

Accessible e-learning in Higher Education

The Distributed e-Learning Accessibility (DelAcc) Project

TechDis

May 2007

Version	Date	Status	Author	Reviewed/ amended by
1.0	07.05.2007	Draft contents	Sara Dunn	SB/EA [TechDis]
1.1-1.4	22.05.2007	Redrafts	Sara Dunn	SD
1.5	23.05.2007	Complete draft report	Sara Dunn	SB/EA [TechDis]
2.0		Amended complete report	Sara Dunn	SB/EA [TechDis]
3.0		Final for commissioner	Sara Dunn	SB/EA [TechDis]

Contents

Foreword from TechDis

1. Background to the DelAcc project
2. Overview of 12 participating projects
3. Accessibility issues encountered
 - 3.1 Organisational issues
 - 3.1.1 Staff awareness
 - 3.1.2 Staff training
 - 3.1.3 Resource constraints
 - 3.2 Project planning issues
 - 3.2.1 Lack of advance planning for accessibility
 - 3.2.2 Accessibility spin-offs and trade-offs
 - 3.2.3 Content from third party sources
 - 3.2.4 Copyright and licensing
 - 3.3 Project implementation issues
 - 3.3.1 Development formats
 - 3.3.2 Media types
 - 3.3.3 Graphical issues
 - 3.3.4 Delivery platforms
 - 3.3.5 Testing
4. Lessons learned
 - 4.1 Organisational lessons
 - 4.2 Project planning lessons
 - 4.3 Project implementation lessons
5. Recommendations
 - 5.1 For future funders
 - 5.2 For future content developers

Foreword to follow from TechDis

1. Background to the DelAcc project

This project builds on the wider work of the JISC TechDis service, which supports accessibility and inclusion across UK higher, further and specialist education through the use of technology.

It builds in particular on the work done by the 24 HE Academy Subject Centres¹ under the auspices of the JISC Distributed E-learning (DeL) Programme.²

Twelve of the 24 Subject Centres participated in the DelAcc project, representing the main e-learning themes covered by DeL, as well as a broad range of academic subjects.

Aims and objectives

The DelAcc project sought to:

- raise awareness of disability and e-learning issues within DeL development teams based in Subject Centres
- exemplify practices that highlight e-learning as an enabler using the work carried out under the DeL programme
- provide a mechanism for documenting processes and harvesting cases when working with e-learning.

The project facilitated a frank discussion with the participating projects concerning the accessibility and disability issues encountered. This report documents those issues and the lessons learned, as well as providing a set of recommendations for future project participants and funders.

2. Overview of 12 participating projects

A tabular overview of the 12 participating projects is provided below.

¹ See <http://www.heacademy.ac.uk/distributedelearning.htm> for more on the JISC DeL/Higher Education Academy Subject Centre Projects

² See http://www.jisc.ac.uk/whatwedo/programmes/programme_edistributed.aspx for more on JISC's DeL programme overall

No.	Case study title	Platform/content type	Subject area	Case study description
01	Accessibility of audio content on the Spoken Word Service website	- standard web pages - web audio - web video	generic social sciences/ humanities	Reviews the accessibility of the audio and video content served from the Spoken Word project website and makes suggestions about how to serve these multimedia resources in the most accessible way
02	Images of Salvation: dyslexic students' experiences of using a CD-ROM based resource.	- CD ROM - web graphics	history	Reviews the practice and experience of using the Images of Salvation CD-ROM in a specific learning setting
03	Using podcasts to disseminate information about Inter-professional Education to an academic community	- standard web pages - audio podcast	health/social care	Explores how podcasting materials have been employed in Inter-professional Education (IPE)
04	Enabling simultaneous access to far-away (and far out) artworks in a variety of media	- standard web pages - web graphics - web audio - web video	performing arts	Reflects on the development of a visually-intensive, web-based resource for inter-disciplinary, contextual studies in performing arts. Issues are explored regarding the development of a resource which, on the surface, appears not to be amenable to common perceptions of accessibility
05	The ePET and EPICS ePortfolio projects: review of accessibility issues	- standard web pages - VLE - e-portfolio	medicine	Focuses on the use of the ePET ePortfolio within medicine at Newcastle University. Initiatives to increase diversity and extend support for learners with disabilities within medicine are explored

06	Assessing the Accessibility of Reusable Learning Objects	<ul style="list-style-type: none"> - standard web pages - VLE - RLO 	information and computer sciences	Provides information on the design, development and deployment of Reusable Learning Objects (RLOs) to support the teaching of Information and Computer Sciences (ICS). Examines some of the issues involved in ensuring that 'reasonable adjustments' can be made to ensure delivery to a diverse student body via a wide range of technological devices.
07	Developing a Generative Learning Object (GLO) for Teaching Introductory Statistics in Social Science	<ul style="list-style-type: none"> - RLO - VLE 	social sciences	Reviews the development of an interactive teaching resource for demonstrating basic statistical principles to social science undergraduates, with the possibility that the resource could be adapted for teaching within other fields of study
08	Physical sciences question bank project	<ul style="list-style-type: none"> - standard web pages - VLEs - online assessment systems 	physical sciences	Aimed at producing a bank of physical sciences questions which can be used for formative or summative assessment. It will be possible to import and export questions to different assessment systems for computer based assessment.
09	Philosophy of religion mind-mapping project	<ul style="list-style-type: none"> - standard web pages - proprietary graphics 	philosophy of religion	Reviews the development of an interactive online e-learning environment for teachers and students of philosophy of religion and related subjects. Based on a series of mind maps charting the material covered within the Senior Honours philosophy of religion course.

10	Accessibility of Assessed Online Discussion Groups	- VLEs - discussion boards	biological sciences	Reviews the use of online discussion groups on various VLEs by students of biological sciences
11	Distributed e-Learning Accessibility Case Study for the LearnEM Project	- RLOs	engineering sciences	Describes potential accessibility issues pertaining to the use of resources created by the LearnEM project. Reviews individual elements of the resources (e.g. text, images, Flash animations), and highlights how having the resource as a content package (rather than available on a remote website) improves accessibility
12	Self-paced animations using PowerPoint for Intermediate Economics: access considerations	- PowerPoint slides	economics	A round-up of the access issues with making animations in PowerPoint to explain dynamic mathematical models

The projects represent a broad range of digital platforms and technologies, some e-learning specific, and some generic but with particular e-learning uses, including:

- virtual learning environments (proprietary and non-proprietary)
- discussion boards (proprietary and non-proprietary)
- online assessment systems (proprietary and non-proprietary)
- e-portfolios
- podcasts
- learning objects (reusable and generative)
- proprietary presentation slides (Powerpoint)
- proprietary mapping graphics (Mind Genius)
- proprietary authoring tools (Flash)
- web audio and web video (various formats)
- web graphics (various formats)
- CD ROMs
- standard web pages

3. Accessibility issues encountered

All participants in the study interpreted the term accessibility in its widest sense - getting usable learning content to as wide a range of end users as possible. Thus definitions of accessibility included, but were not limited to, the specific issues raised by end users with disabilities. Accessibility was linked by a number of participants to their institution's widening participation agenda.

The accessibility issues participants encountered can be grouped into three overarching categories:

- organisational issues
- project planning issues
- project implementation issues

Within each category participants encountered both unexpected barriers and unanticipated affordances relating to accessibility.

3.1 Organisational issues

3.1.1 Staff awareness

One of the primary aims of the DelAcc project was to raise awareness of accessibility and disability issues amongst participating teams. The teams had a wide range of previous knowledge about disability legislation and policy, and about technical accessibility issues. Some were quite expert:

'The primary aims of the [project] did not directly relate to accessibility. However, there was an awareness of the need to support accessibility, and evidence that this was incorporated into practice, probably because it is embedded within the units/staff responsible.' (Project 05)

while others had little or no knowledge or experience. The great majority commented that participating on the project had improved their knowledge and awareness:

'I had not been aware that access for disabled people would be such an important issue when I first conceived of the [learning resource]. When I discovered its importance I made inquiries about relevant policy ... I became familiar with the [legislation] as well as the recommendations outlined by W3C.' (Project 09)

'[The project] focused team members' attention on the development of... e-learning materials and raised the profile of accessibility issues within [our] work.' (Project 04)

'There is a significant staff development aspect associated with this [project] and it presents an opportunity to raise awareness and

explicitly surface accessibility issues through team discourse ... The team discussed these issues throughout the projects ... Discussions extended to accessibility issues beyond the learning object itself and into the physical world of lectures, colleges and supervisions.’
(Project 07)

The project team providing e-portfolios for medical students (Project 05) was aware of specific legal developments in accessibility within their subject area.³

While awareness was raised amongst the DelAcc participants, they also pointed out that disability awareness generally across HE staff is not high. This is a problem when staff are creating learning content:

‘Perhaps the major issue is the experience of the academic undertaking the work [of creating learning content]...If [academics] are more aware of the accessibility of [content] in different formats, then [distribution/re-use] would potentially be a quicker process.’
(Project 08)

We return to this issue in section 3.2.3 below on third party content. An interesting point emerged in one project concerning the tendency to consider accessibility only in terms of the student as end user. Accessible content development and delivery platforms are also necessary for disabled staff:

‘There are two considerations for the use of electronic tools. The first is for the [delivery platform] itself, the second is for the [student] end user. In relation to the delivery platform, there is a front end for accessing the [learning content] - by academics. There is currently no explicit consideration for ensuring that the user interface is fully accessible.’ (Project 08)

3.1.2 Staff training

This issue could also be considered a project planning issue. Many participants wrestled with the question of whether it was more effective to train academics to create accessible content (a distributed model) or better to allow academics to use their ‘core skills’ in creating the content, and use specialist teams to ensure that accessibility is taken into account (a centralised model).

‘Within the information and computer sciences disciplines, it can be anticipated that most academic staff will have the requisite

³ The General Medical Council’s requirements for medical qualification have been seen to be at odds with the requirements of the Disability Discrimination Act. New guidance is currently being developed by the GMC and a number of medical schools. See the General Medical Council web site:
<http://www.gmc-uk.org/education/gateway%5Fproject/> (accessed 16 May 2007)

[technical] skills to develop [learning content] themselves. However, whilst technologically advanced, they ... may not be fully aware of the wide range of associated educational and motivational issues, including the importance of [disability] legislation. On delivery of the first [learning content] it quickly became clear that adjustments were required to ensure ... conformance with accessibility standards. This was undertaken by the development officer... This was deemed to be a more effective approach than bringing each participant up to speed with disability legislation and its implications for interactive learning resources.' (Project 06)

'Creating learning materials that are high quality in terms of pedagogy, design and accessibility ... is a difficult task requiring specialist skills. Authoring tools could be created [by the project team] that paste the lecturer's choice of text into a template. Alternatively, we could require lecturers to submit content for conversion by the [project team].' (Project 12)

'The content resources [the project team] produced were editable, thus allowing the resources to be tailored for users who have particular accessibility needs....[However] any modification of the resource requires time and expertise that may not be available to the lecturer.' (Project 11)

Whichever end of the distributed/centralised development spectrum a project adopts, much depends on the appropriateness and completeness of guidelines given to content authors. For example, one project found that in order to ensure accessibility, additional content was required from the original author which had not been part of their author brief - in this instance copy for alt tags to describe visual elements of the learning content:

'If a [piece of learning content] includes an image, then it has to be appropriately labelled and alternative text descriptions provided... the original [content] author may be the only person best placed to provide this information... If considerations of inclusiveness were more prominent [at the outset] then suitability of questions [in accessibility terms] may be more satisfactory. (Project 08)

This reinforces the view held by most participants that accessibility requires considerations and adjustments throughout the development cycle, not just at the relatively late stage of manipulating the content on its given development platform.

3.1.3 Resource constraints

Most participants commented that they could not make all the adjustments for accessibility they would ideally like to because of resource constraints - both financial and staff time:

‘Due to the size of the [audio and video learning resource collection] it is not feasible within current resource levels to provide captions and text transcripts as a standard feature...’ (Project 01)

‘Each [proprietary online] assessment system likely to be supported by the project could have been investigated in more detail. However, given the time, staff and funding available, this could potentially have made the project outcomes more difficult to achieve.’ (Project 08)

‘There is a danger, particularly on technology projects with a short or limited duration, that accessibility issues may be neglected.’ (Project 05)

For some projects this necessitated prioritising.

‘[Our recommendations included] developing a plan for making the audio and video resources accessible when measured against WCAG AA, i.e. developing a sub-set of accessible resources, starting with the most popular.’

We look in more detail at this issue in the next section on project planning.

3.2 Project planning issues

3.2.1 Lack of advance planning for accessibility

The DelAcc project developed as a secondary outcome from the original DeL projects. As a result the majority did not have accessibility as an original project outcome. Many participants realised that they could have planned their projects differently if accessibility had been a priority consideration at the start:

‘Given more forethought and guidance, the project might have been able to allocate more time and resources to request advice and expertise regarding additional requirements that would benefit students with personal preferences.’ (Project 08)

- Not factoring in testing of materials and/or delivery platforms

One area mentioned several times in this regard was testing. A number of participants did conduct testing, either specific accessibility testing or broader usability testing. A number did not. Even those projects which did incorporate some form of testing programme said that with hindsight the testing would have been more extensive and conducted earlier:

‘It would be advisable to carry out more thorough accessibility testing using a guide such as the TechDiS Web Accessibility Self-Evaluation Tool and/or user testing whilst developing e-learning resources, as

this could save time and provide more accessible resources as a consequence.’ (Project 11)

‘Despite accessibility not featuring in the initial build criteria for this project, the [product] is reasonably accessible. It would benefit from some broad user testing and usage studies to make it even more usable. It is highly recommended that extensive and continuous user testing is carried out to ensure that learning support systems ... are created to align with curriculum and user requirements.’ (Project 05)

‘To date there has been no formal evaluation of the resources and their impact on learners - this is currently underway. Materials will be trialled with a variety of users with different accessibility needs. In particular, it will be important to engage users with visual impairment and motor difficulties, especially in relation to delivery via mobile devices to ensure that they can successfully use the resource.’ (Project 06)

Perhaps allied to a lack of testing was a lack of reference to industry guidelines against which to test - accessibility guidelines were referred to by very few of the projects. The WAI’s Web Content Accessibility Guidelines (WCAG) were referred to by only three participating projects, the IMS Guidelines for Accessible E-learning by only one, and Section 508 of the U.S. Federal Rehabilitation Act by only one. In this latter case, lack of testing during the project was justified because only tried and tested generic products were being used:

‘The [project’s] approach is to rely on the accessibility of standard web tools which have been extensively tested. In addition to a web browser of the student’s choice (plus whatever screen or audio accessibility enhancements a student chooses), access to the discussion groups is provided via a virtual learning environment (VLE). While the arm of the study conducted at [one HE institution] utilized ... software developed in house, the rest of the testing has been carried out using the Blackboard VLE. This software has been tested extensively and is compliant with Section 508 of the U.S. Federal Rehabilitation Act.’ (Project 10)

- Planning for sustainability

The issue of sustainability was not very prominent amongst participating projects. However, one project was aware of the challenge of sustainability including the need to incorporate accessibility as an ongoing development aim:

‘[Beta evaluation makes it] clear that the [project] idea is a good one. The challenge, once [the project] is released, will be in creating a user community willing to maintain and expand it. This goes beyond simple dead link management and extends into the continual updating and addition of both primary and secondary sources... It will

be important to keep accessibility issues in proper focus during this process.' (Project 04)

3.2.2 Accessibility spin-offs and trade-offs

Many participants talked of 'spin-offs' and 'trade-offs' in relation to accessibility. They realised that most decisions about format and approach involved benefits (affordances) for one group and potential dis-benefits or barriers for another. Participants described this as one of the major areas of learning to come from taking part in the project.

As an overarching principle, a number of participants commented that the process of digitising and/or aggregating learning resources is inherently increasing accessibility:

'[The team] seeks to overcome barriers to access such as distance, private art collections, inadequate libraries and lack of money. It then seeks to overcome the practical barriers to multimedia usability such as the paper-based and linear-access form of the scrap-book. It accepts that the study of art-works in their original forms was always less accessible to blind and deaf users. It does not seek to address that problem, believing that such users will already have developed alternative strategies for studying the arts by the time they enter higher education.' (Project 04)

'Accessibility was not an explicit consideration of the project. However, the project team were aware that making questions available in electronically means they can be imported and exported in a variety of formats ... These questions could be utilised by different assessment systems that might provide accessibility benefits, depending on the end user's needs.' (Project 08)

Interoperability was also posited as having accessibility as a spin-off:

'[The project] was a technical one to extend [the learning resource] to better support interoperability standards. The proposal made not direct reference to accessibility, but greater interoperability does generally improve accessibility by reducing dependence on particular devices/software.' (Project 05)

Along with the positive spin-offs however come some more difficult decisions regarding trade-offs between different user/learner needs:

'Video and audio resources may support inclusion for a wide range of learners, but specific attention then needs to be given the needs of those with visual and auditory disabilities.' (Project 01)

'The shift in emphasis away from traditional historical source material (typically documentary) towards visual images was used to encourage the students to broaden their horizons regarding the ways

in which past societies may be discussed. Although this shift in emphasis did not catch the imagination of all the students ... the dyslexic students in particular responded immediately and positively to the idea of taking a broad view of society and of using non-documentary sources.' (Project 02)

'Using podcast has helped established a connection between podcast listeners [learners] and the podcast content. The human voice from the podcast content has made listeners engaged in the content in a way that differs from the written word.' (Project 03)

'Interactive RLOs are by their nature media rich, often making use of a variety of audio, video, text, graphics. As such they provide a more diverse learning experience, thus fulfilling the requirements of those with alternatively learning styles and needs. However, some students with disabilities will have difficulties with particular media.' (Project 06)

'A significant problem presented by the project was that it seemed to favour one group of disabled people (those with dyslexia) over another (those with visual difficulties).' (Project 09)

'We focus on exploiting a distinctive format [animated slides] that makes topics significantly easier for a lot of students... The advantages of animated slides are mainly cognitive, and particularly apply to students who have a reading or attention difficulty... Against all the affordances are pitfalls. Powerpoint makes it very easy to create presentations that are boring, unappealing or annoying. What is merely annoying to most users may be totally unusable for a user with a visual impairment or reading difficulty.' (Project 12)

TechDis and others in the field have posited a 'holistic' approach to accessibility in higher education learning provision.⁴ This approach moves away from narrow technical issues of accessibility in favour of the consideration of the overall accessibility of learning outcomes. A number of participants adopted this approach, either implicitly or explicitly:

'Rather than aim for an unattainable standard of universal access, the accessible learning approach prompts us to consider our resources in this context and what key advantages they provide for different categories of user.' (Project 12)

'[The resource's] explicit appeal to visual learning styles may itself aggravate problems experienced by non-visual learners. This was not regarded as a disadvantage. Linear, text-oriented and aurally based learners' needs may have been better catered for by traditional

⁴ See for example: Seale, J. (2006) 'Disability, Technology and E-learning: challenging conceptions' *ALT-J* 14(1); Kelly, B., Phipps, L., Swift, E. (2004) 'Developing a holistic approach for e-learning accessibility' *Canadian Journal of Learning and Technology* 30(3)

teaching environments and methods. [The resource] is intended as a complementary resource, not a replacement of other methods.' (Project 04)

3.2.3 Content from third party sources

While some of the participating projects were creating their own original content, others were repackaging, aggregating or signposting third party content. The latter group experienced a range of issues relating to accessibility, and as with most of the other issues encountered, third party content presented both opportunities and problems.

A number of projects commented that third party content they linked to was often not accessible, and this adversely affected the overall accessibility of the learning experience they wanted to deliver, for example:

'There are unavoidable hazards associated with [the team's] insistence on linking to primary sources wherever possible, in that we have no control over the delivery of, for example, images of paintings in art galleries and museums. Sound works may also be delivered in different ways and some may require specific plug-ins, or specialised software (QuickTime, Windows Media Player, RealAudio, ShockWave etc). In some institutions, this may require installation by computer support teams rather than by the end-user... The [learning resource] also links to a vast array of external materials and, at present, we are unable to confirm how accessible those external resources are.' (Project 04)

'Where applicable the [learning resources] will link to existing online learning resources providing additional learning materials. When used within a VLE, they can also be linked to on-line scholarly resources subscribed to by the host institution. Clearly it is impossible to ensure the accessibility of external resources.' (Project 06)

Conversely, the projects which focus on repackaging existing third party content found that their inputs were increasing accessibility, even if that was not the primary aim:

'The content packages produced were editable, thus allowing the resources to be tailored to users who may have particular accessibility needs. This contrasts with resources that are available as websites that may only be linked to "as-is".' (Project 11)

'[For some content] an academic author was contracted to make the content from scratch. For [some other content] an academic contact donated the slides currently being used in his course. Both sets of content were subjected to a thorough review by [the project team] pasting the content into a pre-designed PowerPoint 2000 template, making the style consistent, fine-tuning the animations and improving some aspects of accessibility.' (Project 12)

'Where feasible, [learning content] may be imported in a variety of formats and exported in other formats. If [learning content] can be readily imported/exported between systems, then this makes the [content] more accessible to a wider audience of students who might otherwise be restricted simply because their institution subscribes to a particular [learning] system.' (Project 08)

This last project (08) also encountered some quality control problems with third party material, which were not straightforward to address:

'The project team is provided with [learning content] by a third party source. It has to be quality checked for information such as metadata (creator, level of difficulty etc). It is a challenge to ensure that each question has sufficient supporting information and metadata to make the question usable by a range of users.' (Project 08)

3.2.4 Copyright and licensing

It was perhaps surprising that in a project focusing on accessibility, a number of participants raised copyright and licensing issues. Nonetheless, some projects found copyright to be one of the primary causes of lack of access:

'The single largest problem (challenge?) has been copyright - and negotiating with different types of provider, working under different funding arrangements and within different legal systems. Fixed-term licensing, as opposed to open-ended permissions, has also proved to be complex, given the one-off grant [for the project].' (Project 04)

'The [team] did consider uploading the [learning content] into the Jorum repository. However Jorum regulations insist that all IP rights to the [resources] are given over to them. All existing [resources] were developed by third parties as a result of development funding, and contracts did not state that contributing the [resource] RLO to Jorum would be a requirement. It has therefore been impossible to give Jorum full rights without the written consent of the authors.' (Project 06)

On the up side, some projects were able to enhance access by removing copyright hindrances to accessibility:

'The content packages produced [by the project] were editable, thus allowing the resources to be tailored to users who may have particular accessibility needs... The copyright status of these resources is clear and allows such changes to take place.' (Project 11)

3.3. Project implementation issues

3.3.1 Development formats

Choice of development format is one of the most difficult decisions in e-learning resource development. For some projects the format was the leading issue - particularly for projects where repackaging or interoperability were principal aims:

'A key focus for the project was the transfer of learner information between [various learning] systems. [The project worked to] achieve greater XHTML compliance ... The [XSL] transforms achieved an almost perfect separation of data from format ... And hence performed excellently from the point of view of accessibility (content is more easily personalised for screen readers or changing font size or colour), as well as cross-browser compatibility, and thanks to the pertinent use of tagging in the XHTML pages, the ability to extract relevant data from the resulting files.' (Project 05)

The repackaging project (Project 11) aimed to take existing web-based third party materials and remove dependencies to create modular resources that are IMS standards compliant packages. The project reported a number of access related benefits to this development approach:

'The content packages that were produced were editable, thus allowing the resources to be tailored to users who may have particular accessibility needs. This contrasts with resources that are available as websites that may only be linked to "as-is".

The flexibility of the mode of delivery (upload to VLE, sent by email, hosted on internal server etc) allows choice in the method of presenting the resource to the user, therefore if one method cause an accessibility issue, this can be changed to a more suitable method.

The original website contained a side navigation bar, linking to different sections of the tutorial and other resources. This was removed when creating content packages and thus enlarged the screen area taken up by the actual content of the resource, benefiting users who may need to enlarge the size of the text to view the resource.' (Project 11)

An interesting contrast was a project which used widely available WYSIWIG software - Powerpoint - as its development format, to aid customisation by non-technical teaching staff:

'We started out with the intention of providing [Powerpoint] slides for use in lectures, but saw that this was just one of the ways the material might be delivered to students. There was an explicit hope that lecturers would customise the material by adding or deleting slides or text, or even adding an audio narration. The multiple ways in which this content could be used or adapted meant that we could not regard our work as producing the finished product. There had to be a compromise between ease of customisation and ease of access.' (Project 12)

For some projects however the choice of development format was the cause of some of the biggest problems faced:

‘Creating the [learning resources] raised a number of technical difficulties. . . The project team decided to use Mind Genius software because the [team’s Institution] has a site licence for this package, and hence it seemed likely to be the most accessible to the students. Disability Services at the [Institution] also recommends Mind Genius software – promoting it as an assistive technology which can help certain disabled students to organise and plan.

Learning how to create mind maps using the software was straightforward. Putting them into a form that could be used in the classroom was more complex. However, the real problems began when we tried to export the Mind Genius files into HTML format for uploading onto the web site. Every file required a significant amount of technical alternation before it could be displayed on the web site. Moreover, the difficulty of making the resulting files readable by anything but the latest version of Internet Explorer was also considerable – and at one stage looked set to become a project breaker.’ (Project 9)

One increasingly common proprietary development format for e-learning content, Flash, was either being used or considered by a number of projects:

‘In order to allow wide access, the [learning resource] operates as a stand-alone learning environment within a Flash enabled web browser, a technology which is now embedded within most educational and home PCs.’ (Project 7)

‘[The team was recommended to] consider the use of Flash for development of accessible video resources. . . Flash is the format that has the largest market share at the moment and is considered the most accessible format.’ (Project 01)

But Flash presents problems in HEIs, first because using it as an authoring tool requires expertise that is often not available in-house, and also because it ‘locks content away’ in a proprietary format:

‘Rather than locking [learning resource] text up in Flash content, display text in HTML and only use Flash for the necessary animations in a resource. This is likely to encourage more reuse of content.’ (Project 11)

3.3.2 Media types

There was discussion within many of the projects about the accessibility affordances and problems presented by other media types. Project 11 provided a succinct tabular account that serves well as a summary of the

main issues encountered across the projects. An edited version of this is reproduced with permission here:

Disability/ Media Type	Visual Impairment	Dyslexia	Motor Disabilities
HTML Text			
Affordances	Valid HTML ensures screen readers are able to read out text in a way not possible by simply using a text book. Text can also be enlarged by the browser or contrast changed in order to become more readable by certain visually impaired users.	Some students who have dyslexia can read text with high contrast colour schemes more easily i.e. yellow text on a black. The browser settings can be altered so that more students are able to read these [resources]. The student could also use a screen reader to read out text.	If a student with motor difficulties is unable to use a mouse, it is possible to navigate the [resources] using only the keyboard. Keyboard shortcuts are provided for moving to the next and previous pages.
Problems	Some specialised symbols (such as Greek letters) may not be read by a screen reader.		The keyboard shortcuts don't work in all browsers.
Images			
Affordances	Each image has an alt tag to convey information to those who are unable to see images. Some images can be enlarged when clicking on them. Some browsers allow zooming in on images.	Images can supplement text to give better overall understanding of the concepts being presented.	All images and enlargements can be accessed through only using the keyboard for navigation.
Problems	Some images may require a greater alternative description. Also some maths	Some images contain textual information which can't be transformed by	

	equations that are displayed as images and don't have adequate descriptions.	the browser.	
Flash			
Affordances	Vector graphics can be rescaled without losing resolution. Text accessible in IE	Presents information in a differing way.	Can be navigated using the keyboard with Internet Explorer.
Problems	Some animations difficult to capture all information in a text description. Not accessible in other browsers when using screen reader	Text presented within animation, which can't be redisplayed to be high contrast.	Not possible to navigate using other browsers.
Video and audio			
Affordances		Can present information in a more direct and engaging way, which suits some learning types.	Video and audio can be accessed through keyboard navigation.
Problems	Unless adequate transcriptions and descriptions are included, some information could be missed.		
Data Tables			
Affordances		Clear and concise method of presenting data.	
Problems	Screen reader may not be able to present info in a meaningful way.		

3.3.3 Graphical issues

The media type which was the focus of most activity across the participating teams as a whole was web-based graphics. For projects dealing with very visually based content, it was recognised that the provision of 'alt' attributes alone was not going to make the learning experience accessible for visually impaired students:

'Within the [project] site, non-decorative images utilise the <alt> attribute to provide descriptive text alternatives specifying what they are (e.g. 'Man with a Movie Camera - film' or 'Le Labyrinthe - image'). Decorative images such as the [project] logos are identified as such. There is need for an informed policy on the <alt> tagging of images, particularly of famous artworks... It is likely that it will be most appropriate to continue to tag the image with only the title and author of the work, but to write an additional guide for tutors who intend to use [such resources] with visually impaired students so that additional metadata can be provided for specific purposes.' (Project 04)

One of the projects focusing on interactive learning resources (discussion boards) recognised a requirement for students and /or moderators to be aware of making images accessible for people using text only or speaking browsers:

'[The] role of the moderator is important in ensuring both integrity and accessibility of assessment. Although to date I have not encountered an instance of any student posting an image directly to the online discussion boards (as opposed to images embedded in materials which may be linked to), in such cases it would be incumbent on the moderator to ensure that appropriate alt descriptive text is included to ensure accessibility for visually impaired students.' (Project 10)

3.3.4 Delivery platforms

All but one of the participating projects was developing material for delivery the internet. Of these, some were standalone web sites, some were downloadable resources delivered via generic web sites, and some were resources delivered via specialised virtual learning environments, including Moodle, Blackboard, WebCT and home grown systems.

The well-known proprietary virtual learning environments were known to have been tested for accessibility, and some participants relied on suppliers' specifications regarding this:

'The [team's] approach is to rely on the accessibility of standard web tools which have been extensively tested. In addition to a web browser of the student's choice (plus whatever screen or audio accessibility enhancements a student chooses), access to the discussion groups is provided via a Virtual Learning Environment

(VLE). While the arm of the study conducted at one HEI used ... software developed in house, the rest of the testing has been carried out using the Blackboard VLE. This software has been tested extensively and is compliant with Section 508 of the U.S. Federal Rehabilitation Act.’ (Project 10)

However, one project saw the virtual learning environment as a barrier, both in terms of technical flexibility and student usability:

‘Unfortunately ... Moodle was unable to display Mind Genius files. Once the mind maps were on their own web site, it was possible to provide links to them from Moodle. ... Many of the students were unfamiliar with Moodle and seemed to have difficulty getting around the site. Many found it difficult to find information on Moodle.’ (Project 09)

‘The inclusion of the teaching and learning packages in the VLEs seemed to give rise to some accessibility issues whilst using the JAWS screen reader. In a VLE the administrator of the course can choose between *flow* or *choice* navigation; *choice* produces a list of links in a left hand frame. This reduces the amount of screen space available for displaying the resource and causes a screen reader to read out each link. This is obviously not desirable, therefore it may be better to use *flow*, which simply presents previous and next buttons to navigate through the content. The screen reader also had difficulty with the frames based layout of the VLE and didn’t always read the text for the correct page. This could be extremely confusing and therefore if a student requires the use of the screen reader, then the content should be delivered outside of a VLE.’ (Project 11)

For this reason and for more general purposes of reusability and access, Project 11 and others created resources which were designed to function either inside or outside a VLE:

‘The [learning resource] is delivered to most students via [a bespoke VLE]. ... In terms of accessibility, the objective has been to be compliant with Section 508 and WCAG 1.0 Priorities 1 and 2, as well as usable for persons using adaptive technology. [The VLE] is not there yet, but progress is being made. In order to allow wide access, the [resource] operates as a stand-alone learning environment within a Flash enabled web browser, a technology which is now embedded within most educational and home PCs.’ (Project 07)

One project was producing resources for delivery via online assessment systems. These systems were seen as a considerable barrier in terms of both compatibility and accessibility:

‘Given that this project’s primary aim is to develop a question bank with questions that can be adopted by different assessment systems, the core risk involves compatibility issues. Perhaps each assessment

system likely to be supported by the project could have been investigated in more detail. However, given the time, staff and funding available this could potentially have made the outcomes of the project more difficult to achieve. One potential solution would be to have full details of the usability of a system from the manufacturer or a third party evaluation.' (Project 08)

4. Lessons learned

4.1 Organisational lessons

- Addressing accessibility in new resources can be a staff development opportunity and chance to review the accessibility of existing provision
- Many staff responsible for creating learning content do not have:
 - general awareness of accessibility requirements
 - competence to address technical accessibility requirements
- At the moment the accessibility of interfaces used by HE staff - as opposed to the student end user - is a very low priority
- A distributed content creation model requires:
 - investments in staff training for accessibility
 - comprehensive briefings for content authors, which include accessibility
- Accessibility requires considerations and adjustments throughout the development cycle, not just at the relatively late stage of manipulating the content on its given development platform.
- Appropriate allocations of staff resources and time need to be factored in at the outset if accessibility considerations are to be comprehensively addressed

4.2 Project planning lessons

- Accessibility needs to be planned for at that start; 'retro-fitting' is often impossible and always resource intensive
- Testing is an important element of project planning and tends to be overlooked. Both overall usability and specific accessibility testing are likely to yield very important lessons for development. Testing early in the development cycle will be more effective than leaving testing until after resources have been released for use.
- A number of off the shelf products - particularly VLEs - have been extensively tested for accessibility, but many, including more specialist or niche software, have not
- It is important to investigate the accessibility ratings of off-the-shelf products before committing to use them - this includes development formats and delivery platforms
- Digitising content, and promoting its interoperability and shareability are processes that inherently support the aim of increased accessibility
- However, accessibility affordances for one group of students may represent barriers for another group; a holistic accessible learning policy, developed at project planning stage, can take account of these issues
- Third party content can often present insuperable accessibility barriers, unless projects are able to repackage content into accessible formats
- Copyright and licensing considerations can prevent the redistribution of existing content or access to new content - copyright can be one of the primary barriers to access

- Each media type - HTML, digital images, Flash, video and audio - offers both affordances and barriers for students with different learning needs; understanding these is an important part of project planning and implementation

4.3 Project implementation lessons

- Choice of development format is crucial, and its significance is not always obvious in accessibility terms - especially for non-technical project leads
- Commonly available office software can be used by non-technical authors to create high-quality and accessible content, provided clear non-technical guidance is given
- Flash is an increasingly common development format and has a reasonable reputation for accessibility; however, it is a proprietary format and as such can inhibit or restrict the re-use and re-packaging of learning content
- Flash also requires technical expertise from developers which may not be available within HEIs
- The creation of content for 'alt' text or long descriptions of visual elements is often best done by originating authors, and can be overlooked in commissioning briefs
- Where a subject is inherently predominantly visual or aural - for example visual arts subjects or music studies - alt tags of images or descriptions of audio content are unlikely to be pedagogically sufficient; additional and alternative approaches to learning outcomes are required in these circumstances
- Moderators in interactive learning activities such as bulletin boards, discussion groups, synchronous chat have a responsibility to promote accessibility
- Virtual learning environments are an increasingly common delivery platform for digital content and for interactive learning experiences; however, they can present a barrier to some students, either because of learning style, IT competence or more technical accessibility problems, particularly concerning navigation
- Validating against technical web guidelines such as WAI WCAG is quite technical, and interpretation can be complex; it needs to be undertaken by developers with appropriate knowledge and expertise
- The TechDis self-evaluation tool can provide useful guidance.

5. Recommendations

5.1 Recommendations for future funders

In order to promote accessible learning content and learning experiences in HE, funders should:

1. Consider offering a service to HEIs to assess the accessibility of commonly used software, for example online assessment systems, on request, to help HEIs plan accessible content development; the results of these tests should be made available to all HEIs via the TechDis web site
2. Include HE staff in the category of 'user' in the e-learning development cycle. Consider resourcing an evaluation programme on the accessibility of interfaces staff use to develop or deliver e-learning content, including authoring tools, VLE administration interfaces etc; present these evaluations on the TechDis web site
3. Require that project proposals incorporate a draft accessibility policy; ensure that any policy takes account of current holistic/accessible learning approaches as promoted by TechDis, as well as IMS Guidelines for Developing Accessible Learning Applications
4. Recognise that developing and implementing a thorough accessibility policy for an e-learning project requires additional staff expertise and time
5. Require that proposals demonstrate consideration of whether a distributed or centralised development model is best used to ensure accessible development; ensure that the whole development cycle is reflected in this, including content authoring as well as programming and delivery
6. Require that proposals include a brief summary of the accessibility affordances and barriers of their chosen development and delivery formats; consider providing a simple template for this
7. Require that proposals demonstrate that staff development opportunities are maximised and made explicit during the course of a project, and learning associated with accessibility and disability is documented; consider providing a simple template for this and consider putting this documentation on the TechDis Community VLE
8. Require that proposals incorporate a testing programme with learners, including disabled learners; ensure this testing programme is both formative and summative; promote the use of the TechDis self-evaluation tool as part of this testing process
9. Ensure that proposals demonstrate a thorough understanding of any licensing and copyright issues likely to be encountered; this includes any licensing arrangements (territories, types of use etc) on existing material to be used (whether as primary or secondary sources), as well as licensing agreements for newly created content
10. Consider developing a briefing on the affordances and barriers of Flash, given its increasing prominence as an e-learning development and delivery platform; present this briefing on the TechDis web site.

5.2 Recommendations for future content developers

In order to deliver accessible learning content and learning experiences in HE, content developers should:

1. Include an accessibility policy for the project in your proposal:
 - a. take account of the accessible/holistic learning approach promoted by TechDis, and its implications for your project
 - b. decide whether a distributed or centralised model of content development is more appropriate for your project, and address the implications for accessibility
 - c. include a summary table of the anticipated accessibility affordances and barriers for your chosen development and delivery platforms
 - d. include a policy on third party content - be clear about your parameters regarding accessibility of content over which you have no control
 - e. ensure your team is aware of the IMS Guidelines for Developing Accessible Learning Applications and their relevance for your project
2. Be aware of the current levels of knowledge and expertise regarding accessibility and disability within the project team; supplement this with expertise from either within or outside your HEI, including expert resources such as TechDis
3. Recognise that addressing accessibility is a staff development opportunity; explicitly include this in project planning and document any learning during the course of the project; share this with your peers
4. Wherever relevant, include accessibility considerations in briefs for originating authors; remember this is an issue whether or not authors have any technical role (for example in producing text for 'alt' tags or long descriptions, descriptions of animations etc)
5. Ensure that testing is included in your project plan:
 - a. ensure that testing is conducted early in the development process as well as on end-products
 - b. ensure that testing covers usability and general issues of access as well as specific disability issues
 - c. test against WAI WCAG
 - d. refer back to the IMS Guidelines for Developing Accessible Learning Applications
 - e. consider using the TechDis self-evaluation tool
6. Where a specific delivery platform or platforms is being used by the project, ensure that you are aware of any compatibility and accessibility issues that may arise; consult with technical and disability support colleagues, and consult outside sources such as TechDis
7. Ensure that you have fully considered any copyright or licensing issues that may arise for your project; this includes being sure that you can re-use existing content in all the ways you plan to, and that you have

- appropriate licensing agreements for any new content you are creating
8. Don't neglect commonly available office software as a development and delivery platform; programmes such as Powerpoint can be used to develop high-quality and accessible e-learning content, and have the advantage of being familiar as well as widely available
 9. In projects that include interactive learning experiences such as discussion boards, synchronous chat etc, ensure that moderator briefings and instructions for students address any commonly encountered accessibility problems
 10. To aid sharing and reusability:
 - a. Where a project assumes delivery of content via a VLE, plan for optimum reusability by developing content in such a way that it can be used outside a VLE as standalone content
 - b. When using proprietary formats such as Flash, try to ensure that only the pieces of content that actually require animation are developed in Flash, and other elements of content are developed in open, non-proprietary formats.

[ends]
Sara Dunn
24 May 2007