Enhancement of Blended Learning Materials and Methodologies to Promote Inclusivity (12071)

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SUMMARY

Students with learning special educational needs, difficulties, and disabilities can represent a significant proportion of the overall students in higher education. Difficulties and needs such as dyslexia, dyscalculia, dyspraxia, dysgraphia, ADHD, and colour blindness can often face barriers to their education. The Covid pandemic changed the way that education was undertaken overnight, resulting in acceleration of digital and blended learning methodologies, but this haste for development may have led to less emphasis being made on inclusivity for all end users.

To help promote inclusivity a group consisting of students from various levels, disability officers from the student's union, learning and teaching specialists, and technical and academic colleagues were assembled. Initially, the team examined the accessibility of existing materials and methodologies for teaching and were asked to provide feedback through a structured questionnaire to obtain an initial benchmark based on:

- Clarity of Instruction,
- Ease of use for materials,
- Level of accessibility,
- Level of interaction from materials,
- Overall satisfaction.

Based on the resulted of the structured questionnaire the team investigated each of the questions and outlined barriers to learning students may have from the material to these aspects. Key themes were established and enhancements on materials were made ensuring, multiple colour schemes, digital options for all material, with capabilities for audible reading, accessibility across multiple viewing platforms, and implementation range of learning methodologies and technologies. These technologies included the use of digital interactive learning materials, virtual reality simulations, interactive quizzes, presentations, practical work, and paper based simulated exercises to help create a diverse learning environment.

After new materials were developed based on the above feedback, the team once again examined the materials and completed the same structured questionnaire to gauge improvement of the materials within the key themes outlined above and were materials and methodologies implemented into a level 4 surveying class. To help with the overall success of the material,

after implementation feedback was sought by the larger cohort of students within the class to review the overall efficacy of the materials and teaching from an inclusivity perspective.

The author noted an increase in interaction with the students during in-person taught sessions and an increase in engagement from the students while implementing new technologies. Feedback sought from the students was generally positive and showed an improvement in overall inclusivity and highlighted appreciation from students for this. However, comments were also made on how further improvement could be made on inclusivity by looking into some of the less common learning difficulties and examining how material could be further developed for these students.

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1. INTRODUCTION

Within the past few years many students have seen the way of learning and teaching significantly change and develop with the use of online, blended, and face to face learning. Universities have created and altered materials, ways of working and delivery methods. While some students have thrived from these changes, others have struggled to adjust to new ways of working.

Within the University of Derby, a suite of online and blended material was developed including an interactive digital learning platform for students within surveying modules. The idea of this was to help provide an insight into field work, explaining concepts and theories, and giving access to remote data to help promote improve understanding and greater support. While the development and implementation of this system was widely well received and student feedback, grades, and apparent understanding improved, it became apparent some students were struggling to access and obtain the true benefit of these resources due to their special educational needs.

In the United Kingdom (UK) 16.5% of all students have a registered Special Educational Need (SEN). One of the most prevalent special educational need types comes from Speech, language and communication issues, accounting for 25.1% of those students with SEN in the UK (Department for Education, 2022). However, there are many other types including but not limited to: Emotional and mental health, Moderate learning difficulties, Physical disability, hearing impairments, and visual impairments.

The prevalence of SEN is perhaps misunderstood in general society and might be more common than people believe. The International Dyslexia Foundation (2017) suggest that "*85% of those students have a primary learning disability in reading and language processing*" with "*as many as 15–20% of the population as a whole*" experiencing symptoms of dyslexia. Similarly, the National Institute of Health (2019) suggest "*3.7% of the population suffer dyscalculia*". Finally, a study undertaken by Faruqui et al (2022) looking into Colour Vision Deficiency (CVD) suggests 1 in 12 men (8%) and 1 in 200 women are classified as colour blind. As education should be provided and accessible to all, it was decided that improvements in the digital learning environment could be made to help the students with special educational needs obtain the full benefit from the new resources.

2. INITITAL SYSTEM DEVELOPMENT

The initial system focussed on three modules, two undergraduate, 4BU505 Site Surveying 1 taught to all Construction and Civil Engineering Students and 5HX508 Infrastructure Surveying and Asset Management mainly for Civil Engineers and one post-graduate module 7BU507 Geomatic Monitoring and Asset Engineering, which encompassed students from construction and civil engineering undergraduate backgrounds. The development of these systems focussed on allowing students to get the best experience from blended learning and enhance their opportunities for learning individually, as well as support their face-to-face practical education.

2.1 Development Steps and Outcomes

To do this a series of teams were put together and conducted a review into what needed to be achieved by the new learning materials and how best to undertake this. One of the key themes discussed was the learning styles and attention spans of students. It was noted from research that students had average attention spans ranging from 10-20 minutes (Sousa, 2011), while lapses in attention came in intervals throughout their studies, with the first being at 30 seconds from starting a specific task, the next being 4.5 minutes and increasingly shorter intervals until the student has lost all attention to the original task (Bunce, Flens, & Neils, 2010). It was noted that all these studies relate to the students doing one task for an extended period, whereas studies showed that when students are undertaking multiple consecutive small tasks changing in nature, their attention spans could be extended.

With this research, the authors decided to create a system which broke each module down into a series of smaller units. The units created were typically one per week, each had a list of desired requirements set out by the universities online content check list and aligned to specific learning outcomes within the module.

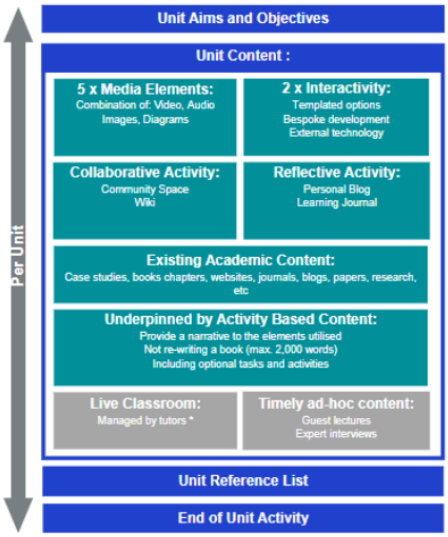

Figure 1 University of Derby (2021) Online Content Check List

2.2 Interactive Environment

The interactive learning materials were designed to engage the learners in smaller bite sized sections of learning within the unit, such as having videos, written text, live sessions, diagrams, audio, journals, websites, etc. All these learning environments were underpinned by knowledge checks throughout from the students, which contained elements such as unit activities, where students must complete worksheets, reflections, polls, research etc to further enhance their online learning.

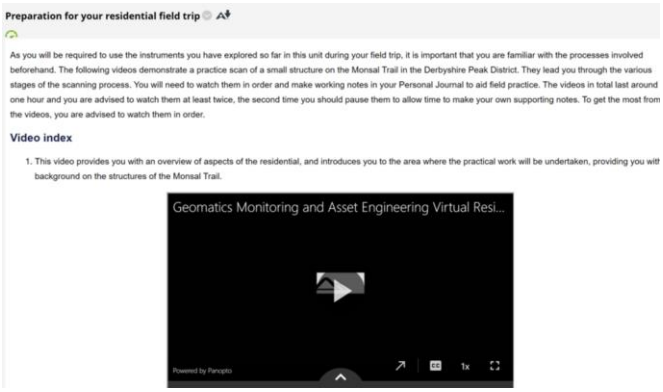

Figure 2 Spalton et al (2022) Final Module Content

2.3Practical Website Creation

Alongside the universities online learning platform, to ensure the students were able to get the best out of their practical sessions, a learning environment was set up that allowed them to have specific instructions for undertaking the desired works. This system was an interactive environment and broken each practical down into overview, equipment required, methodology, results, and analysis of results.

Figure 3 Example Equipment Required for Two Peg Test

To ensure continued interactivity is instilled in all systems, the website include practical and theory elements behind the activities. To help this further a range of material was included within the website, such as in the equipment listed section text descriptions and images of the specific item were included. Further to this, when clicking on the piece of equipment, it redirects the webpage to further information about that specific piece of equipment. Where possible, all

information was provided in two different formats, such as images and text or in the case of the methodologies, a step-by-step instruction list and a video of the practical being undertaken with audio and visual descriptors.

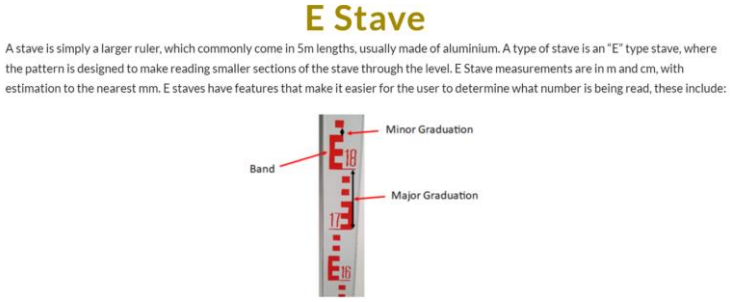

Figure 4 Stave Landing Page from Equipment List

2.3 Review of Inclusivity

While the initial system was shown to be generally successful and received generally good feedback from most students and showed positivity to being able to access the materials from their devices and how students were able to use the materials successfully. However, some comments were made about some of the elements, such as not having subtitles on the videos and background noise making it hard to tell what is going on for some. Comments were also made on the colours used by staff in some of their drawings, making it hard to differentiate between them for some of the user. While inclusivity was a factor in the initial system development, this was not always at the forefront looking into as many ways as possible to improve this element for students, mostly due to time constraints and having to put these systems out so quickly with the continually changing post-covid educational environment.

Due to this, two review teams were created to have a look at the initial system, the first being the students who used the system in the previous academic year were to be polled again. The second is a team of representatives from the university including, academics, technical staff, representatives from the Union of Students (US) and their inclusivity officer and team, learning and teaching specialists and managers from the discipline area. However, this time the poll would be changed, instead of focussing on use of materials and how these enhance learning, it would be focussed on access to the materials, ease of use, general accessibility of the elements within the units, clarity of the instructions on the task, and finally overall satisfaction with the material (for the students).

2.3.1 Findings of the Initial Review

As the student feedback was obtained from a broad spectrum of students, the accessibility questions were generally answered well. Despite most responses being complimentary of the

system, some other comments were made on how improvements could be made around specific element, such as the colour on drawings being a recurrent theme, understanding the speakers on videos when the language being spoken is not your native language, and some comments around ease of navigation for the practical website were also highlighted. Particularly that of having some of the pages hidden from the main navigation panel.

Within the staff representative session, it was agreed that the materials have made a good start into allowing the material to be accessed and fully utilised by all, further development was required. Several representatives of the group did not come from built environment backgrounds and did not understand the material from the origin of the project, helping give the perspective of a fresh pair of eyes. This particular group notes that in several places there was assumed knowledge and perhaps explanations were not as detailed, or tasks were not as prescriptive as they could be based on this. The use of surveying books and printed copies of workbooks and guides were noted in discussion and alternative media formats were to be explored.

The use of a range of media from text, images, and videos was commended in the group as an area of good practice and the material was found to be engaging by the group. However, it was also noted that improvements in the accessibility of these, such as by using alternative descriptors, audible elements, subtitles, video captions etc could be used to help expand the accessibility of the resources.

Some recurring themes cropped up in both groups, such as the colour on some of the diagrams being very close and while not suffering from any colour visual disturbances, both groups noted that these may be a challenge for some users. Similarly, comments were also made on the overall ease of navigation on the website through the navigation bar. As these themes were highlighted multiple times in different groups, this will be one of the key focuses to improve before the next round of feedback.

3. IMPROVING INCLUSIVITY

To improve the inclusivity of the overall system, the representative team again met and looked through the comments made from the previous system student feedback and colleagues from the Union of Students (US) inclusivity teams brought experience from barriers they have had to learning and feedback from students across the university of their challenges and barriers to learning. Throughout these discussions, key themes of inclusivity came up including that may be able to help with the overall accessibility of the materials, like providing alternative formats where possible, using existing digital assistive technologies, such as media players and windows systems with ease of access features.

To help meet these key themes, smaller targets were formulated to help achieve these themes, including the adoption of tablets for in field use, including the storing of data, accessible media formats, enhanced formats for colour selection, and website changes to allow for ease of use.

3.1 Mobile Device Utilization

Comments outlined within the group was the use of digital technologies for most elements of the module, including the theory and for exploring the methodologies of undertaking the practical sessions. However, comments were raised about why have a device such as a phone or tablet and then record some of the survey data, e.g., booking levels in a standard level book. This was of particular importance for one member of the panel who had Carpal Tunnel Syndrome (CPS), a nerve entrapment neuropathy, which can affect up to 10% of the adult population and accounts for 90% of entrapment neuropathies (Sevy and Varacallo, 2022). This was noted as a common complaint from the US representative for inclusivity stating that he has received many complaints of students who struggle with repetitive movements, such as writing and even holding pens due to this.

To help mitigate against this, a series of ruggedised tablets were purchased and loaded with a series of programs, including the materials for theory, practical website, data collection software, and some basic analysis of data and data processing software. This allowed students to become fully digital throughout the process and have all the information wherever they are, even if there is no phone signal, helping achieve the full potential of the digital resources.

Figure 5 Handheld Group (2022) Algiz 10x Tablet Available from: https://www.handheldgroup.com/rugged-tablets/

3.2 Improving Colour Detection

One of the biggest issues of inclusivity from the original system was the use of colours when explaining concepts, such as the two peg test and layering to students. An easy was to do this is to incorporate colour into any annotations and corresponding tables, allowing students to visually see where the numbers originated. However, different types of Colour Vision Deficiency (CVD) exist. The National Eye Institute (2019) suggest red-green colour blindness is the most common, where people struggle to differentiate between red and green colours, with a blue-yellow colour-blindness being less common. Lin, et al (2019) breaks colour blindness further into:

- **Deuteranomaly**- Green look more red.
- **Protanomaly** – Red looks more green.
- **Protanopia and deuteranopia –**Unable to tell the difference between green and red.
- **Tritanomaly –** Hard to tell the difference between blue and green, and between yellow and red.
- **Tritanopia-** Unable to tell the difference between blue and green, purple and red, and yellow and pink.

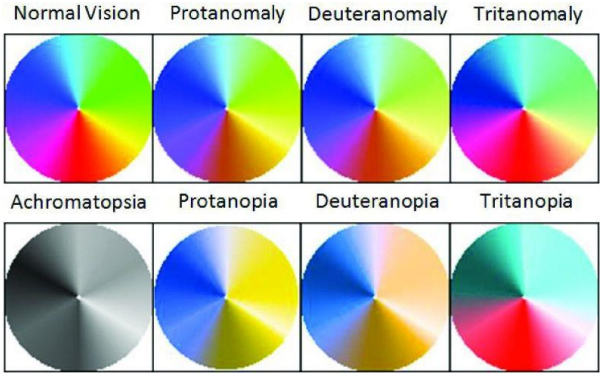

Figure 6 National Eye Institute (2019) Types of Colour Blindness

Due to the spectrum of colour vision deficiencies going across the colour wheel, it was decided that it is not possible to go with a set colour theme that would benefit everyone. As the materials were fully digital and on a live website, enabling add ins to the website were achievable and this then allows the user to change the colour of lines. Figure 5 shows one setup of a two-peg test and illustrates the difference from horizontal planes to two stave readings while the level is placed outside of the two pegs. The three key lines in this drawing all have significance in explaining the concept and the coloured lines correspond with data in further tables. Within the website, students can change the colours of each of these lines to whichever colours they like within a colour scale, tailoring the experience to suit their needs. Wherever a concept using colours like this has been used, this option has been made available to students.

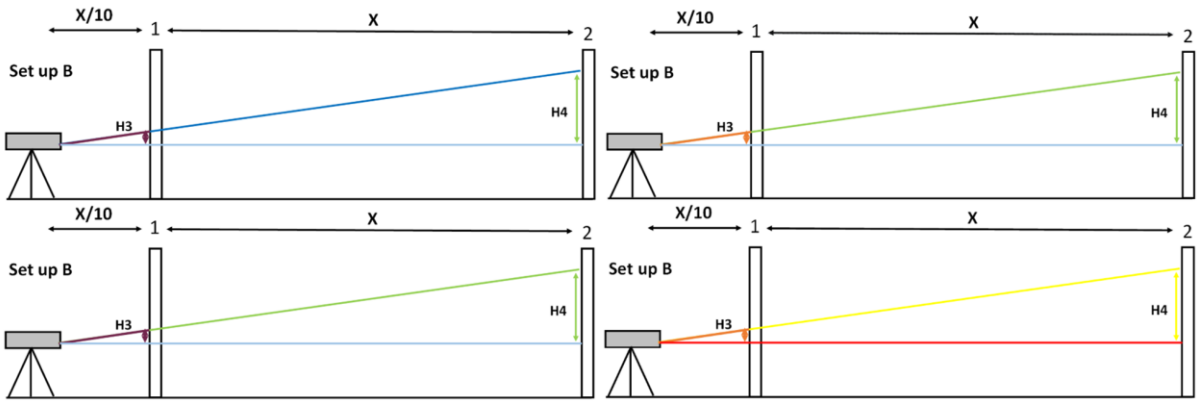

Figure 7 Two Peg Test Colour Option Examples

3.3 Media Improvements

Media improvements were another key theme throughout both feedback sets and highlighted improvements that could be made within images and videos. The changes required for images was mostly making sure that all images had appropriate alternative descriptors via text associated with them. The video material required a much bigger change to ensure their accessibility was improved, the first step of this was to create captions of all the videos, helping people read along what was happening while watch the video, meaning they could now be played without sound. Secondly, from the captions, a transcript of the video was made and available for download from the original video source, allowing people to read the briefings, without the need to watch the videos. Finally, to help one of the original feedback pieces from the student about understanding what was being said in the video when English is not your native language, a translate function was used for the captions into a range of languages via Google. While these are automatically translated via computer and not translated by a person into the individual languages, it is hoped that they may enable the person into achieving an overall concept of the video and only used in specific areas as an aide to learn, rather than being relied upon solely.

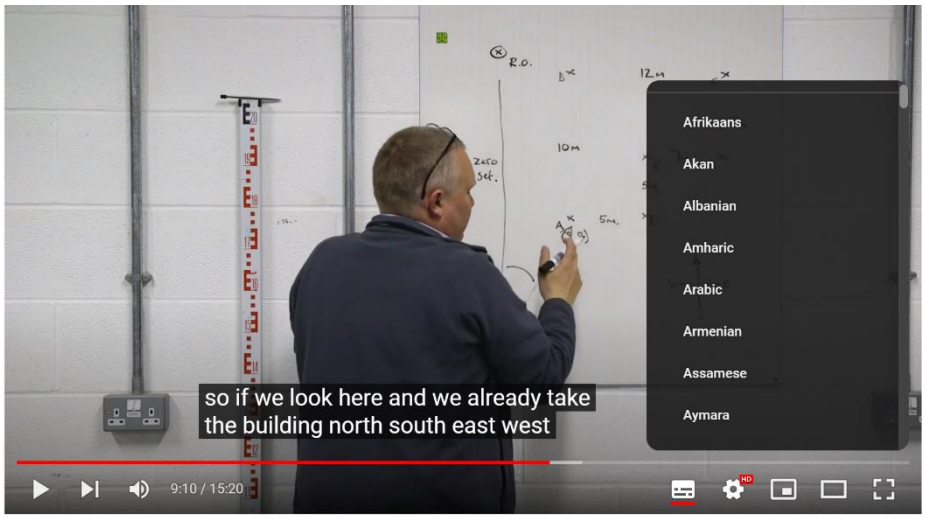

Figure 8 Example Video with captions and Available Caption Language Translations

3.4 Website Improvements

Overall navigation from the website was an issue highlighted multiple times in the initial feedback. Previously the layout of the website resulted in the users having to navigate between multiple sections, for example to complete the 4BU505 Surveying 1 module, students had to use the equipment, health and safety, and the specific surveying 1 module page to find all their information. Feedback received that moving between these separate sections was tedious and did not flow well while they were studying. A decision was made to alter the layout of the website so that each module had all information required within its own menu directory. For example, the 4BU505 surveying 1 module now had a flow from the health and safety element at the start, introduction to the equipment they are using, weekly activities, before finally directing them to the final assessment activities, providing a more logical order throughout the module.

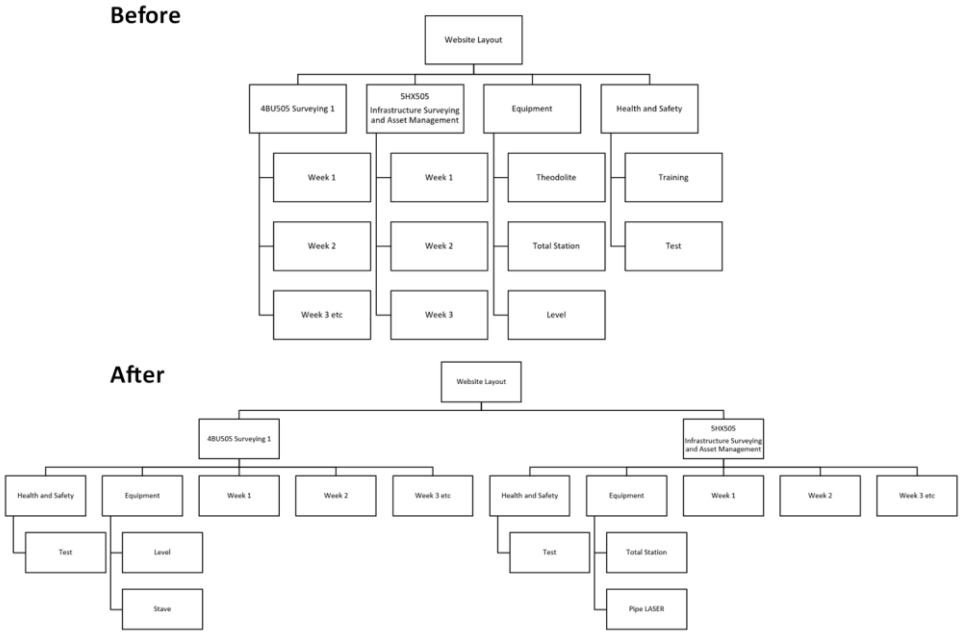

Figure 9 Indicative Website Navigation Menu Layouts

4. IMPROVED REVIEW OF INCLUSIVITY

For the second round of feedback the two cohorts were again asked. The first being the same student cohort undertaking the module were asked again. Alongside an enhanced panel of reviewers were recruited in addition to those on the original panel. This new panel consisted of a range of students but also particular attention to students who would most benefit from these inclusivity measures and who were keen on being involved with the development of new resources which help promote inclusion and ease of access while studying. The cohort again looked at all resources and were asked to comment on ease of access, level of accessibility, level of interaction, and overall satisfaction with the resources.

The ease of access to resources from multiple devices slightly decreased by 1%, however with the increase in respondents and increased level of functionality, such as the colour options and enhanced translation features, this was generally considered to be a success by the team, as these new ways of working appear to be simple enough to use for most users without reducing the overall satisfaction. Throughout all cohorts the adoption of tablets for all aspects of the module was widely well received with comments being made on the ease of accessing the resources while they were in the field, the enhanced elements of being able to draw on the tablets, and for the ease of logging data. While the inclusion of these tablets was predicted to be a good idea the overall benefit for all students and positive feedback was far greater

than originally predicted, potentially due to the current generation of students already being so well versed with technology already.

One of the students on the panel noted how much of a different the colour options was to their learning and being able to analyse these in a way that they can now clearly see has had a significant benefit to their learning. Multiple students noted that while the translations were not always fully accurate, it helped students when accents or sound levels of videos made it difficult to hear and having the subtitles gave them a greater understanding of what was going on in the video. Due to this future works will be investigated about having translations undertaken more professionally, rather than computer generated to help promote this benefit further, however there may be a trade off between languages available.

The question regarding overall satisfaction were again well received and presented a small increase from the initial feedback obtained. While the percentage value did not change much, comments made in the written section were extremely positive about changes made including some made from students about how these resources have developed in ways that made them understand topics which they were previously struggling with due to barriers in learning, misunderstanding of material, or lack of clarity in instruction. Positive comments like these show that improvements were made in overall inclusivity of the resources as was the intended purpose, but further work may also be required.

5. CONCLUSION

Throughout researching and developing the resources for surveying it was clear that there will never be a one size fits all approach to education and learning. Similarly, a project designed to help promote inclusion will not always benefit every student on a module. However, what was clear is barriers to learning are inadvertently put in place during the development of resources, design of practical assessments, and the ways assessment briefs are created. Inclusivity changes can be particularly tailored towards specific needs and barriers to learning, such as with colour changing mechanisms in illustrations for students with colour visual deficiencies or more general approaches, such as in ensuring clarity of instructions on tests and activities including ensuring that the wording you use is clear and concise. What has been clear throughout this project is making these small changes can have a huge positive impact on learners and helping them become independent learners. Above this the feedback received from students about making changes to help remove these barriers to education has been of particular significance and pleasure for the authors in helping these students achieve their full potential.

While undertaking the project has been a challenge as for what to improve on and what to leave out due to time constraints of the project, the knowledge from the author on special educational needs and disabilities has increased dramatically increased and lessons learned will continue to be implemented in design of teaching materials and methodologies in the future. Despite this an element

made clear was inclusion and remove barriers to education is an ongoing struggle for many students and there are always improvements that can be made by academics.

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