

Understanding Accessibility as a Process through the Analysis of Feedback from Disabled Students

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ABSTRACT

Accessibility cannot be fully achieved through adherence to technical guidelines, and must include processes that take account of the diverse contexts and needs of individuals. A complex yet important aspect of this is to understand and utilise feedback from disabled users of systems and services. Open comment feedback can complement other practices in providing rich data from user perspectives, but this presents challenges for analysis at scale. In this paper, we analyse a large dataset of open comment feedback from disabled students on their online and distance learning experience, and we explore opportunities and challenges in the analysis of this data. This includes the automated and manual analysis of content and themes, and the integration of information about the respondent alongside their feedback. Our analysis suggests that procedural themes, such as changes to the individual over time, and their experiences of interpersonal interactions, provide key examples of areas where feedback can lead to insight for the improvement of accessibility. Reflecting on this analysis in the context of our institution, we provide recommendations on the analysis of feedback data, and how feedback can be better embedded into organisational processes.

CCS Concepts

• **User Characteristics~People with Disabilities** • **Accessibility~Accessibility design and evaluation methods.**

Keywords

accessibility; online learning; distance learning; qualitative data analysis; content analysis; disability; disabled students;

1. INTRODUCTION

As interaction with web technologies becomes integral to education and work, it is essential to not only support universal access to information, but to develop processes of accessibility that produce equitable experiences in activities conducted online. Feedback from users should be a key resource for accessibility.

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This can support a view of accessibility work as a process that draws on reported experiences to continually make improvements. The richness of user experiences may be best captured in qualitative feedback, but such data can be problematic to analyse and utilise. Equally, the use of disability as an umbrella term masks a need for understanding of diverse and individual contexts and issues. These complexities may lead to limited or unrepresentative use of feedback in processes of accessibility.

This paper explores user feedback in the context of online distance learning (ODL). For many disabled people, ODL can be the best, or only, means of effective tertiary education. It can allow them to develop digital and work skills, to interact with peers, and to gain subject knowledge or accreditation. ODL goes beyond the use of static web pages, or short, single goal interactions, to an expectation of extensive use of digital tools and networks in long-term activities that play an important role in a person's life. Courses are increasingly based online, with digital materials, communications channels and tools providing the primary means of study. This may be combined with printed materials and located exams, tutorials and residential schools. Many students require flexibility across these digital and physical arrangements to fit their needs and preferences.

In this paper, we reflect on the analysis of over 6,000 student evaluation feedback comments from disabled students studying with The Open University UK (OU). The OU is an ODL institution that has relative maturity in its approaches to achieving accessibility, having supported thousands of disabled students over decades. However, we still seek to improve the processes through which staff can understand the needs of disabled students and respond to these across the institution.

We consider how open comment data is particularly valuable but also how it can be difficult to harness at scale. Our aim is to make these types of data more usable through a data-driven approach that represents the views of the respondents, and can integrate with organisational processes. Our contributions are to provide insights into how such feedback data can be analysed usefully through automated and semi-automated approaches. Having applied these to a dataset alongside a manual analysis, we identify some of the accessibility challenges this data highlights, and how these inform our conceptualisation of accessibility as an on-going process.

2. BACKGROUND

There is recognition that holistic approaches to accessibility require processes that complement the development and use of technical guidelines. While guidelines provide a means towards awareness and compliance to common requirements, they cannot

resolve all the problems encountered by disabled users, nor do they present a complete means to improve accessibility. Empirical studies have identified limitations in the capacity of such guidelines to ensure accessibility. For example, Power et al. (2012) found that only 50.4% of problems encountered by blind users in evaluations were covered by WCAG 2.0 [16]. Brajnik et al. (2010) found that even expert evaluators could find it difficult to reliably identify problems in websites using WCAG 2.0, or to reach shared agreement on the problems that existed [3].

Complementary approaches to understanding disabled users and their experiences in context are desirable. Sloan et al. (2006) outlined how contextual factors and user profiling should be represented in such approaches [24]. Kelly et al. (2007) make recommendations for user-focused accessibility policies and processes that attend to the diversity of users, user aims, and use contexts [11]. Building on this, Cooper et al. (2012) suggest that accessibility cannot be considered as an intrinsic quality of a resource, but that accessibility is only truly achieved with consideration of user and contextual factors. In this regard, they distinguish the value of the BSI 8878 standard, which aims to represent best practice in user-focused processes to embed accessibility in the creation of websites and mobile apps [5].

Where digital technologies become embedded into important life activities such as work or study, there is further imperative to consider users and contexts as a part of accessibility processes. The intertwined nature of this is identified by Seale et al. (2015), who find that support from institutional staff, appropriate training opportunities, and attitudes towards technology are key factors in the 'Digital Capital' that impact on the use of general and assistive technologies by disabled students [21].

Rather than considering contextual or experiential issues as distinct from accessibility, it would be fruitful to consider how steps to understand user experiences can be brought into the work of achieving accessibility in organisations. Profiling users to understand and serve their needs has been highlighted as a valuable yet complex undertaking [20]. Routine processes of gathering feedback from users offers an additional and perhaps complementary means to gain the contextual and experiential information necessary for this step to occur.

2.1 The institutional context

Research has described how responsibility for accessibility in educational institutions is spread across many roles, including disability support staff, technologists, those responsible for creating materials, convening courses, and management [10,22]. For effective practice to occur, responsibility for accessibility should be embedded into institutional cultures [22,24]. Linder et al. (2015) find that without these strategic efforts, responsibilities can be unclear and work to ensure accessibility can be overwhelming [14].

In taking a broad view of accessibility, it is to be expected that a variety of types of challenges need to be overcome. At the OU, it has been deemed appropriate to develop formal structures that bring together staff from across the institution to co-ordinate accessibility efforts. However within these structures, there are still distinct sub-groups, responsibilities, expertise and processes devised to deal with different types of challenges. For example, faculty-based accessibility coordinators bring subject-specialist knowledge to collaboration with learning technologists to make an online learning activity accessible, whereas disability support services and the exams office collaborate to ensure support for a student needing adjustments to undertake an examination.

General feedback on student experience is received as standard through surveys of students such as the one reported here. Other mechanisms can generate more immediate or specific feedback, such as the use of feedback buttons and forms embedded into pages of the Virtual Learning Environment (VLE). The survey is expected to reflect the whole course experience. Through either approach, an essential challenge is that the right people receive relevant information from these feedback mechanisms.

While accessibility is addressed wherever possible at design and production stages of courses, and systems and tools for learners undergo in-house accessibility testing, there is a continuing need to be responsive to emerging challenges, learner contexts, and technology changes. In this regard, there is value in exploring means to better understand, categorise, and utilise this general student feedback, such that accessibility-related comments can be identified and dealt with. More specifically, accessibility issues with a particular tool, for a particular group, or those that relate to issues with a learning activity or assessment can be highlighted and acted on in appropriate ways.

2.2 Data from users in accessibility processes

Data from users can take a variety of forms and may be applied to different ends in processes to evaluate and improve accessibility. The potential and challenges of this remain under-explored.

Cooper et al. (2016) explores the use of learner analytics to identify discrepancies in retention for disabled students. Registration and completion data is used to identify the likelihood that disability significantly impacts on the completion rates of any particular module. This appears a suitable approach to identifying courses that may contain barriers for disabled students, however it is noted in the paper that this does not help us to identify what these barriers are, or where specifically in a module they occur [4].

Further data sources, such as VLE activity logs, can identify if there are points where students appear to stop engaging. However, a challenge to this is that students may engage with materials in different ways. They may, for example, download the module material in alternative formats, or be provided with audio or printed book versions of some or all of the course materials.

User testing is considered good practice in accessibility and usability. It is employed at the OU to test new and re-designed systems, as well as third-party tools that students are expected to use. This is considered to produce rich and valuable understanding. It is also resource intensive. Aizpurua et al. (2007) highlight the challenge that user testing cannot fully represent the diversity of the user population. The authors raise several issues relating to subjectivity in such testing: Users and evaluators have to interpret what constitutes a problem, and decisions need to be made on the tasks and context used for testing. These are likely to be somewhat artificial for the user who takes part [1].

Subjectivity is also a characteristic to be recognised in the use of survey data, and in any means of allowing individual user experiences to be heard and understood. However, Cooper et al.'s (2012) assertion that accessibility is not an intrinsic quality of a resource [5] helps to highlight the value of such data. If true, it follows that no resource can be objectively assessed to be completely accessible, independent of specific users and contexts of use. Therefore, in addition to assuring that resources are compliant with standards and testing them in advance of deployment, assessments of accessibility should account for actual usage in some way.

As an alternative means to identify accessibility issues, Cooper et al. (2016) also explore the use of open comment survey data by manually coding instances where respondents describe accessibility problems. The exercise is limited to a small number of modules, but results appear to provide a different perspective to that produced from the analytics approach [4].

As noted above, analytics drawn from use can provide an objective view of the interactions between users and resources, but they lack rich detail of use context, or explanatory power. Subjective data such as survey responses provide insights into the ways in which resources have been used that are not otherwise available. They are not without problems as a source, but can provide this data at scale and from real contexts of use in a way that is not possible from user testing. They can also be repeatedly captured and analysed over time from user populations, to form an on-going process of understanding, improving and ensuring accessibility.

It is also necessary to consider the structures that are most suitable for eliciting context and user perspectives. While experience and satisfaction are commonly measured through closed questions on Likert-type scales, these do not provide space for expressing the use context or issues that arise. Seale (2014) argues that there is a lack of disabled student voice in disability research on experiences of higher education. Where found, accounts of experience are often highly mediated by research instruments [22]. While the construction of mechanisms for feedback may always entail some form of mediated design, open space for comment on generic questions provides greater scope for disabled people to raise issues according to their own agendas.

2.3 Analysis of open comment feedback

In some tension with the desire to increase student voice is the need to understand and categorise unstructured forms of data, such as survey comments, to effectively inform accessibility work in an institution. Open comment feedback, especially when received at scale, is difficult to analyse and therefore to act upon. Manually reading large numbers of comments, or identifying relevant or actionable information from these, is a challenge.

A number of approaches to analysis could provide insights from this data, but the resource implications and form of results vary. Automated approaches to content analysis offer the potential to identify trends and differences across a corpus of feedback. This may be particularly important when the amount of feedback received is large, and there is a need to identify trends within a sub population of this. At the same time, targeted use of manual approaches supports human interpretation of data and maintains a more direct understanding of the student voice.

Key word methods are a relevant approach for automated analysis. These identify differences in the frequency of use of particular terms across different texts [18]. The aim is to determine words that are of relevance for a given context. Here, the relevance of words is defined by their frequency of occurrence. We wish to know which words are frequently/infrequently used by disabled students in their feedback compared to the feedback comments of students that did not declare a disability. This approach provides insights about what disabled students mention more often, or less often, than non-disabled students. Such insight could be a starting point to allow a corpus of accessibility-related feedback to be better understood, within a larger corpus of feedback from across the student population.

There are several approaches to define the 'keyness' of words in a corpus of text [13]. Here, we use Rayson's (2008) approach to calculate the log-likelihood ratio between the frequency of a word from one dataset compared to the frequency of that word in a reference dataset. The exact formula is described in their paper. Essentially, the larger this ratio is, the higher the 'keyness' of the word is considered to be. Based on the ratio, we can signify the degree to which a term is unusually frequent in one body of text when compared to another [18]. Ullmann (2015 and 2017), for example, used this method to determine keywords of reflective thinking in an educational context [26,27].

By combining feedback data with student profile information, the approach can also be applied to identify terms that appear in feedback unusually frequently or infrequently from people declaring specific categories of disability, when compared to the wider set of student feedback comments. Through this, feedback can be linked in a broad way to information about the individual respondents.

This automated approach can be combined with manual approaches, either at word- or comment-level. As key words may reflect specific types of issues, these can be categorised, forming dictionaries of related terms. Comments express meanings that are not fully comprehensible through an individual word or phrase, so thematic analysis offers a means to identify and interpret themes and code comments according to these [3].

In the following sections, we describe and reflect on our application of these methods in order to better understand and utilise a set of feedback data from disabled students. By extension, such methods could be applicable to other systems where open comment feedback is gathered from users.

3. METHOD

In this section we introduce the method used to capture the survey data, and describe the analysis methods applied to it.

3.1 Survey approach

All OU students are asked to fill in a survey evaluating their experience of each module they take. A module is likely to form part of a qualification, but it also stands alone as a course on a particular subject. Each module generally represents 300 or 600 hours of study time.

This survey includes four open comment questions and 40 Likert-type closed questions. The following three open comment questions are the focus of the analysis presented in this paper:

- 1) What aspects of teaching materials, learning activities or assessment did you find particularly helpful to your learning?
- 2) What aspects of teaching materials, learning activities or assessment did you find not particularly helpful to your learning? We would welcome any further suggestions or comments to consider for future editions of the module.
- 3) Do you have any other comments to add about your study experience on this module?

A further open comment question asks students to provide feedback on their specific tutor. This is intended for use by the tutors themselves and is not a part of this analysis.

The survey is primarily filled in online. Where the student has no known email address, a paper copy is sent to them via mail. Students are asked to fill in the survey in the period between the completion of the module presentation and the publication of their results. The rationale for this is for their responses to reflect the

whole experience of the module, but ideally for them not to be influenced by their final result.

Separate from this survey, students are prompted to declare any disabilities during each process of module registration, and are able to personally update the records of their disability. While it is recognised that some students will not declare their disabilities to the university, the processes used have been revised over time, leading to increased detail and levels of declaration.

Open comment responses to the survey are primarily intended to be used by the staff responsible for designing and delivering the relevant modules. Closed question responses are analysed across the institution to provide quantitative understanding of student satisfaction. Respondents are asked to consent to the University storing and analysing the data, and are given a separate option to consent, or not, to their comments being published in an anonymous form.

Although several institution-based projects have researched the disabled student population directly through targeted approaches (e.g. [19]), this survey is part of routine university activity and therefore can be utilised on a continuous and historical basis to provide insight into the experiences of disabled students. While additional surveys, or more specific questions for disabled students are a possibility, concerns of survey fatigue are considered in the institution's data collection strategy. This is backed up by research that suggests that increasing the number of surveys given to students is problematic [15]. Disabled students, who may already have additional bureaucracy to deal with, should be able to offer general feedback on their study experience, without being overburdened with significant additional questioning beyond that given to others. Making the best uses of the relevant data that is received is therefore our focus in this paper.

3.2 Key word analysis process

For the calculation of the log-likelihood of terms, all comments have been processed with the same technique. The focus of this analysis is on nouns. A custom script annotated all comments with part-of-speech. The part-of-speech information was used to filter all texts according to nouns (singular or mass, and plural noun - NN, NNS, singular and plural proper noun - NNP, NNPS). All nouns were converted to lower case, which ensured that, for example, 'Disability', and 'disability' were counted as the same term. Additionally, terms that consisted of multi-word nouns were kept together. These single and multi-terms of nouns were the input for the calculation of the log-likelihood ratio.

Each occurrence of a term within a comment contributed to the frequency count. The dataset of all comments was split into several datasets, each specific to a disability type. For each dataset we calculated the log-likelihood ratio for all words of the comments with the specific disability flag and compared them with the words of all other comments. We excluded rare words by filtering words that occurred less than five times in either of the two sets and words that occurred less than five times in the dataset with the comments written by students with a declared disability.

3.2.1 Key word analysis software

The analysis of the open comment data was conducted within the R software for statistical computing [17]. The R openNLP package [9] was used to annotate all text with part-of-speech. All annotated open comment data was pre-processed to lower-case with the R text mining package tm [6]. Custom scripts implemented the analysis including the calculation of the log-

likelihood ratio described by Rayson [18]. The inter-rater reliability was calculated with the R scripts provided by Gwet [8].

3.3 Categorisation of Keywords

To further understand the survey comments at the word-level, the key words identified as unusually frequent or infrequent for responses from disabled students were categorised. As an initial basis for this, four categories were devised that broadly reflect distinct areas of concern for accessibility in online education [21-23]. These were: Course-related; Disability-related, People and Organisations; and Tools and Resources. To test the coherence of these categories, a word categorisation exercise was undertaken, where staff with expertise in accessibility and study. The top 100 words found to be unusually frequent or infrequent in comments from all disabled students were provided to these coders to categorise. The coders could also mark terms as either not belonging to any of the categories, or not being a word.

3.4 Targeted thematic analysis

The identified key words were also the subject of a manual thematic analysis [3]. This approach supported the identification of emergent themes and meanings through interpreting comments in full. As this is a resource intensive activity when the data set is so large, the keyword analysis provided a means to target this towards a subset of all the comments. A member of the research team read and coded the comments that contained each of the top 10 key words for each category of disability. Where the word was very common, used in more than 30 comments, only those that were explicitly related to disability were coded. Otherwise, all instances were coded. The analysis was conducted using NVivo 10 software, allowing the generation of reports and visualisations with the developed coding structure.

4. RESULTS

4.1 Descriptive statistics

A total of 93,148 open comment texts (counting each answer to a question individually) were received from students who studied in modules in 2014-15. Of these, 6,792 were received from students who had declared a disability.

Table 1: Response rates according to disability category

Declared disability	Response Rate (%)	Total comments identified
Autistic Spectrum	29.7	163
Fatigue / Pain	39.1	857
Hearing	43.3	759
Manual Skills	42.4	385
Mental Health	32.5	1956
Mobility	40.4	1768
Other	36.4	695
Personal Care	37.6	31
Sight	38.4	643
SpLD e.g. Dyslexia	27.7	1779
Speech	40.4	67
Unseen	37.3	869

This comprises 7.29% of the overall dataset, which is comparable to the proportion of students who had declared a disability and remain registered on a module after 25% of the module was completed in 2014-15 (7.30%). At this broad level, it appears that the responses received from disabled are proportionate to the population that continues in their studies beyond the first weeks.

To provide a more detailed picture, Table 1 describes the total number of comments that can be identified as coming from students declaring each category of disability and the response rate - the proportion of survey responses received from the total number of surveys that students were asked to complete. This shows some variation, which will provide a focus for future attention on the representativeness and inclusivity of the feedback approach. It is important to note that answering of open comment questions is not compulsory in order to submit a response. In our future work we aim to develop a more detailed analysis of commenting behaviours in responses.

5. ANALYSIS

This relatively large data set presents opportunities and challenges. In most categories of disability, there is a large number of comments (>100 for 10 of the 12 categories). This is favourable for identifying significant results in automated content analysis approaches, but presents a challenge for manual approaches that identify qualitative meanings and themes. As such, we look to combine the approaches described above to best understand the feedback provided by disabled students.

5.1 Keyword Analysis

The frequency of word use can be used to identify differences between comment data sets. In this case, comparisons were made between comments from respondents declaring a disability with the wider data set of comments from all respondents. This was performed for both the whole set of comments from disabled students, and for each disability category.

Below we provide a list of the top 100 unusually frequent or infrequent key words that emerge from this analysis across all comments from respondents declaring a disability. The terms are ordered so that those earlier in the list are to be considered more unusual according to their log-likelihood ratio. A minus sign (-) denotes terms that were unusually infrequent. All other terms are found to be unusually frequent. In order to avoid publishing terms that relate to identifiable areas of the institution, such as courses, subjects, people or places, some terms are replaced with a term representing the category of word, such as course 1, or place 2:

disability, dyslexia, transcripts, screen reader, place 1, examiner, disabilities, daisy, dyslexic, ring, books, comb, health issues, mini lectures, voice, help, spiral, subject 1, print, computer skills, TMA¹, student support, activities (sic), invigilator, readings (-), examples (-), study guide (-), role (-), theories (-), hospital, family circumstances, person 1, material (-), level (-), titles, illness, colleagues (-), subject 2, waffle, illustrations, tutor, papers (-), DSA², subject 3, weather, study skills, evening classes, approach (-), support, subject 4, good, course tutor, information, place 1, chapters (-), techniques (-), elements (-), island, textbooks, tutor guidance, computer, sites, font, process (-), advantage, question,

¹ TMA (Tutor Marked Assignment) is a form of assessment

² DSA (Disabled Students Allowance) is a form of funding available for disabled students in UK Higher Education to support their studies.

learning (-), hit, course 1, health, tabs, versions, student, shame (-), (face to) face tutorials, moderators, manuals, numbers, children (-), course 2, way things, assignment (-), bit (-), degree pathway, terms (-), security, treatment, circuit, things, headings, opportunities (-), others (-), difficulties, depression, interview, course 3, page numbers, telephone, assistance, video materials.

The top 10 unusual terms for the 10 categories with >100 responses are presented below in Table 2. It is important to note that this does not mean that feedback from smaller population categories should be ignored. However, this particular form of analysis is only appropriate to larger scale data sets.

Table 2: Unusually frequent or infrequent words for each category of disability. A minus (-) denotes terms that were unusually infrequent rather than frequent.

Autistic Spectrum: bus, place 1, region, textbooks, miles, skills, coursework, someone, course (-), degree
Fatigue / Pain: disability, periods, material (-), study skills, disabilities, support, manuals, approaches, learnt, module
Hearing: disability, examiner, transcripts, hearing problem, hearing, place 1, illness, students, subject 1, learning (-)
Manual Skills: course 1, subject 2, disability, October, courses, subject 2, times (-), part, questions (-), material (-)
Mental Health: disability, health issues, name 1, confidence, subject 3, internet explorer, time (-), student support, health, mentor
Mobility: disability, ring, comb, disabilities, ALE, discs, student, circumstance, hospital, illness
Other: waffle, course theme, learning (-), sentences, subject 4, moderators, attention, versions, disability, facts
Sight: disability, screen reader, difficulties, schools, knowledge (-), problems, student support, advice, comments, screen
SpLD e.g. Dyslexia: dyslexia, dyslexic, mini lectures, disability, voice, place 2, disabilities, assignment (-), module (-), support
Unseen: subject 5, treatment, documentation, subject 6, subject 7, subject 8, health, assessment guide, marks, disability

This analysis provides evidence for some broad findings about the survey data: Firstly, the prevalence of disability, health, and accessibility-related terms suggest that many disabled students do use the survey questions to discuss matters relevant to accessibility.

Secondly, the general nature of the questions means that they do this in the broader context of their experience, hence there are a number of terms related to courses, materials, technologies and staff, which may also be related to accessibility issues.

Thirdly, there are distinctions in terms used between categories of disability, suggesting that these groups raise different issues and use different language.

However, the meanings behind word use can be unclear without further investigation of semantic context. For example, does an instance of 'ring' occur in the context of ring binding of printed versions of materials as a reasonable adjustment, or in the context of ringing someone on the telephone, or both? Additional forms of analysis are needed to answer questions such as these.

5.2 Categorisation of key words

The categorisation approach manually assigned keywords where appropriate to one of four categories: Course-related; Disability-related, People and Organisations; and Tools and Resources. This exercise was undertaken by 5 coders. In order that the meaning of specialist terms (e.g. DAISY) were recognised, the coders all worked at the University in an area relating to disability or accessibility.

The inter-rater reliability for the five coders coding each of the 100 words according to five categories was .64 (Fleiss' κ [7]); 95% CI .56-.71; %-agreement of 71%). According to the benchmark of Landis and Koch [12] the κ value of .63 is substantial. We see this level of inter-rater reliability as acceptable for the context of this study.

The analysis of this coding activity found that agreement between 3 or more coders (simple majority) was reached on 94 of the 100 words. The agreed words fell into the categories as follows in Table 3:

Table 3: Results of the Categorisation Exercise with the top 100 unusual key words for all disabled respondents

Category	Terms agreed by 3+ coders	Examples of terms agreed
Course-related	25	assignment, readings, textbooks, module pathway
Disability-related	12	disabilities, dyslexia, depression, illness, health
People and Organisations	14	course tutor, examiner, student support, name 1
Tools and resources	21	books, font, screen reader, daisy, ring, computer
None of the categories	22	advantage, opportunities, numbers, place 1

In inspecting the outcomes of this activity, several issues warrant further investigation. A large number of words were deemed to fall outside of the categories. These could be considered irrelevant to an accessibility perspective on the comment data, but some of these, including the examples terms given above, such as 'advantage', or 'numbers' suggest that they may be relevant.

A further issue is that there appears to be an area of semantic overlap between course-related and resource-related terms, such as textbooks, materials, or readings. For example, 'textbooks' were considered to be course-related by 4 of 5 coders, while 'books' was categorised as 'Tools and resources' by all 5 coders.

The value of a categorisation scheme such as this depends on its purpose. Our purposes are currently two-fold: firstly, the categories could allow us to further understand differences between comments from different categories of declared disability. This could distinguish the types of issues being raised by people with diverse disabilities and health issues. Based on such categorisation work we can identify distinctions between – for example – themes being raised by students declaring a mental health issue, where many relate to human support, when compared to a mobility issue, where tool and resource related issues are more prevalent.

Secondly, we see potential to automatically categorise comments according to a dictionary of reference terms, such that these

comments can be utilised more effectively as feedback within organisational processes of quality enhancement. For example, comments including terms that were categorised as relevant to 'Tools and resources' could be automatically brought to the attention of staff that deal with technical production, tools, and platforms. Alternatively, if comments featured course-related terms, these could be automatically sent to staff who co-ordinate accessibility in the student's subject area. The key word approach offers the potential to identify terms that should form a part of such category-based dictionaries.

Developing suitable categories and dictionaries of keywords for each purpose is an on-going process of which this activity is a first stage. Manual thematic analysis provides an opportunity to explore the semantic usage of these keywords and the themes within the categories.

5.3 Thematic analysis

In this section, example concepts from the thematic analysis are presented according to the categories of key words used. We use this to consider methodological issues related to the categories and key words, and to explore examples where feedback appears to offer insights unlikely to arise from accessibility guidelines or user testing. Quotes used to illustrate this section are used in a selected and limited way to maintain anonymity.

5.3.1 Course-related themes

Many of the comments that contain course-related key words do not explicitly relate to accessibility or to the respondent's disabilities. Students express opinions on various aspects of their course experience in the survey. Two common concepts that do relate to disability are the relationships between course structure and time pressures, and the form and style of course materials.

A variety of comments discuss the impact of course structure and scheduling on study. Fixed points for engagement, such as examinations, deadlines, and tutorials, were a common focal point where issues could be exacerbated under pressure. For example a respondent noted that their goal of gaining the highest possible grade in a module was complicated by the inclusion of an exam where:

"poor memory makes me very reliant on the handbook for formulae and definitions, so I waste a lot of time looking things up".

Workload pressures were also a concern where events in the person's life, or the additional demands of studying with a disability, impacted on the ability to engage in the course. The impacts of dealing with institutional and external bureaucracy in these situations are a key example where specific comments given in the feedback data can focus the attention of staff.

Regarding the categorisation of terms, there is a cross-over in keywords that relate to courses and those related to the form and style of resources provided. For example, 'Textbooks' is considered as a course-related term in the categorisation, and comments discuss the relative merits or problems of online materials when compared to print. Course-related terms are also a point of comparison with other educational experiences. For example one respondent noted the advantages of ODL study and of the OU materials over their prior educational experiences, where Aspergers caused difficulties in absorbing information from lectures and standard textbooks.

Related to this are comments where subject-specific matters raise issues, particularly in relation to assessment-related key words such as 'assignment'. Outside of commonly understood

challenges in areas such as mathematics, the richness of the comments provide insights into the complex decision-making and use of tools that occur as part of the student experience. For example that:

“trying to type mathematical equations and such ... is notoriously tricky. It was quicker to handwrite assignments for the most part, even though handwriting is difficult for me due to dyspraxia... definitely more difficult to write than, say, a humanities essay.”

A further course-specific concept was where those with hearing problems commented on the integral use of audio in specific courses. Although the materials and activities were accessible, challenges raised from this ranged from those who needed more guidance on tasks like slowing down recordings for language learning, to taking part in online collaborative activities where audio was one of several possible conversation channels. Feedback on such individual experiences are important to the specific faculty, and also to the wider technical and support staff at the university who can develop guidance and make improvements to tools and resources.

5.3.2 Disability-related themes

Terms such as ‘disability’ and ‘disabled’ were the most prevalent key words in the comments from disabled students. Comments containing these terms are generally relevant feedback for accessibility. As such, it would be possible to identify a large amount of accessibility-related feedback from a corpus such as this by searching for matches from a dictionary of disability-related terms. However the comments using these terms are very diverse in their focus.

For example, a comment that crosses Disability-related, Course-related and Tools and Resources key words stated that the recommended study hours suggested in the course information did not take into account their disability, and that although they were aided by the IT products provided to support them, they still had to spend additional hours above those expected. This created tension with their job, as like many ODL students, they studied part time while working full time.

However, there is also a need to understand the context of the enquiry that places a burden either on the respondent to explain the background to the issue, or on the reader of the feedback to access this information through some other means. The level of description provided by the respondent about their disabilities is variable. It is helpful when personal circumstances are described in an explanatory and specific way, related to the issue at hand. For example, one respondent provided a detailed statement of phobias caused by their Autistic Spectrum condition, and how these led to anxiety in collaborative work. The respondent continues by providing a detailed account of how the group work was valued but also caused issues and required sensitivity to their needs.

In other cases, the context is less clear, and so is the ability to understand the issue raised by the respondent. Increasing the utility of these comments requires reference to other data sources, such as the detailed profile created by the respondent with support staff, in order to contextualise the issues faced.

A further concept in comments that highlights the need for individual context information are the emergent challenges faced by users with multiple disabilities. For example, one respondent notes their difficulties in navigating the VLE, forums, and online tutorials due to a sight disability “and other disabilities”. They go on to reflect that they should:

“have accessed the disability service more and asked for maybe some personal tuition on how to navigate and utilize the resources before I started the course”.

More information can aid understanding of the impact of the ‘other disabilities’ and facilitate a better response. The comment that more support should have been taken up also provokes reflection of what more could have been done to encourage this engagement with support services early in the student’s journey.

5.3.3 People and organisations

This category highlights many of the issues where resources, the individual, and organisational processes interact together. Issues raised in comments containing keywords such as ‘others’, ‘student’, or ‘tutor’ were commonly related to the support received from the organisation’s staff, or the mediated interactions and events held with other students as part of their courses.

Regarding support from the organisation, two key themes are the development of the person over time, and the essential importance of consistent interactions and information from staff.

A key role of staff and of organisational processes is to allow the student to develop over time. The capacity of engagement with education to prompt and support a person as they diagnose and are learning to learn with disabilities is evident. For example having dyslexia “which was only just diagnosed”, a respondent:

“lost all my faith and confidence but with help and support I soon got back into it and began enjoying studying again.”

Respondents clearly express the value to them of staff who are seen to make consideration of their needs. Challenges to this occur when students move between tutors or support staff either as a result of their progression between modules, or because of staff changes. Expectations emerge from one experience and inconsistencies can then be problematic. Amongst the many positive comments about staff, those showing an inconsistency with expectations highlight areas where processes and guidance may need refinement.

For many, opportunities to interact with other students and with educators are a strongly desired feature of the educational experience. Yet while work has occurred to make sure that tools are technically accessible, such experiences can push at the boundaries of capabilities. It was notable that the pace and direction of interactions are often dictated by other students, and that this can raise particular needs for accommodation as a person develops their digital skills and strategies. For example, a respondent stated that since they were fairly “new to being blind”, they were outside of their “comfort zone”, and that:

“The amount of reading of so many student replies in the forums and analysing each ...was a bit too much...perhaps my lack of familiarity with a screen reader was a hindrance here and other blind students may of found it particularly stimulating”.

Collaborative activities also challenge the ability to plan and work ahead of schedule. This is mentioned as a key strategy for some students who know that their circumstances can change. For example stating that “due to disability planning when I need to work is paramount, however having to rely on others where cut off times or deadlines were not adhered to” created problems.

The ability to study without needing to attend a campus and with flexibility of interactions is considered a strong positive benefit of ODL. Yet learning online can foreground new challenges of social interaction in education. Any perceived failings can disrupt a student’s sense of confidence and belonging. It should also be noted that other respondents stated that they had chosen to study

through ODL because they expected that it would allow them to limit or control the need for interpersonal interactions. This diversity of feedback can help the institution maintain a balanced awareness of needs - that interaction with other students is valuable to many, but is not possible or expected by all.

5.3.4 Tools and resources

Comments using terminology for specific forms of resources and tools provide feedback on efforts towards inclusive design, such as making alternative formats and transcripts of audio available, and the provision of adjustments for individuals. Because it provides first-hand experience, this feedback highlights areas where additional help and guidance is needed. Comments implicitly or explicitly highlight issues of digital literacy and areas where technologies present barriers. For example a respondent noted the value of being given DAISY materials but was:

“still unable to upload them properly to my iPod and cannot navigate through them. I need something to actually play them on properly”.

In a further example, another respondent noted that audio provision had helped them in their studies, but stated that in addition “I know I shall need a better screen reader”.

A conceptualisation of accessibility that addresses this developmental perspective on confidence in learning skills and in the use of technology would clearly be useful to effective support of students or users of other systems over the longer term. One role of feedback in this is that it allows rich insight into the journey users take with regards to building digital literacies and coping with change over time.

Respondents noted that they benefited from the capacity to use alternative formats and through the delivery of material online. In other cases, barriers, limitations, or preferences against study using a computer are a concern expressed in feedback. For example, eye strain and pain in sitting limit some students’ ability to sit in front of a computer for long periods. Responses show variable levels of awareness of the services offered to aid students in these situations. The university offers printed materials free to students who require this due to their disabilities, and has developed services for all students to request printed material as courses move to being delivered online. It is particularly notable that feedback identifies areas of misunderstanding based on past experiences with older processes and tools. The feedback data identified as relevant to this particular issue is now an input into an institutional project to improve the guidance given on computer-based study for specific disabilities.

5.3.5 Further keyword themes

The categorisation used here is a first attempt based on common distinctions in literature. It is notable that several of the unclassified terms relate to comments that discuss specific times and places, or related terms such as ‘process’, or ‘periods’. The uses of these often refer to procedural or event-based issues. A further category could be developed around such a theme. An alternative would be to develop categories that link to particular roles and responsibilities in the organisation.

6. DISCUSSION

This paper has described our use of several processes through which open comment feedback from disabled users can be analysed. Our aims are to develop a more nuanced understanding of the accessibility-relevant issues raised in this feedback, and to identify ways through which feedback can be further embedded

into institutional processes. In the following sections we offer some recommendations drawn from our reflections on this work.

6.1 Approaches to analysing feedback

6.1.1 Devise ways to use information about the respondent and context to aid understanding

Information describing the individual’s context and condition is of great value when accessibility-related issues are raised. In this analysis, we took a broad approach of analysing feedback according to the categories of declared disability. This required a link to be drawn with other information held about the individual. This approach showed some benefits over the common binary categorisation of a user as either a person who has declared a disability or not. At its simplest level, this allows us to see that different types of issue do arise for different groups. Given that disability support staff do develop expertise in supporting those with particular disabilities, this also offers a means through which to deliver feedback to the relevant staff in the organisation.

However, there is a broader need to understand cause and effect which open text comments leave up to the respondent to express. Some comments state only that an issue arose ‘because of a disability’, while others refer in detail to interactions between multiple disabilities, work, study, and significant life events.

Ambiguities about the user could be resolved by further reference to, and improvement of, other sources of information held about the individual such as profiles. Users are unlikely to want to repeat detailed information that they have already reported elsewhere. It may be pertinent to aim to design feedback tools or guidance such that ambiguities about the context and cause are avoided. There are equally, issues of privacy and data protection that have to be considered in working with these data sources. A related issue of relevance, discussed in section 6.2.1, is that this information will be dynamic: There is a need to consider how information is updated as disability and skills change.

6.1.2 Develop automated approaches to aid identification of accessibility-relevant issues

Any substantial service, platform or organisation could generate large amounts of feedback given a suitable mechanism and population. This could include surveys or feedback forms embedded into a website or web system. The results of the key word approach applied here, and the creation of dictionaries of terms relevant to particular categories of terms, suggests that automated approaches can be used to identify accessibility-related comments from a more general body of feedback.

The value of these approaches is in providing overviews, identifying trends, and to help to categorise feedback such that it can easily be brought to the attention of the right people in the organisation. At some stage, manual interpretation allows contextual information and staff expertise to be included in understanding the issue and developing any appropriate response. With large bodies of feedback that contain some accessibility issues, automated approaches should be developed and improved through the data analysis process, such that the organisation continually learns to make better use of feedback.

6.1.3 Evaluate the accessibility and representation of feedback tools through analytics

Understanding trends in response and commenting through analytics should inform evaluation of the representativeness of feedback processes. Such analytics can identify underrepresented

groups and have the potential to prompt further investigation of strategies to improve the inclusivity of feedback mechanisms.

6.2 Developing process-driven accessibility

6.2.1 Conceptualise the development and changes to the user over time as part of accessibility processes

In line with other researchers [5,11,21,25], our analysis of feedback highlights the importance of understanding the users engagement with technology in context as part of accessibility. In particular, having skills, strategies, and confidence-levels that are developed and disrupted over time. A timely piece of information or direction can make a huge difference to individual experiences of accessibility. An unexpected difference between course resources or a temporary change to abilities could have long-term ramifications. A process-based focus for accessibility therefore means attending explicitly to changes to individuals over time and to their engagement with a range of actors and artefacts.

6.2.2 Develop a focus on socially-accessible designs for interaction

The ability, or inability, to engage effectively in shared events impacted on confidence and subsequent actions. While tools were technically accessible, the pace of online discussions, the quantity of information, or the use of multiple communication channels could be overwhelming. As described above, a developmental perspective in which users can become comfortable with greater interaction over time and with the right support appears important.

6.2.3 Design mechanisms for feedback to be relevant, responsive, and reflective

The survey offers benefits in terms of reflecting an individual's holistic experience across a module. However it does mean that there is a lengthy delay if students waited until the survey to give feedback on immediate challenges faced early in their study experience. Survey responses are not likely to be the communication channel of choice for immediate problems. Faster and more focused forms of feedback, such as embedded buttons in web-based systems, can complement the survey's capacity for longer-term reflection. Accessibility therefore needs to be ensured for these feedback opportunities, and such feedback should be analysed for accessibility-related responses. Useful data can also be gathered from logs of requests and other communications.

6.2.4 Consider the relationship of users with the organisation

Activities such as online study, work, or the sustained use of a social media service can entail a long-term relationship between an individual and an organisation. This may support continued interactions around accessibility as part of that relationship. However this could vary significantly depending on the type of relationship or organisation. For example, a student may feel comfortable describing an experience to a university after finishing a course that an employee would not want to reveal to their employer. Levels of trust and prior experiences may influence the type of feedback received and the design of mechanisms for this.

6.3 Integration of feedback into organisational processes

6.3.1 Work to get the relevant feedback to the right (groups of) people

While organisations differ, it is to be expected that there are multiple stakeholders who play different roles in achieving

accessibility [10,14,22]. A challenge is for feedback comments to reach those who should understand or act on them in the most effective ways. Automated and manual processes for sorting, linked with processes of delivering and using feedback as part of accessibility work, will support a complete feedback loop.

6.3.2 Use key words and categorisations of feedback to refine roles and responsibilities

A further issue raised in prior work such as [14] is the need to better articulate responsibilities for accessibility in organisations. It may be that feedback can play a role in this. The forms of issues raised in feedback can be diverse. If they need to be acted on, they should all relate to an individual or group role that takes responsibility for them. In this way, feedback might drive the involvement of staff in a ground-up means of refining top-down staff structures and roles.

6.3.3 Use feedback to make grounded examples of user experiences more visible to staff

Aside from comments that present a clear issue for investigation or action, there are many that have other forms of value. Online and distanced interactions can create a lack of understanding of individuals, and experiences of disability can be hidden, even to those who interact with disabled users regularly. As such, feedback offers a rich source of grounded examples for training, scenarios and use cases for design, and morale-boosting stories of the impact of accessibility work.

7. CONCLUSIONS AND FUTURE WORK

The processes developed through this research could be relevant not only to online learning, but to other web-based platforms and organisations that rely on their users being able to not only access, but perform and develop through their online interactions.

The findings further evidence the need to understand accessibility in context and reflect the changing individual user. The approaches trialled here offer insight into how accessibility-related issues can be identified and understood from more general mechanisms for feedback. A feedback loop with users offers insights that would be difficult to gain through up-front adherence to guidelines or user testing. These insights highlight how skills, strategies and confidence develop over time and the design of interpersonal interactions mediated by technology.

This exploratory analysis has highlighted a number of potentially fruitful directions for future work. We intend to analyse survey response and commenting behaviours, to assess how and why these vary across groups within the disabled student population. We will refine the use of automated approaches to include tools such as sentiment analysis, and will develop dictionaries of terms that form effective categories for comments. We will also look to identify clusters of related issues that emerge from particular groups within the student population. Longitudinal analysis of feedback data offers the opportunity to further understand procedural and developmental aspects of accessibility over the course of a student's relationship with the university.

We also aim to widen our scope to include data from feedback opportunities embedded into web platforms such as the VLE. It would be valuable to compare data and practices with those of other types of organisation where there is extensive and sustained online interaction, in order to understand how relationships between users and organisations impact on these processes.

To be clear, feedback should not replace efforts to make systems and services accessible by design, or to test adherence to standards. But particular elements of accessibility for individual

users emerge from their interaction with working systems. As such, better processes of using feedback can play an important role in improving accessibility over time, and in evaluating the holistic accessibility of an organisation's complex and ever changing provision from the point of view of its users.

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