Testing the accessibility of popular e-learning platforms

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ABSTRACT

A wide range of tools is now available to enable teaching practitioners to create web-based educational materials from PowerPoint presentations, adding a variety of different digital media, such as audio and animation. The pilot study described in this paper compared three different systems for producing multimedia presentations from existing PowerPoint files. The resulting resources were tested by a group of disabled students and a group of non-disabled students. Our findings show that there were statistically significant differences between the two groups in relation to their interaction with the resources. In particular, the students with disabilities were significantly more active in using the available controls to customise the running of the presentations. The data suggest that future work on why students with accessibility issues made different uses of these resources could encourage practitioners' deployment of multimedia resources for the benefit of all learners.

INTRODUCTION

In the UK, the Special Education Needs and Disability Act, 2001 (HMSO, 2001) requires that disabled students are not treated unfavourably in Higher Education establishments and that reasonable adjustment is made to provide them with access to the learning experience available to all students. Policies to promote widening participation, benchmarks and incentives to recruit students from more diverse backgrounds and those with disabilities have led to a doubling of the declared number of disabled students entering Higher Education over the last 10 years (Higher Education Statistics Authority, 2006; Riddell, et al., 2005). It is often assumed by teaching staff that the proportion of disclosed disabled students in practical and laboratory-based courses is low, as they personally encounter few physically disabled students. However, learning disabilities are included in the definition of disability in SENDA, therefore the needs of this group of students must also be considered. It is more likely that a dyslexic student will choose a biological science course than maths or computer science (Richardson, et al., 2003). It is therefore particularly relevant that we seek to increase awareness of this growing trend with our colleagues in bioscience.

The phrase 'reasonable adjustment' in the SENDA legislation requires staff to ensure that all existing students can access their teaching materials in a format suitable for them. This includes the provision of resources that a student can customise, such as providing a lecture handout in the original word document, so that a student with a learning disability could change the font style and colour to make it easier for them to read and understand and the provision of software to enable text to be converted to speech. Microsoft PowerPoint is

widely used in teaching in Higher Education for presentations, lectures and to provide supporting materials on virtual learning environments (VLE) and files can be customised by the student. However use of PowerPoint is still controversial, being highly dependent on the practitioner to provide meaningful content for sound pedagogy (Jones, 2003) and research has been contradictory on whether it benefits student learning (Lowry 1999;Szabo and Hastings, 2000). The now almost ubiquitous use of VLEs in UK higher education (Browne and Jenkins, 2003, Ward, et al., 2001) means that PowerPoint files are now more easily distributed directly to students than ever before. Taking this one stage further, multimedia resources (containing video, animation or sound) can be used as assistive technology by providing alternative formats such as audio, diagrams and images to long sections of unbroken text that can be inaccessible to users with learning disabilities or other disadvantaged groups such as those with English as a second language (Sloan, et al., 2006).

A wide range of tools is now available to enable instructors to add a variety of different digital media to PowerPoint presentations to produce web-based multimedia resources. We report here a pilot study to investigate the use of three systems for the production of online multimedia resources from existing PowerPoint files: two Adobe products, Flash (http://www.adobe.com/products/flash/) and Presenter (http://www.adobe.com/products/presenter/) and a Java-based product, Impatica (http://www.impatica.com/). The resources were evaluated in terms of ease of production for lecturing staff and resource preference by student users. To investigate the premise that making multimedia resources available may benefit students with accessibility issues as well as non-disabled students, two such groups of students were observed using the resources.

METHOD

A user testing protocol was developed as the basis for this study to elicit how undergraduate students with and without accessibility issues used the three different programmes. The three different systems for producing multimedia web-based resources, were used to create the materials for user testing. This provided a realistic and familiar activity to test the delivery systems.

To avoid distractions, we considered it to be important that the content of the teaching materials be directly relevant to the students' course of study. Materials were created for testing from PowerPoint presentations sourced within the School of Biological Sciences and from one outside lecturer. Once the study materials were created, user testing was carried out with individual students and the sessions were both directly observed and video taped for later analysis. Participants were asked to complete a series of questions relating to the content of the presentations. These questions enabled testing of all the features and different presentation media within each format. This approach also allowed us to observe how the students would use the systems in a simulated real-life situation, such as searching for useful information from lecture support materials.

i) Creation of test materials

The project required the production of learning materials using three different formats – Flash, Adobe Presenter and Impatica. In order that fair user testing could be carried out, exactly the same content was used for all three formats. As Flash is a complex programme, it was initially assumed that pre-existing Flash presentations could be sourced within the School and/or by a search online. This content would then be converted to PowerPoint for use in Adobe Presenter and Impatica. However, the sourcing of suitable materials was more challenging than expected and the conversion from Flash to PowerPoint not straightforward. It was therefore decided to take a different approach and start with PowerPoint presentations that could later be

converted into the different presentation outputs. Several PowerPoint presentations containing animations were found within the teaching materials presented in the Faculty of Medicine and Biological Sciences and were made available by the kind permission of their authors. One presentation used was from a lecturer at Trinity College, Dublin (permission granted by author). Four of these presentations were used to create provisional materials.

Due to the different ways in which Flash, Adobe Presenter and Impatica handle PowerPoint files, slightly different versions of each presentation had to be created for each platform in order for them ultimately to appear identical in content. Narrative scripts were written for each presentation and sound tracks were recorded, edited and cued to the relevant animations.

To avoid over exposure of the test participants to the materials and to work within acceptable concentration levels, the period that each user tested the materials was kept to a maximum of one hour. Following some pilot testing, two topics were selected for full user testing, one based on basic concepts in immunology and the second on the process of DNA replication. Initial trials suggested that it would take a minimum of 30-40 minutes to view the material passively and it was felt that this would give an overall user testing time within the 60 minute maximum.

An example screenshot of each of the different web-based presentation formats are shown in Figures 1-3. [insert figures 1-3]

The resources can be viewed at: http://www2.le.ac.uk/Members/jlb34/research/demo

ii) Recruitment of users for testing

Current undergraduate students were recruited for user testing. Disabled students at the University of Leicester can register with the AccessAbility Centre to ensure that their needs are highlighted and relevant steps taken to support their studies. The AccessAbility Centre records showed that there were between 15 and 20 students with registered accessibility issues (excluding mental health problems) in the School of Biological Sciences. To recruit the test subject group (those with registered accessibility issues) the AccessAbility centre sent out a letter of invitation to Biological Science students registered with them. An email was also sent to all students within the School and to the first four years of students on the Medical School's MBChB programme, asking for volunteers. Students were offered a small cash fee for completing the task. Ten students were recruited and came individually to user testing sessions. Each subject was asked to complete a form notifying us of the nature of their registered accessibility issues.

A matched control group was recruited once the subject testing was completed. Participants were matched for year of study, gender and course of study. The control group was recruited by email and this elicited a very large number of replies so that matching the test participants was easily achieved.

iii) User testing

User testing sessions were carried out in a private office. The sessions were run by one member of the team, who took notes and video taped the session. Students signed a consent form to give their permission to the video taping of the session. The video tapes were used solely for data collection so that timings, actions and questions could be reliably recorded and analysed later.

The computer used for testing was running Windows XP and was the same machine used to create and test the materials, to ensure that all software, visual and sound problems had been identified. A simple HTML page was created to host six links to the testing materials. There were six presentations to view: a Flash, Impatica and Adobe Presenter presentation of each of the two participants chosen (Immunology and DNA replication). The resources were presented in the following order to all participants:

1. Immunology – Flash version
2. Immunology – Impatica version
3. Immunology – Adobe Presenter version
4. DNA replication - Flash version
5. DNA replication – Impatica version
6. DNA replication – Adobe Presenter version

The sample size in this pilot study was too small to allow for meaningful variation in the order in which the presentations were viewed by each subject. Each system displayed the materials in a different way. On each system, audio was synchronised to play with animations and started automatically with each new slide. The Flash presentation did not progress from slide to slide without user intervention to click to move forward through the presentation. During the Impatica presentations, participants had to click to start the presentation but thereafter it played automatically. The script of the audio narration was displayed at top right of the screen automatically in time to the audio soundtrack. Participants could skip ahead by selecting a slide from its title on the left hand pane, or by using the fast forward control. The Adobe presenter system played automatically. Again, the script of the audio narration was displayed in the 'notes' tab in time to the audio soundtrack. Participants could skip ahead by selecting a slide from the title on the right hand pane, or by using the fast forward control. The thumb tab displayed a list of slides with small thumbnail images of each slide as well as their titles.

Participants were given minimal information about the project and the task, namely that we were interested in how students interacted with e-learning resources. They were asked to answer three questions about each of the presentations. These questions were designed to encourage them to make use of the various features of the three different platforms. Questions were based on the scientific content of each presentation and therefore appeared to test the student's knowledge of the subject (e.g. immunology) rather than their use of the system. Questions were designed such that they either addressed information contained in the text on the slides, audio track or some graphical element of the presentation. The questions were structured so that the balance between these three aspects was the same for each presentation, though the subject content of the questions differed. Participants were also asked to comment on the three different styles of presentation once the test was completed. The answers given by the students from the task questionnaires were marked and their scores analysed.

Quotations from test participants

Comments made by the participants were transcribed from the video recordings. Test participants were asked to comment freely on their experience of using the three presentation formats. The majority of the comments were unsolicited; a few were made in response to the observer asking the participants to comment on the experience of user testing at the end of the session. A selection of these comments are included in the discussion section.

RESULTS

User testing
Ten participants with accessibility issues were recruited and tested individually. Seven of the participants were registered with dyslexia, one with dyspraxia, one with a visual impairment and one with a hearing impairment. There were two males and eight females from a range of years of study and courses within the Faculty. The control group of 10 non-disabled students was matched for gender, year and course of study to the test group.

Factors analysed:

a) Features used
Records were made of which features of Adobe Presenter and Impatica were used by the participants. These features related to any operation that could be performed such as using the play or pause button, clicking on the tabs in Adobe Presenter to view a script or different menu view or using the slide selector in Impatica. We found that, overall, the disability test group used significantly more features than the control group (Fisher's exact test, $p < 0.001$). Figure 4 shows a graphical plot of the number of times the two groups used a particular feature of Adobe Presenter or Impatica.
[insert figure 4]

b) Scores
The question sheets completed by the participants were marked and the number of correct answers totalled. There was no statistically significant difference between the scores obtained by the two groups (test mean score= 17, control mean scores=16, $t = 0.379(18)$, $p > 0.05$).

c) Use of search facility
Adobe Presenter and Impatica both provide a search facility that can be used to search for keywords or phrases within the text of the slide or script. Some students made good use of this feature to find answers to the questions they were asked to complete. However, when the data were analyzed (see Table 1), there was no statistically significant difference in the use of search facilities between the test and control groups (Fisher's exact test, $p > 0.05$).
[insert table 1]

d) Time taken to complete the task
Initially it was assumed that the test participants might take longer to complete the tasks and view all the presentations than the control participants. However, in this study we found that there was no significant difference between the overall time taken by the two groups to complete the exercises (test group mean time =2381s (s.d. =597), control group mean time=2083s (s.d.= 273) $t = 1.431(18)$, $p > 0.05$).

e) Use of navigation tools
Several navigation tools exist in both Impatica and Adobe Presenter similar to VCR controls and those common to Internet media players (play, stop, pause, fast forward, rewind). A note was made of how many slides played before the subject made use of any one of these controls. In our study, the test participants located and used these controls more quickly than the control group and this difference was statistically significant (Fisher's exact test, $p < 0.001$).

g) Preference for software
When students were asked which of the three presentations they preferred, there was a significant preference for Adobe Presenter (Fisher's exact test, $p < 0.001$) over the other two formats tested (Impatica and Flash). See Table 2.
[insert table 2]

DISCUSSION

This project also investigated the use of the resources created by the three systems by two groups of students in order to gain information on whether students with accessibility issues made different uses of these alternative formats when compared to a control group of students.

Students with accessibility issues include a wide spectrum of disabilities: although the majority of the participants were registered as dyslexic, the group also included students with visual and hearing impairments. Whilst these disabilities cannot be compared directly, SENDA legislation (HMSO, 2001) enforces the remit of accessible design for all students, and this is likely to be representative of the composition of students with accessibility issues in any given cohort. Therefore, it was important to us in this pilot study to look at this group as whole and their reaction to the materials presented.

The users were asked to perform distracter tasks (answering questions based on the content of the presentations) while using the web-based resources under observation. This usability-testing format allowed the comparison of the use of resources by students with and without accessibility issues. The aim was not to explicitly examine the absolute accessibility of each resource but gauge the comparative usability experience of these two groups. The relationship between the usability and accessibility of web sites and therefore web-based teaching materials is a complex one (Petrie and Kheir, 2007). Usability is widely accepted in terms of the definition provided by ISO 9421: 'the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use' (International Standards Organization 1992-2000). Accessibility, however is a more complicated issue (Iwarsson and Ståhl, 2003) and is often expressed in terms of guidelines and recommendations for design. The Web Accessibility Initiative offers the definition 'Web accessibility means that people with disabilities can use the Web. More specifically, Web accessibility means that people with disabilities can perceive, understand, navigate, and interact with the Web, and that they can contribute to the Web.' (Henry, 2006). Petrie and Kheir (2007) demonstrated that accessibility issues and usability issues are two overlapping sets of problems and neither is a wholly contained subset of the other. Although products should comply with national legislation, the fact that accessibility standards focus on guidelines and checklists rather than the concepts of usability, means that it is essential that products used in the educational environment be tested by both disabled and non-disabled students. A study by Mackey and Ho (2008) demonstrated that there was a strong correlation between usability factors and the perceived improvement in learning by students using a web-based multimedia tutorial. Crowther et al. (2004) argued that user testing for educational resources removed interface problems and frees the students to concentrate on the educational content.

In our limited study, the most striking result was that the group of disabled students used significantly more 'user control' features than the non-disabled group. From observation, this was not because the students were confused, randomly clicking on control icons or losing their way in the resources, but they were actively seeking out information by selecting appropriate sections of the material more directly than the control group. For example, two disabled students commented:

'I like the [Adobe Presenter] one... you could go straight to slide three instead of sitting all the way through the presentation again'

'it was really good to be able to pause [Impatica presentation] quite easily and to have the words [narrative script] up on the screen, although they are quite small and you can't just read them all the time, if you pause it you an go through it'

It is possible that these students were used to customising their own learning experiences and personalising their computing environment to facilitate their own learning and as such were perhaps more self-aware than the control group who mostly appeared to passively watch the presentations with little interaction. Our study found that the disabled participants located and used these controls more quickly than the control group and this difference was statistically significant, again indicating that these students expect to be able to control their environment. Adobe Presenter and Impatica both dictate a layout and visual appearance, which can be customised within certain ranges but ultimately, conforms to a standard format. The look and layout of the two systems described here rely on some well-known visual navigation aids and controls, for example, both use VCR-type symbols (pause as two vertical bars, stop as a square, play as a single arrow head and skip or fast forward as a double arrow head). One student commented:

'[Adobe Presenter] was set out like iTunes or Windows Media Player that I know, so I know fast forward, play, stop was here [indicates to control bar at bottom of screen] '

The paper-based tasks given to the students during the test session were devised as a distracter to help them engage with the material and encourage their interaction with the software. The questions addressed the science topics covered in the presentations and the answers required recall from different elements of the presentation (graphical, sound and textual). We found no statistically significant difference between the scores obtained by the two groups, indicating that the questions did not discriminate between the two groups and that they had comparable knowledge of the underlying science content.

We found that there was no significant difference between the overall time taken by the two groups to complete the exercises which was surprising given that extra time is something regularly offered to students with accessibility issues in examinations and other formal assessments. However, the data were skewed by a test one disabled subject who completed the tasks in the shortest recorded time and a control subject who took the longest recorded time. Although the test group participants appeared to take more care and time reading the text on the screen, their use of the controls to stop and start the presentations often meant that they later made more efficient use of their time when looking for the answers to various tasks.

The significant preference for Adobe Presenter over the other two formats tested (Impatica and Flash) could have been due to the fact that this was the format presented last and thus may have appeared easier to use as the students had become accustomed to the previous presentations. However, at least one student remarked that they could not see the video controls on Impatica and several commented that the layout of Adobe Presenter was uncluttered, clear and familiar.

The majority of the test group were students with dyslexia. A study by Alty et al (2006) found that while non-dyslexic students' learning outcomes improved most when presented with sound and diagrams rather than text alone, the opposite was true of a group of dyslexic students undergoing the same tests (Beacham and Alty, 2006). This was a surprising finding given that dyslexic students are thought to have the most problems with

text alone; Beacham and Alty suggest that this could be due to being forced to develop considerable compensation skills for text over other media. Here, we demonstrate that these students are taking more control over the resources they used in the test than the control group by using their navigation, playback and audio controls. To gain statistically significant results on such a small scale project was very encouraging.

FUTURE WORK

This pilot study with a small number of participants and limited scope has raised several interesting questions. How do dyslexic students customise resources for their own use? Where is their attention focussed on the resource and does that differ from non-disabled students? Further research with dyslexic students in particular could provide useful and practical information for practitioners when creating resources for use online to support lectures or to deliver other material. Eye tracking, mouse/motion tracking studies with further usability testing could elicit how and why disabled students were using the systems differently.

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BIOGRAPHICAL NOTES

Joanne Badge is Web Resources Development Officer in the School of Biological Sciences at University of Leicester, providing support to academic staff for online teaching. She has a background in promoting online resources for biological sciences.

Alan Cann is a senior lecturer in the Department of Biology at the University of Leicester, UK. He has over ten years experience of developing and delivering online learning and is particularly interested in online assessment and interactivity. In recent years he has worked extensively developing new formats for online learning materials.

Emma Dawson was employed as research assistant to prepare the materials for this study and carry out the majority of the user testing.

Jon Scott is Director of Studies in the School of Biological Sciences at the University of Leicester. His main areas of teaching interest are neuroscience and human systems physiology which he teaches to biology and medical students. He is also involved in teaching developments in relation to key skills in the biosciences.

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Table 1

Table 1 :The use of the search facility was counted over all four presentations (two Adobe Presenter and two Impatica), there were 10 students in each group.

	Used search facility	Did not use search facility
Disabled students (test group)	6	34
Non-disabled students (control group)	3	37

Table 2

Table 2: The number of students that stated a preference of presentation format.

Stated preference	Disabled students Total number questioned 10	Non-disabled students Total number questioned 10[a]
Adobe Presenter	8	6
Impatica	1	1
Adobe Macromedia Flash	1	1

[a] one student had no preference and one student liked a combination of features from all three formats, both excluded from calculations.e.

Figure 1: Screenshot from the Flash presentation of 'Immunology' content.
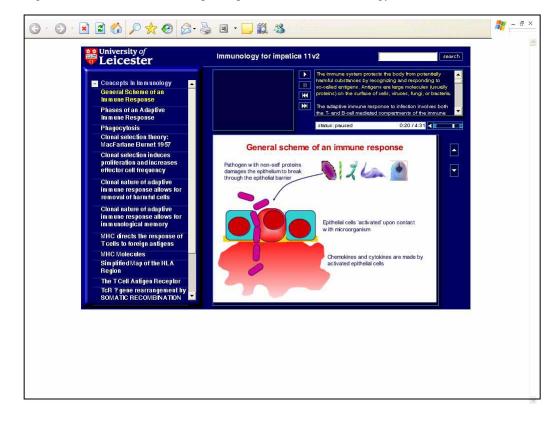
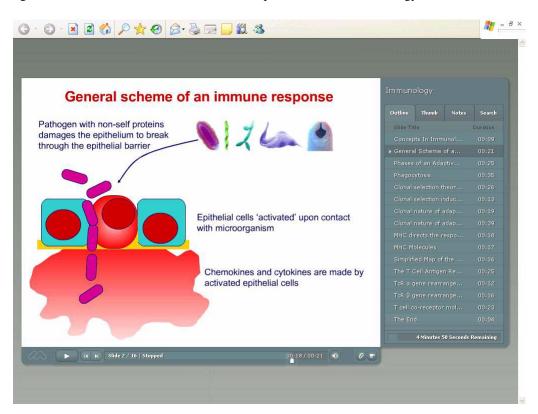Figure 2: Screenshot from the Impatica presentation of 'Immunology' content.

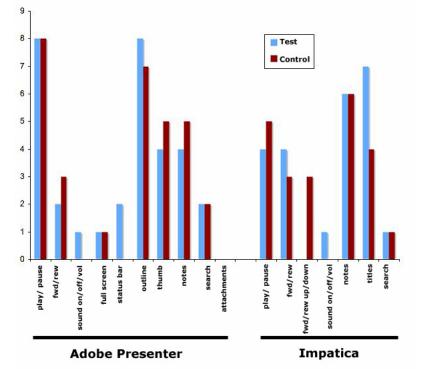Figure 3: Screenshot from the Adobe Presenter presentation of 'Immunology' content.

Figure 4: graph showing the number of times that the navigation and other visual control features of Adobe Presenter and Impatica were used by the test (disabled students) and control (non-disabled students) groups