessible for the target audience (university students and staff), first, the evaluation with experts was run.

6.1.1 Aims

The evaluation with experts was run in order to determine: 1) If the tool is appropriate for its target audience; 2) To what extent the tool is effective as a resource hub for students and staff; 3) To what extent is the tool accessible; 4) Whether there are any usability issues; 5) Areas for further development of the tool.

6.1.2 Participants

The participants were four experts in the fields of Human-Computer Interaction, Accessibility and Software Engineering.

Participant Number	Expert field
E1	Head of Disability Information at UoE, expert in accessibility
E2	Assistant Director at the Disability and Learning Service at UoE
E3	university lecturer, course organiser, past personal tutor and expert in HCI and software engineering
E4	course organiser, expert in accessibility, pedagogy and artificial intelligence

Table 6.1: Expert participants of the high-fidelity prototype evaluation.

6.1.3 Procedure

The participants were met online or in person. The participants have been informed of the aims and nature of the study through Participant Information Sheet (Appendix A) and gave their consent both orally and on paper (Appendix B). Each evaluation session was run individually by the researcher and used Cooperative Evaluation as the main method. Cooperative evaluation is a popular user-interface evaluation method, that is an extension of Think Aloud technique. It focuses on the participant not only expressing their opinions through Think Aloud, but also raising questions and possible discussion points, making them a collaborator [56]. This method was chosen, as the researcher could get more detailed insight into participant's thoughts, as well as gather additional feedback and ideas for future extensions of the system. Each participant was instructed to freely navigate through the system and discover various options and screens, as well as use the accessibility settings. The participants were encouraged to think aloud and raise questions, and the researcher would engage in the conversation if asked to. Afterwards, the researcher would conduct a short semi-structured interview, to find out the positive and negative sides of the tool and get feedback on usability and accessibility of the tool. The questions are available in Appendix J. The participants were also encouraged to share their rating of the tool and their ideas for alternative functionalities' implementation and possible future extensions for the system. At the end of the procedure, each participant was asked to fill in a short questionnaire following System Usability Scale (SUS) [16] that consists of ten usability questions, each rated on a scale from 1(strongly disagree) to 5 (strongly agree) (Appendix K). This provided the researcher with quantitative data in addition to qualitative data gathered in the previous part of the evaluation. The participants were able to provide additional feedback as an answer to non-mandatory open questions at the end of the questionnaire. At the end, all experts were asked to rate appropriateness, intuitiveness, effectiveness, and lack of confusion on a scale from 1 to 5.

6.1.4 Data Collection and Analysis

The recordings from the evaluation sessions were transcribed. Along with the researcher's notes, they were analysed using Thematic Analysis [19]. The answers to the SUS questionnaire were analysed using a popular method of calculation: for each of the positively framed statements, subtract 1 from the score; for each of the negatively framed statements, subtract their value from 5. These values were then added up for each participant and the total score was multiplied by 2.5. The final result for each participant is out of 100. The answers to four questions at the end were noted by the researcher and put on a scale from 1 (most negative) to 5 (most positive).

6.1.5 Results

The following themes emerged from the thematic analysis of the final evaluation with experts:

Resources and guidelines: Overall, the support and learning resources available to users received a very positive reaction, with E1 calling the information *"really helpful"* and E3 naming it *"excellent selection"*. E2 suggested adding Student Wellbeing service

as one of the support carousel topics. When it comes to the guidelines for materials creation, E3 liked the format of the checklist, because *"you can click them, that looks great"* and she said that the functionality to expand the tiles is *"a very good idea because these could be very long"* and *"you don't want people to always scroll down to read everything"*. E4 suggested a possible extension in the future, that could let the user group such guidelines to their own categories and have two rows - for the ones they would and wouldn't use. E1 pointed out that leaving the guidelines as a manual checklist, instead of an automatic one is *"really nice"*, because *"automated checking, particularly around accessibility, is really poor"* and *"it will only pick about 20 to 30 percent of accessibility errors"*, which may lead the creators to confusion. The guidelines checklist functionality was called *"managing system"* by E3, but she also suggested to add *"dragging and dropping multiple files"* to the overview of the material.

Message generation: The topic of message generation was met with excitement and curiosity by the experts, as they found the functionality very helpful to the students struggling with writing emails. E1 liked *"the idea of (...) having a sample (...) email template"*, while E2 found it *"really nice"* and said she would recommend this to students. With regards to suggestions for future development, E2 suggested adding prompts about *"physical access or not being able to get into the class"*, *"staff not wearing microphones"*, and *"lack of awareness of the accessible and inclusive learning policy"* among staff. E1 added that the system could use *"having flags"* that inform service employees *"if someone puts anything in it that suggests they're at risk of harm"*. Additionally, E3 suggested adding an option to fill in the prompt as a form in addition to the implemented text field.

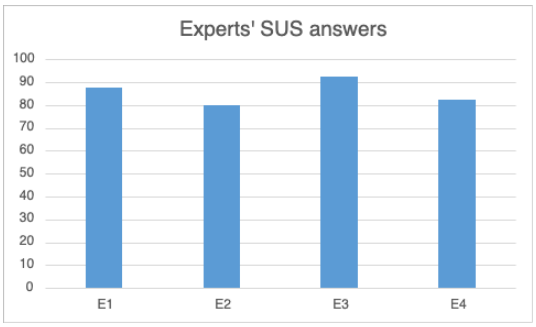
Usability: When speaking of usability of the website, experts mentioned the clear information structure, simple, easy to navigate interface, and intuitive icons. E1 liked *"the fact that there's not loads of information on a single screen, it's quite simple, very clear"* and said it is *"really clear what you're looking for"*. E3 mentioned that the page looked *"very clear to me"* and that *"the text is big enough to work on a tablet"*. When going through different options and functionalities, no experts felt lost at any time, rating their level of confusion as mostly 1 or 2 out of 5. E1 added that the resources are *"nice and straightforward"*, while E3 judged the icons as *"very clear"*, *"intuitive"* and *"placed in the right place"*, but suggested to add an option to *"click the title and go back to the main page"*. E4 has added a suggestion to consider adding alternative design of overlays (information maps), giving the user an option to open them on the same page, not "over" it.

Accessibility: The accessibility of the tool was rated very positively by all experts: E2 enjoyed *"the contrast, the font you've used, very accessible"*, while E1 claimed *"what we call focus visible, which is the red outline"* is really *"visible"* and *"clear"*, but mentioned it should be *"solid rather than dots"*. E2 has also warned the researcher to *"make sure the pop-ups are accessible for screen readers"* when talking about information maps. E3 found the colour scheme *"very good"* and suggested to *"allow people to customise colours"* in the future. When it comes to the accessibility settings, E4 mentioned that these should be already available in the browser configuration, but E1 said that *"as long as they work together, it's good"*. Another suggestion was made by E3 to *"put the most used fonts on top of the list"*. All experts agreed that the tool would be accessible to users with various disabilities and mentioned good keyboard

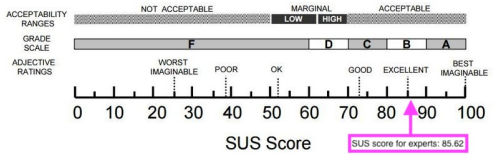
navigation, simple layout and *"big, easy to click icons"*.

Appropriateness of the tool: Overall, the tool was perceived very positively and the feedback from experts suggests that it is highly appropriate for students with disabilities and university staff. Experts commented on its effectiveness in facilitating communication and resource access, with E2 saying that she likes how *"it's giving students an easy way and support to communicate their accessibility needs to the wider university"*. Both E1 and E4 mentioned the centralisation of resources and information as an advantage of the system, because *"it potentially saves time"* and *"you could see useful things you didn't know about"* (E4). E1 called it a *"one-stop-shop"* and said that *"people would find it helpful"*. The tool's "accessibility-hub" nature was thought to benefit the university community through offering them convenient and comprehensive support. On top of that, both E3 and E4, who are academics, said they would use it *"whenever necessary"* and recommend it to their colleagues and students. E1 added that students would be able to visit the place, because right now *"it's so devolved within the university"* and central hub would be a place to go for many of them.

SUS results: The results of the SUS questionnaire among experts were calculated according to the methodology described in Section 6.1.4. The score for each expert is presented in Figure 6.1a. The average score among the expert is 85.62, which is rated as "excellent" on the SUS score scale developed by Bangor et al [16]. This suggests that the experts perceived the tool as usable and effective.



(a) SUS scores per expert.



(b) SUS score for experts on Bangor et al's scale

Figure 6.1: SUS score for experts.

Final rating: Figure 6.2 presents the experts' final ratings for four categories. Appropriateness was rated as mostly fives and one four, with E4 saying that once the tool is complete and has all relevant information added, it would be a five. Intuitiveness was rated as mostly fours and one five, with experts, who rated it as four, mentioning that they like the overall layout of the page and needed to get a bit more familiar with the functionality of generating messages contents and opening information maps. All experts agreed that the tool will be highly effective in sharing resources with students and staff, as it's well structured and contains clear information. Finally, two experts said they did not feel confused at any point of the interface navigation, while E1 and E2 mentioned being confused by some wording in the teacher mode, but they pointed out that they're not academics themselves and hence may not be familiar with "the whole university courses structure".

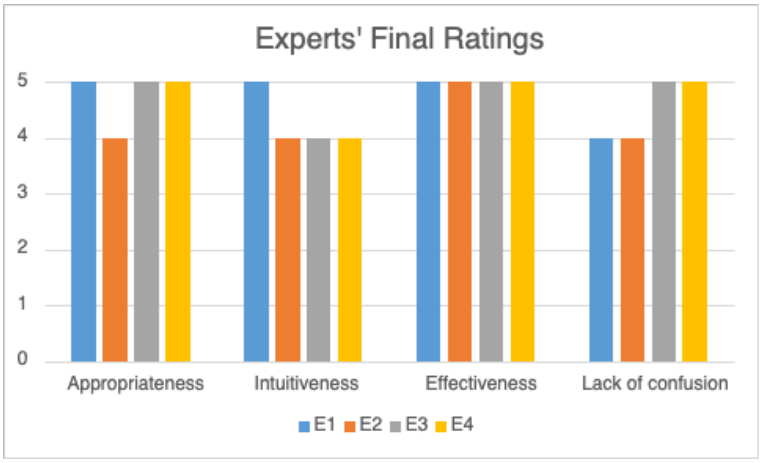


Figure 6.2: Final ratings given by experts

6.2 Evaluation with students and academic staff

After the high-fidelity prototype evaluation with experts, another round of evaluation was conducted, this time with potential users.

6.2.1 Aims

The user evaluation of the high-fidelity prototype aimed to determine: 1.) The extent to which the tool is effective at presenting key resources to students and staff; 2.) The positive and negative aspects of the tool; 3.) Whether there are any usability and accessibility issues; 4.) Ideas for future development of the app.

6.2.2 Participants

The participants of this part of the study were potential users representing two categories: members of teaching staff and students. Two students (P1, P2) and one member of staff (P4) have taken part in the previous stage of the project - the formative evaluation - and they were involved so that the researcher could gain insight into their opinion about the tool's evolution, while the opinion of other participants served as a new perspective. Three student participants (P1, P2, P3) identified as students with disabilities. Balancing the sample gave the researcher insight into an overall reception of the tool in the university community.

6.2.3 Procedure

All participants were informed about nature of the study prior to the sessions, and were familiarised with Participant Information Sheet (Appendix A) and consent form (Appendix B). The participants expressed their consent both orally and on the sheet or in the digital questionnaire. The researcher met each participant individually either online or in person. Similar to the high-fidelity prototype evaluation with the experts, the participants were asked to browse freely through the high-fidelity prototype and think aloud. Task-based evaluation was not employed at this stage, as the participants were

Participant Number	Description
P1	university applicant with ADHD returning to education
P2	Bachelor's Computer Science and Mathematics Student identifying as colorblind
P3	Bachelor's Computer Science and Mathematics Student with ADHD and on the Autism spectrum (AuDHD)
P4	university tutor, course organiser and expert in computer science ethics and robotics
P5	final year Bachelor's student at University of Edinburgh
P6	university lecturer at the School of Informatics, expert in computer science education
P7	final year Bachelor's Computer Science student
P8	final year Bachelor's student at the School of Informatics
P9	final year Bachelor's CS and Mathematics student
P10	final year Masters student

Table 6.2: User participants of the high-fidelity prototype evaluation

supposed to be set in a natural setting, and the amount of options was judged as not too numerous during the formative evaluation. Afterwards, a semi-structured interview was conducted with some participants (P1-P4) (Appendix J), and all participants were asked to fill in the same SUS questionnaire (Appendix K) as the experts, since the usability questions were simple enough to be understood by people without any experience in HCI. All participants were able to add their feedback as answers to questions in the questionnaire following the SUS statements.

6.2.4 Data Collection and Analysis

The recordings from the evaluation sessions were transcribed. Along with the researcher's notes, they were analysed through Thematic Analysis [19] using open coding, to extract the most important topics and patterns. The answers to the SUS questionnaire were analysed using the same mathematical method as in Section 6.1.

6.2.5 Results

The following patterns emerged during the final evaluation with potential users:
Resources and guidelines: The type and amount of gathered resources were received very positively among potential users. P2 noted that *"there are a lot of resources"* and was happy to see the support section *"because now it's very difficult to find such stuff on uni's website."*. All users had no problems with finding information that was available in the support and learning setions, and P3 said that she *"found everything I think I'd need"*, while P8 added that *"resources were great"*. P1 has suggested adding more information about communities and societies related to accessibility that are active at the university, saying it would be *"a good thing to have right next to all other resources, especially for new students"*. P4 was excited about the idea to be able to check his

materials against the provided guidelines saying it would be *"very helpful and I would use it when needed"*, while P6 added that it *"looks really useful"*. P9 said that the "learn more" helped her *"understand more about what difficulties other people might be facing"*. P5 and P7 suggested adding more resources in the future, such as University Careers Service or links to Learn resources.

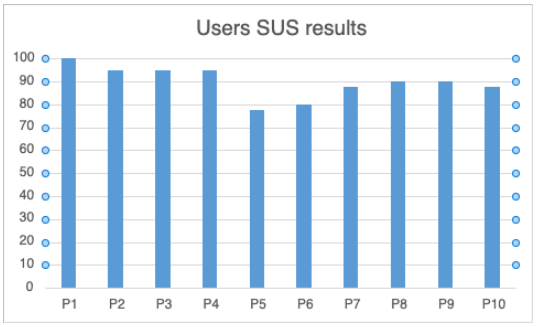
Message creation: The functionality that was met with the most excitement among the users was *"generate a message"* in student mode. P1, who has taken part in the formative evaluation too, said that he's *"glad it's here, because I know how stressful it is for neurodivergent people, like me"* when asked about support with writing messages, and then added that *"it's even great for people who just want to compare their email to something"*. A similar view was shared by P9, who said she finds *"writing more official email incredibly stressful"* and thinks this functionality is *"really helpful"*. P2 added that although he doesn't struggle with writing emails, he found *"the generate message feature most interesting"*. There were a few suggestions to add an empty prompt *"in case someone doesn't find a topic that matches what they want to generate"* (P9).

Usability: With regards to usability of the tool, many participants mentioned the simple design, intuitive layout and easy-to-identify options as advantages of the tool. P3 said she liked *"that it is easy to find what you're looking for"*. Some participants mentioned that the information maps were helpful with finding out what certain option is offering, with P2 saying that *"the design made the content more readable and clear"*, while P8 added that they're *"very clear information about what to expect before going in"*. This suggests that the information maps were effective in improving usability of the tool in terms of predictability and information structure. P7 suggested that in the future the researcher could add *"maybe a simple interface which had your most used tools"* that would personalise the interface for each user. P4 found the structure of the webiste clear and when asked rated the statement "There were places where I felt lost or confused" as "strongly disagree". With regards to the wording used in the tool, P9 said that *"Some naming conventions are not very clear"* and pointed the "managing accessibility accommodation requests" as one of the examples, where the wording is not clear. She also added that it should be made more clear that *"the learn more section specifically includes more resources and materials on awareness"*, which would make the user more confident in navigating through the interface.

Accessibility: While navigating through the interface, P3 said that she *"really liked the accessibility settings"* because they *"allowed me to modify the website to my preferences"*. P4 was specifically excited about the amount of changes he could do to the font, saying *"That's interesting, now I have to check how far I can go..."*. P2 focused on the colour scheme of the website, as he said that he has had *"some problems with colours on websites in the past, but that looks great"*. He also suggested to add an option to let the user choose their own colours. Another suggestion about the colour scheme was made by P3, who said she would like to see a scheme *"with less bright colours"* and suggested *"maybe adding one option with softer colours"*, which would be more comfortable to users on the Autism spectrum. P1 said he *"tried changing different settings to see what works best for me"*. P6 was also excited about the option to navigate through the website only through keyboard.

SUS score: The results of the SUS questionnaire among the participants were calculated according to the methodology described in Section 6.1.4. The score for each user is

presented in Figure 6.3a. The average score among the potential users is 89.75, which is rated as ”excellent” on the SUS score scale developed by Bangor et al [13]. This means that the tool is perceived as usable, intuitive and effective by its target audience. Such SUS score suggests that the target audience is confident while using the tool, affirming the tool's intuitiveness and effectiveness. It also indicates that users perceive the tool as not only easily navigable and comprehensible but also as highly efficient in fulfilling their intended tasks. With nine out of ten scores being over 80 themselves, it proves the users' satisfaction with what they were offered with in terms of resources, functionality and flexibility.



(a) SUS scores per participants.

(b) SUS score for particiapnts on Bangor et al's scale

Figure 6.3: SUS score for participants (potential users).

6.3 Discussion

To perform final evaluation of the tool, two user studies were run on the high-fidelity prototype. The first study conducted with experts answered the question of how appropriate and effective the tool is, along with determining the level of usability and accessibility of the system. The overall feedback was highly positive, which was reflected by average score of 85.62 on SUS questionnaire, that puts the tool in ”excellent” category. The final ratings with overall average result of 4.63 indicates that the tool is considered to be appropriate for its target audience, intuitive to use, effective in presenting resources to staff and students and clear in its structure and contents. The second part of the study was conducted with a group of ten potential users of the system. It discovered users' positive reception of the tool and terms of its usability, accessibility and the kind of resources presented. Functionalities such as message generation and guidelines checking were thought of as useful and creative, while at the same time, the users had many ideas for various extensions of the work, which proves that the tool serves as a good foundation for future projects. The average score of 89.75 places the tool in the ”excellent” category again, what confirms that users are highly satisfied with the presented solution and feel confident using it. This chapter has therefore answer **RQ2** and **RQ3** by presenting the most effective functionalities and visual design choices that result in an effective, accessible and highly usable website serving as an accessibility hub for students and staff of University of Edinburgh.

Chapter 7

Conclusions and future work

*This chapter sums up the work in this report and discusses its limitations and ideas for future extensions. It sums up the answers to **RQ1,2,3**.*

7.1 Research questions

RQ1:What are the main difficulties that higher education students and university staff find in creating and accessing accessible e-learning materials and spaces?
This question was answered through a literature review in Chapter 2 and through the interviews conducted with students with disabilities, university teachers and support staff in Chapter 3. The most notable and prevalent barriers were time constraints, lack of uniform and clear guidelines and support from the university (for university teaching staff) and lack of understanding of acessibility foundations and policies, limited support and communication, and inaccessible study materials (for students). Various examples of past research were brought up, with important findings from Langørgen [36] (faculty), Amin [14] (visual disabilities), Wajdi et al [55] (Deaf and HoH students), Emmers et al [27](ADHD), Adams et al [23](Autism Spectrum), Pino et al [43](SLDs), and Kent [32] (physical disabilities).
RQ2: What is the best way to design an online platform for university students and staff that serves as an accessibility hub?
To answer this question, a round of interviews was first run (Chapter 3) with 2 students with disabilities, 3 members of faculty in higher education and 1 expert in accessibility and disability support. They informed the design by describing their experiences with accessible education and barriers in accessing materials, resources and support. first set of requirements for the design was derived based on the interviews, literature review and guidelines related to universal design, accessible web content and accessible material creation. A low-fidelity prototype of an online accessible hub was created in Figma [2] and evaluated through cognitive walkthrough and task-based think-aloud evaluation, to derive strengths of the current design and recommendations for redesign. These were then used to implement the design as a high-fidelity prototype of the accessible hub website using React.js [3].

RQ3: To what extent is the created website usable and what is its impact on

students with disabilities and university staff, in terms of appropriateness, effectiveness and ease of use?
This question was answered through final evaluation. First, cooperative evaluation was run with 4 experts in the field of HCI and accessibility. Then, think-aloud evaluation was run with 10 potential users (students with and without disabilities, and university teachers). Results were obtained through SUS questionnaire and semi-structured interviews. In terms of **appropriateness** four experts judged it on average as 4.75/5, suggesting that the tool is highly suitable for its target population. Both experts and potential users pointed out the type and amount of resources available on the website as one of the advantages of the system. Experts and users who had previous experience of teaching were excited to see the accessibility guidelines for materials and the way they were presented. Students with disabilities who were interviewed mentioned the messages creation as one of the most helpful pieces of the application, as it would decrease time and stress they encounter. With regards to **effectiveness** of the tool, all experts rated the tool as 5/5, suggesting that the tool is significantly effective in presenting and centralising all needed resources and guidelines to staff and students. The experts and users with teaching experience mentioned they would recommend it to the university students as it is a clear and readable system centralising all needed resources. The participants mentioned the colourscheme and overall design as one of the most positive aspects of the website that would make the information easier to access and understand. Users were very happy to see functionalities such as guidelines checklist and message generation working as they expect them to, fulfilling the initial requirements and following the redesign recommendations. Finally, when it comes to **ease of use**, the SUS result of 85.62 for experts and 89.75 for the users categorises the tool as 'excellent' in terms of usability. Experts rated the system as 4.5/5 for lack of confusion and 4.25/5 for intuitiveness, suggesting that the tool is easy to follow, and that the users don't require technical support to feel confident in navigating it. Aspects like accessibility settings, clear integration with browser settings and assistive technologies, as well as appropriate choose of icons and information maps were mentioned.

7.2 Limitations and recommendations for future work

Due to the prototype-nature of the work and limited time and resources of the project, there are some limitations and possible future extensions of the presented project that need to be discussed.
Appropriateness for different groups of students: The guidelines and relevant literature reviewed in Chapters 2 and 3, along with the interviews described in Chapter 3, informed the design of the tool with careful consideration of teaching staff and students from various categories of disabilities. Even though care was taken to engage users with various backgrounds into the evaluation studies, only a limited sample was obtained due to a difficulty of finding students with disabilities willing to spend time on research on such sensitive topic. The tool was consulted and evaluated with members of faculty and students with ADHD, motor disabilities, colourblindness, autism and learning disabilities, however decisions considering a perspective of Deaf students and students with visual impairments other than colourblindness were informed by literature review and experts opinion only. An improvement in this field would involve engaging a wider

range of students with disabilities to evaluate the tool and its effectiveness, as well as to obtain a wider perspective on potential usability and accessibility issues with the developed system.

Functionality enhancement: The formative and final evaluations of the tool showed that even though the experts and participants were very happy about the offered functionality of the tool, most of them had various suggestions on what possible extensions could be employed in the future, to make it a comprehensive platform serving as an accessibility hub. Remarks about the guidelines checklist alternative presentation were made, with participants expressing a desire for more flexibility in how checklist items could be presented. One expert proposed a form-like structure for message generation prompts, while another participant suggested an option for an empty prompt, which would provide the users with more flexibility and adaptability to their accessibility needs. Furthermore, importance of customisation was emphasised, with two students suggesting incorporation of a fully flexible colour scheme that allows users to choose their preferred colours. This would enhance user experience and cater to users with diverse accessibility needs. Integration with other tools emerged as another important consideration, with users recommending the incorporation of additional functionalities within the ”check my materials” feature, that would allow the members of staff to manipulate their files directly on the website and potentially upload them to their existing platforms or hubs. Additionally, some users mentioned reordering font types or options in one of the modes based on their popularity. Such enhancements would require analytics research to understand user activities and preferences on the website.

7.3 Conclusion

This project investigated what are the barriers that members of University of Edinburgh community may face while providing and accessing study materials, support and guidelines, and how an online ”accessibility hub” platform can be designed and implemented to be suitable to its target audience, effective in presenting resources and easy to use and navigate. User-centred approach to design was assumed and consisted of requirements gathering, low-fidelity prototype design and evaluation, high-fidelity prototype implementation and final evaluation. The qualitative and quantitative data gathered proved that the created tool is effective at centralising and presenting resources and support to students and staff of University of Edinburgh, due to presence of functionalities such as accessible material creation guidelines checklist, AI message contents generation, and access to support and learning resources with use of information maps. Various accessibility measures were considered and appreciated throughout the whole system, with particular focus on accessibility settings and visual presentation of the resources. Empirical evidence is a proof that the proposed prototype can be a solid foundation for future development of an ”accessibility hub” for the community of UoE, with various possible extensions that were proposed at the end of this work. Although the research work presented focused on the University of Edinburgh, it has the potential for broader implementation across other universities in the UK and worldwide. The adaptable design and methodology make the tool scalable, while the design can be tailored to fit the specific needs and the context of different educational institutions.

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Appendix A

Participant Information Sheet

Participant Information Sheet

Project title:	E-learning accessibility in higher education - accessibility online hub for University of Edinburgh students
Principal investigator:	Aurora Constantin
Researcher collecting data:	Julia Iwańczuk
Funder (if applicable):	N/A

This study was certified according to the Informatics Research Ethics Process, reference number 272316.Please take time to read the following information carefully. You should keep this page for your records.

Who are the researchers?

Julia Iwańczuk – undergraduate student collecting and analysing data;

Aurora Constantin – principal investigator, research supervisor;

What is the purpose of the study?

The purpose of the study is to assess current state of e-learning accessibility in higher education along with access to support for students with disabilities. Based on the gathered data, a prototype of a possible solution will be developed and assessed.

Why have I been asked to take part?

You have been asked to take part in the research as you identify as a person with disabilities and/or are an expert in the field of accessibility and/or human-centred design and/or you are a current university student.

Do I have to take part?

No – participation in this study is entirely up to you. You can withdraw from the study at any time, up until the completion if your interview without giving a reason. After this point, personal data will be deleted and anonymised data will be combined such that it is impossible to remove individual information from the analysis. Your rights

will not be affected. If you wish to withdraw, contact the PI. We will keep copies of your original consent, and of your withdrawal request.

What will happen if I decide to take part?

You will be asked to share your experience of education with focus on inclusion and accessibility as well as issues relating to it. You will be presented with the researcher's findings from their background research and asked to share your opinion on them. In the later parts of the study you will be asked to evaluate a proposed technological solution (a website design) which was created by the researcher and presented in form of a prototype. The researchers may ask you to complete simple tasks on the prototype to check its usability. You will be asked these questions during an interview (maximum 1 hour) or a focus group consisting of maximum 6 people (maximum 2 hours). The sound from these sessions will be recorded and notes will be made during these meetings. You will be asked to participate at least once and maximum four times in the study. The latest you will be asked to participate is March 2024. The interviews and focus groups will be conducted either online or at the University of Edinburgh at the convenience of the participant. The exact date of each interview and focus group will be agreed upon with the participant at their convenience.

Are there any risks associated with taking part?

There are no significant risks associated with participation.

Are there any benefits associated with taking part?

There are no material or financial benefits associated with taking part in the study, however drinks and snacks will be provided for in-person sessions.

What will happen to the results of this study?

The results of this study may be summarised in published articles, reports and presentations. Quotes or key findings will be anonymized: We will remove any information that could, in our assessment, allow anyone to identify you. With your consent, information can also be used for future research.

Your data may be archived for a maximum of 4 years. All potentially identifiable data will be deleted within this timeframe, if it has not already been deleted as part of anonymization. All voice recordings will be deleted right after their transcription, maximum 3 months after the interview took place.

Data protection and confidentiality.

Your data will be processed in accordance with Data Protection Law. All information collected about you will be kept strictly confidential. Your data will be referred to by a unique participant number rather than by name. Your data will only be viewed by the researcher/research team consisting of Dr Aurora Constantin and Julia Iwańczuk.

All electronic data will be stored on a password-protected encrypted computer, on the School of Informatics' secure file servers, or on the University's secure encrypted cloud storage services (DataShare, ownCloud, or Sharepoint) and all paper records will be stored in a locked filing cabinet in the PI's office. Your consent information will be kept separately from your responses in order to minimise risk.

What are my data protection rights?

The University of Edinburgh is a Data Controller for the information you provide. You have the right to access information held about you. Your right of access can be exercised in accordance Data Protection Law. You also have other rights including rights of correction, erasure and objection. For more details, including the right to lodge a complaint with the Information Commissioner's Office, please visit www.ico.org.uk. Questions, comments and requests about your personal data can also be sent to the University Data Protection Officer at dpo@ed.ac.uk.

Who can I contact?

If you have any further questions about the study, please contact the lead researcher, Dr Aurora Constantin, +44 131 651 5643, aurora.constantin@ed.ac.uk .
If you wish to make a complaint about the study, please contact inf-ethics@inf.ed.ac.uk. When you contact us, please provide the study title and detail the nature of your complaint.

Updated information.

If the research project changes in any way, an updated Participant Information Sheet will be made available on http://web.inf.ed.ac.uk/infweb/research/study-updates.

Alternative formats.

To request this document in an alternative format, such as large print or on coloured paper, please contact Julia Iwanczuk, +44 7721570842, j.iwanczuk@ed.ac.uk .

General information.

For general information about how we use your data, go to: edin.ac/privacy-research

Appendix B

Participant Consent Form

Participant number:_____

Participant Consent Form

Project title:	E-learning accessibility in higher education - accessibility online hub for University of Edinburgh students
Principal investigator (PI):	Dr Aurora Constantin
Researcher:	Julia Iwańczuk
PI contact details:	aurora.constantin@ed.ac.uk

By participating in the study you agree that:

- I have read and understood the Participant Information Sheet for the above study, that I have had the opportunity to ask questions, and that any questions I had were answered to my satisfaction.
- My participation is voluntary, and that I can withdraw at any time without giving a reason. Withdrawing will not affect any of my rights.
- I consent to my anonymised data being used in academic publications and presentations.
- I understand that my anonymised data will be stored for the duration outlined in the Participant Information Sheet.

Please tick yes or no for each of these statements.

1.	I agree to being audio recorded.	**Yes**	**No**
2.	I allow my data to be used in future ethically approved research.	**Yes**	**No**
3.	I agree to take part in this study.	**Yes**	**No**

Name of person giving consent	Date dd/mm/yy	Signature

Name of person taking consent	Date dd/mm/yy	Signature

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Appendix C

Interview Plans and Questions

C.1 Student participants

1. Greetings, introduce the researchers, present the objective of the study.
2. Participant information sheet and consent forms - questions and clarification.
3. Questions:
   (a) What disabilities do you identify with? What does it impact in your life?
   (b) What are the biggest difficulties you face at the University?
   (c) Has your e-learning experience always been satisfactory and accessible? Do you think your study materials provided by the University are fully accessible to you? Why (not)?
   (d) How easy is it for you to find help with things related to accessibility and disability support?
   (e) How easy do you find the contact with course organisers/university staff?
   (f) What do you wish you university could provide you with for your e-learning?
4. End of the recording. Inform the participant about future of the project. Ask if they have any questions.
5. Thank the participant for their time.

C.2 Faculty members

1. Greetings, introduce the researchers, present the objective of the study.
2. Participant information sheet and consent forms - questions and clarification.
3. Questions:

   (a) When you think about accessible e-learning, what target groups do you think of?

   (b) How often do you consider accessibility during creation of your study materials?

   (c) If you do: does it take you much longer to implement it? How long? Do you always have time to implement what you would like to?

   (d) Do you think the guidelines from the university are clear?

   (e) Do you find it difficult to find relevant resources, tools and information?

   (f) What other support from the university would you like to have?

4. End of the recording. Inform the participant about future of the project. Ask if they have any questions.
5. Thank the participant for their time.

C.3 Support staff (referred to in the report as ”others”)

1. Greetings, introduce the researchers, present the objective of the study.
2. Participant information sheet and consent forms - questions and clarification.
3. Questions:

   (a) How long have you worked in your role? Why did you decide to work here? What are your responsibilities?

   (b) What kind of students visit your service?

   (c) What kind of problems do students using your support have? Can you always resolve them?

   (d) Do you think it’s easy for students and staff to find relevant resources?

   (e) What gaps do you see in the system? What do you wish the University could do better?

4. End of the recording. Inform the participant about future of the project. Ask if they have any questions.
5. Thank the participant for their time.

Appendix D

Pribeanu's heuristics

These heuristics were first published in "A revised set of usability heuristics for the evaluation of interactive systems." by Costin Pribeanu in Informatica Economica, September 2017 [44].

User guidance

1. Prompting
2. Feedback
3. Information architecture
4. Grouping / distinction

User effort

5. Consistency
6. Cognitive workload
7. Minimal actions

User control and freedom

8. Explicit user actions
9. User control
10. Flexibility

User support

11. Compatibility with the user
12. Task guidance and support
13. Error management
14. Help and documentation

Appendix E

Relevant WCAG 2.2 guidelines

Full contents of the guidelines canbe found on WCAG website www.w3.org/TR/WCAG22/ [37].

1.3. Adaptable
Create content that can be presented in different ways (for example simpler layout) without losing information or structure.

1.4. Distinguishable
Make it easier for users to see and hear content including separating foreground from background.

2.1. Keyboard accessible
Make all functionality available from a keyboard.

2.4. Navigable
Provide ways to help users navigate, find content, and determine where they are.

3.1. Readable
Make text content readable and understandable.

3.2. Predictable
Make Web pages appear and operate in predictable ways.

Appendix F

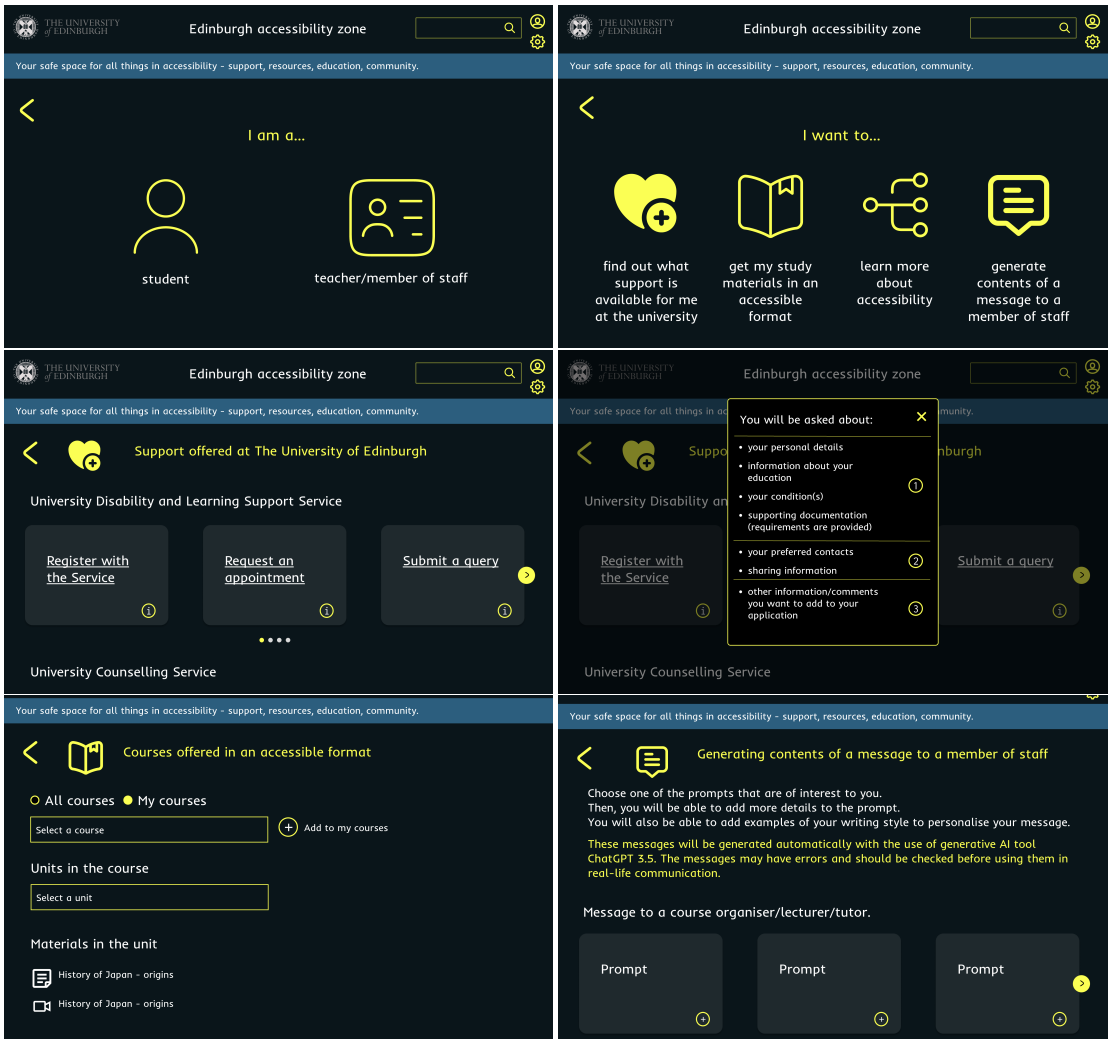
Accessible materials creation guidelines

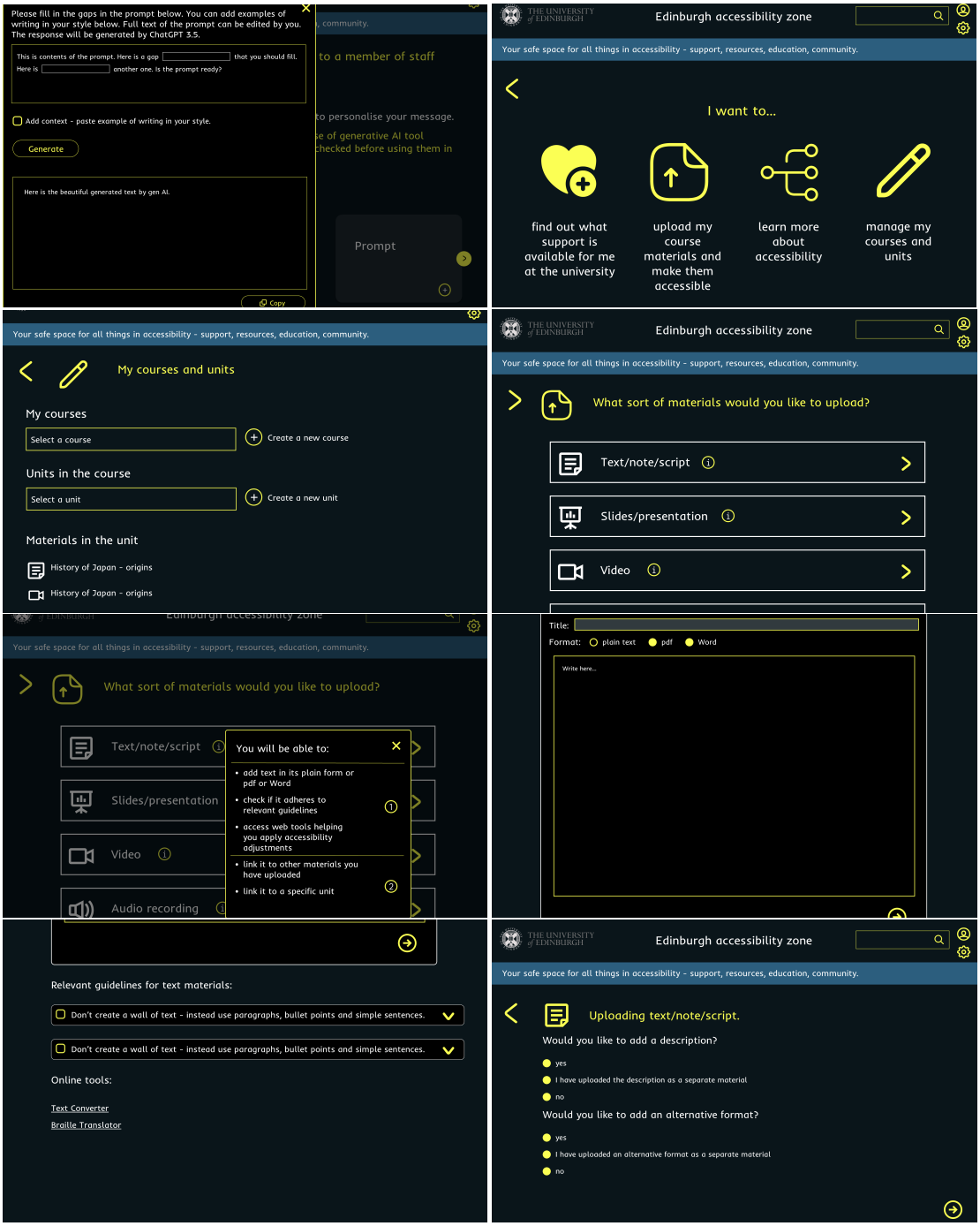
1. Write in plain English and don't use figures of speech and idioms.
2. Use simple sentences and bullets and don't create a wall of text.
3. Follow a linear, logical layout of information and prefer single column layouts.
4. Describe images, use subtitles, and provide transcripts for video.
5. Use good contrasts and a readable font size.
6. Use a combination of colour, shapes and text.
7. Don't make dynamic content that requires a lot of mouse movement.
8. Align text to the left and keep a consistent layout.
9. Don't underline words, use italics or write capitals.
10. Producing at least one other option for materials in alternative formats.
11. Ensure possibility of monochromatic visualization.
12. Produce graphic content in high contrast and make it scalable.
13. Texts must have a solid color contrasting with the background and must not have background image.
14. Don't include texts in the form of an image, or provide an alternative text option.
15. Present topic hierarchy and enumeration.
16. Use at most 80 characters per line.
17. Clarify abbreviations and acronyms on their first occurrence.
18. Give clear identification for table title, header, rows and columns and provide table summary.
19. Make sure the tables can be read linearly.

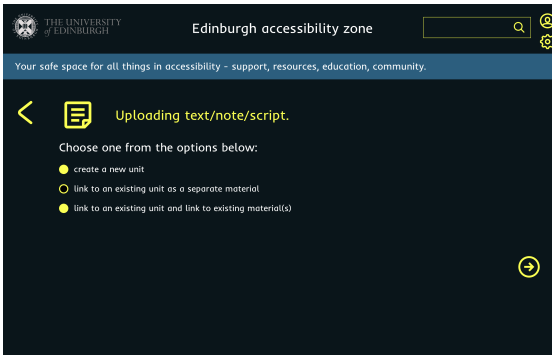
20. All graphs and charts should have a summary presented as subtitles along with a description of the chart's layout, variables' locations, and results.
21. Audio and video content should have visible volume control, pauses, play, and stops.
22. Provide subtitles and transcripts for video and audio content.

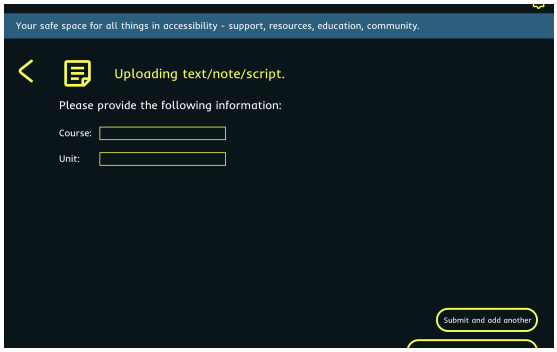
Appendix G

Low-fidelity prototype screenshots




Please fill in the gaps in the prompt below. You can add examples of writing in your style below. Full text of the prompt can be edited by you. The response will be generated by ChatGPT 3.5.
This is contents of the prompt. Here is a gap that you should fill. Here is another one. Is the prompt ready?
Add context - paste example of writing in your style.
Generate
Here is the beautiful generated text by gen AI.
Copy
to a member of staff
to personalise your message.
Prompt
Edinburgh accessibility zone
Your safe space for all things in accessibility - support, resources, education, community.
I want to...
find out what support is available for me at the university
upload my course materials and make them accessible
learn more about accessibility
manage my courses and units
My courses and units
My courses
Select a course
Create a new course
Units in the course
Select a unit
Create a new unit
Materials in the unit
History of Japan - origins
History of Japan - origins
What sort of materials would you like to upload?
Text/note/script
Slides/presentation
Video
Audio recording
You will be able to:
add text in its plain form or pdf or Word
check if it adheres to relevant guidelines
access web tools helping you apply accessibility adjustments
link it to other materials you have uploaded
link it to a specific unit
Title:
Format: plain text pdf Word
Write here...
Relevant guidelines for text materials:
Don't create a wall of text - instead use paragraphs, bullet points and simple sentences.
Don't create a wall of text - instead use paragraphs, bullet points and simple sentences.
Online tools:
Text Converter
Braille Translator
Uploading text/note/script.
Would you like to add a description?
yes
I have uploaded the description as a separate material
no
Would you like to add an alternative format?
yes
I have uploaded an alternative format as a separate material
no


THE UNIVERSITY of EDINBURGH
Edinburgh accessibility zone
Your safe space for all things in accessibility - support, resources, education, community.
Uploading text/note/script.
Choose one from the options below:
create a new unit
link to an existing unit as a separate material
link to an existing unit and link to existing material(s)


Your safe space for all things in accessibility - support, resources, education, community.
Uploading text/note/script.
Please provide the following information:
Course:
Unit:
Submit and add another

Appendix H

Formative evaluation tasks and questions

H.1 Cognitive walkthrough

All tasks begin in the first screen of the prototype.

1. Find a link to Staff Councelling Service and find out what is available to you if you click it.
   (a) Navigate to staff mode.
   (b) Click on ”find out what support is available for me at the university”.
   (c) Scroll to the carousel named ”University Counselling Service”.
   (d) Click on the ”i” icon.
2. Generate contents of a message to your student advisor requesting a meeting.
   (a) Navigate to student mode.
   (b) Click on ”generate contents of a message to a member of staff”.
   (c) Scroll to the carousel named ”Message to a student advisor”.
   (d) Click on the ”+” icon.
   (e) Click the ”Generate” button.
3. Find out what will be the steps of uploading a text material.
   (a) Navigate to staff mode.
   (b) Click on the ”upload my course materials and make them accessible”.
   (c) Find the tile named ”Text/note/script”.
   (d) Click on the ”i” icon on this tile.
4. Add a new video material with subtitles to an existing unit.

   (a) Navigate to staff mode.
   (b) Click on the ”upload my course materials and make them accessible”.
   (c) Find the tile named ”Video”.
   (d) Click the arrow icon on the tile.
   (e) Click the button with an arrow pointing to the right.
   (f) Choose ”yes” in ”add subtitles” and ”no” in ”add a script”.
   (g) Click the button with an arrow pointing to the right.
   (h) Choose ”Link to an existing unit as a separate material”.
   (i) Click the button with an arrow pointing to the right.
   (j) Choose a course and unit.
   (k) Click ”Submit and back to main screen”.
5. Find what materials you can access as a student.
   (a) Navigate to student mode.
   (b) Clik on the ”get my study materials in an accessible format”.
   (c) Choose a course and unit.
6. Find information about Deaf awareness.
   (a) Go to staff or student mode.
   (b) Go to ”learn more about accessibility”.
   (c) Scroll to the carousel named ”Disability awareness”.
   (d) Find a tile called ”Deaf Action” and click on the link.
7. Find out what guidelines you have to follow for audio material.
   (a) Navigate to staff mode.
   (b) Click on the ”upload my course materials and make them accessible”.
   (c) Find the tile named ”Audio”.
   (d) Click the arrow icon on the tile.
   (e) Scroll down to guidelines checklist.

H.2 Task based evaluation with students

H.2.1 Tasks:

1. Find a link to a registration form for University Disability and Learning Service.
2. Find out what materials are available to you in an accessible format.

3. Generate a message to your Student Advisor about dropping from a Calculus course.
4. Find the accessibility settings.

H.2.2 Interview questions:

1. What did you like about the website?
2. Were there any options that you think you wouldn't use?
3. What did you feel when you were navigating through the website?
4. What do you think about the information maps?
5. Do you think you would use such tool? What would you use it for?

H.3 Task based evaluation with faculty members

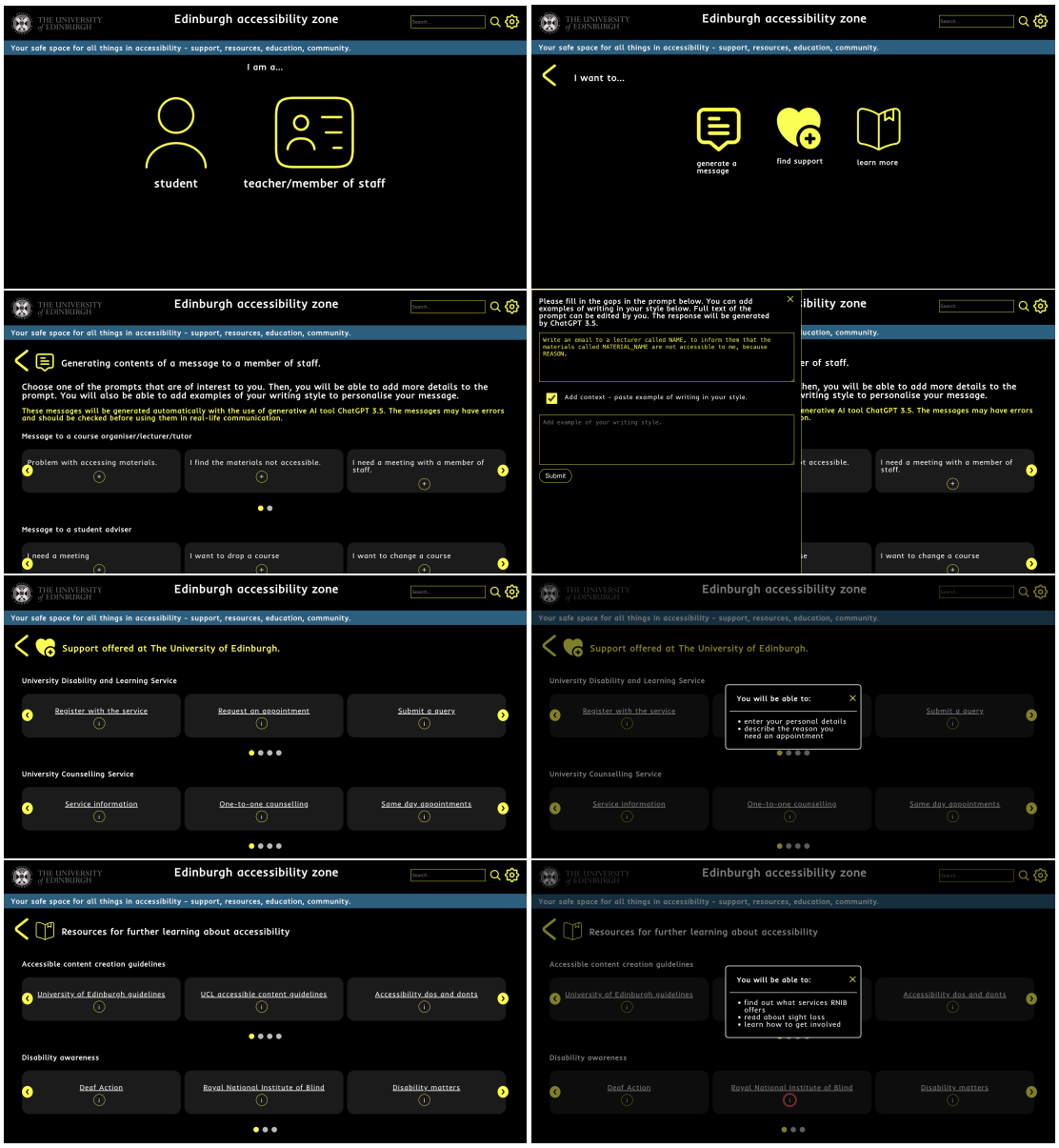
1. Turn on the voiceover on the website
2. Find information about "Staff Counselling Service" and go on their website.
3. Add a video material with subtitles already in the video and add it to a new unit.
4. Find out what are the guidelines for creating text materials.
5. Find how many materials there are in one of your courses

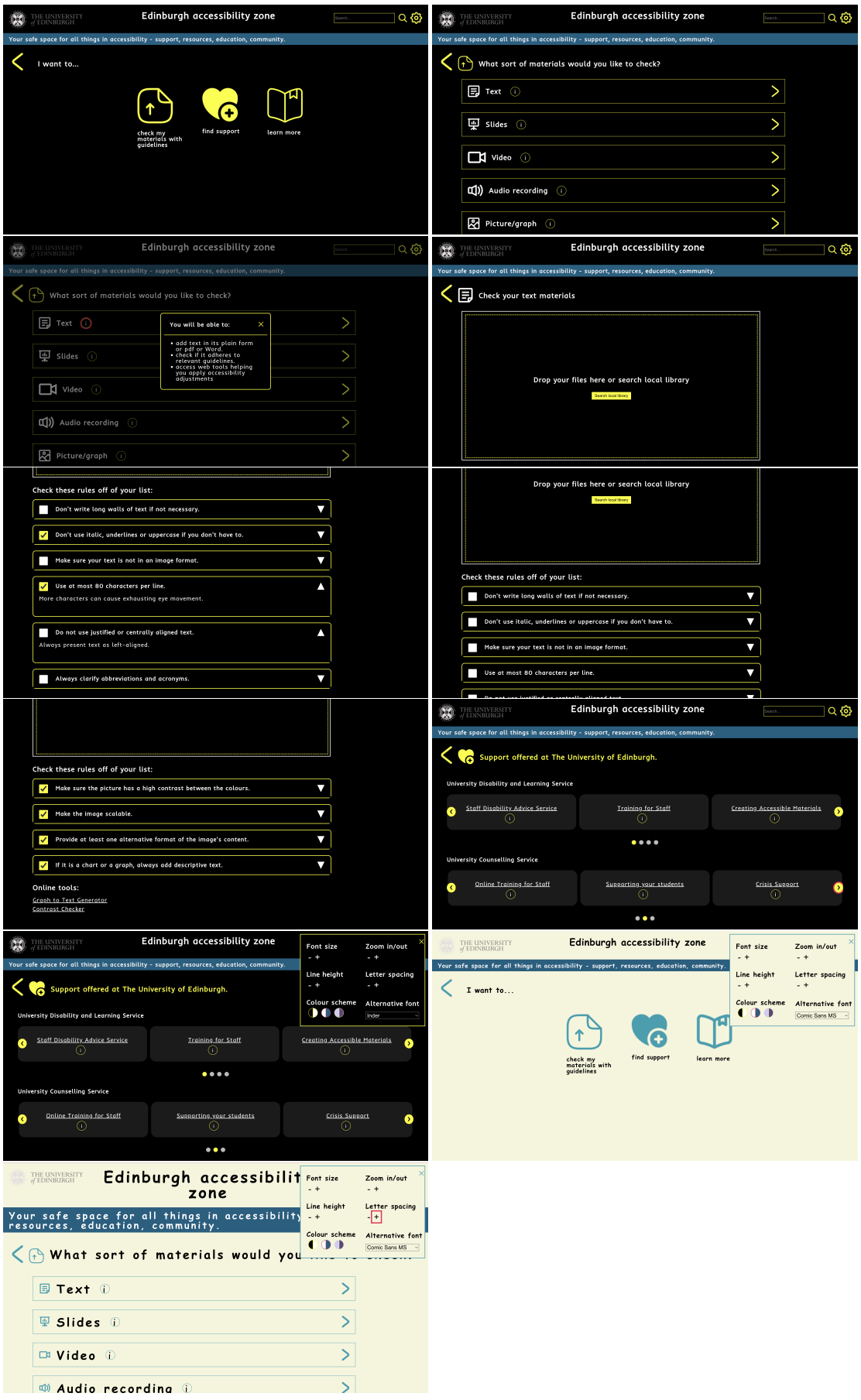
H.3.1 Interview questions:

1. What features did you find useful on the website?
2. Were there points where you felt confused?
3. What are, in your opinion, positive aspects of the tool?
4. What would you change?
5. What do you think about the functionality to upload your materials? Do you think you would use it?
6. Do you think the system would help you with your job?

Appendix I

High-fidelity prototype screenshots




Edinburgh accessibility zone
Your safe space for all things in accessibility - support, resources, education, community.
I want to...
check my materials with guidelines
find support
learn more
What sort of materials would you like to check?
Text
Slides
Video
Audio recording
Picture/graph
You will be able to:
add text in its plain form or pdf or Word.
check if it adheres to relevant guidelines.
access web tools helping you apply accessibility adjustments
Check your text materials
Drop your files here or search local library
Search local library
Check these rules off of your list:
Don't write long walls of text if not necessary.
Don't use italic, underlines or uppercase if you don't have to.
Make sure your text is not in an image format.
Use at most 80 characters per line.
More characters can cause exhausting eye movement.
Do not use justified or centrally aligned text.
Always present text as left-aligned.
Always clarify abbreviations and acronyms.
Make sure the picture has a high contrast between the colours.
Make the image scalable.
Provide at least one alternative format of the image's content.
If it is a chart or a graph, always add descriptive text.
Online tools:
Graph to Text Generator
Contrast Checker
Support offered at The University of Edinburgh.
University Disability and Learning Service
Staff Disability Advice Service
Training for Staff
Creating Accessible Materials
University Counselling Service
Online Training for Staff
Supporting your students
Crisis Support
Font size
Zoom in/out
Line height
Letter spacing
Colour scheme
Alternative font
Comic Sans MS

Appendix J

High-fidelity prototype evaluation follow-up questions

J.1 Questions for experts

1. What did you like and dislike about the tool?
2. Is the website appropriate for the target audience?
3. Was it intuitive to use?
4. Were there any places where you felt uncertain/lost?
5. Do you think it would be effective in presenting resources to staff and students?
6. What do you think about the accessibility of the tool?
7. Any suggestions?

J.2 Questions for potential users

1. What did you like and dislike about the tool?
2. What do you think about the type of presented resources?
3. What functions do you find useful? Would you use the platform often?
4. Did you have any issues with navigating the website?
5. Do you have any ideas for improving it?

Appendix K

SUS questionnaire

This questionnaire was used by the researcher as a form of taking notes from the user interviews in the final evaluation.

E-learning accessibility in higher education - accessibility online hub for UoE community.

Please answer the following questions based on the system demonstration you were shown.

* Required

1. I have agreed to take part in the study and I allow my data to be used in this ethically approved study. *

- ◯ I agree

2. Please rate how much you agree with each statement. *

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I think that I would like to use this system frequently.	◯	◯	◯	◯	◯
I found the system unnecessarily complex.	◯	◯	◯	◯	◯
I thought the system was easy to use.	◯	◯	◯	◯	◯
I think that I would need the support of a technical person to be able to use this system.	◯	◯	◯	◯	◯
I found the various functions in this system were well integrated.	◯	◯	◯	◯	◯
I thought there was too much inconsistency in this system.	◯	◯	◯	◯	◯
I would imagine that most people would learn to use this system very quickly.	◯	◯	◯	◯	◯
I found the system very cumbersome to use.	◯	◯	◯	◯	◯
I felt very confident using the system.	◯	◯	◯	◯	◯
I needed to learn a lot of things before I could get going with this system.	◯	◯	◯	◯	◯

3. What is your opinion about the type of resources present in the system? Would you like to see more of them/different types?

Enter your answer

4. What is your opinion about the support maps (the rectangle-shaped information opening after clicking on the information button)?

Enter your answer

5. What parts of the system did you find interesting and/or useful? Why?

Enter your answer

6. Do you have any suggestions for future improvement?

Enter your answer

Submit

Never give out your password. Report abuse