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Developing a Holistic Approach for E-Learning Accessibility

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Abstract

The importance of accessibility to digital resources is now widely acknowledged. The W3C WAI has played a significant role in promoting the importance of accessibility and developing a framework for accessible Web resources. The accessibility of e-learning provides additional challenges that may not be faced when providing access to other Web resources. The authors argue that there is a need for a more sophisticated model for addressing e-learning accessibility which takes into account the usability of e-learning, pedagogic issues and student learning styles in addition to technical and resource issues. The authors expand on these issues and propose a holistic model for the development of accessible e-learning resources.

Résumé: L'importance de l'accessibilité à des ressources numériques est maintenant reconnue globalement. Le W3C WAI a joué un grand rôle dans la promotion de l'importance de l'accessibilité et de l'élaboration d'un cadre sur l'accessibilité des ressources Web. L'accessibilité de l'apprentissage en ligne offre des défis supplémentaires qui ne sont pas toujours présents dans le cas de l'accessibilité à d'autres ressources Web. Les auteurs allèguent qu'un modèle plus sophistiqué est nécessaire pour aborder

l'accessibilité à l'apprentissage en ligne, le modèle doit tenir compte de l'utilisation de l'apprentissage en ligne, des questions pédagogiques et des styles d'apprentissage en plus des questions techniques et des ressources. Les auteurs s'expliquent sur ces questions et proposent un modèle holistique sur l'élaboration de ressources d'apprentissage accessibles.

Introduction

The importance of universal accessibility to Web resources is widely acknowledged. W3C's Web Accessibility Initiative (WAI) has developed a series of guidelines, which will help to ensure that Web resources can be accessed by people with disabilities. Since the Web is widely used as a delivery channel for e-learning resources it would appear self-evident that the e-learning community should make use of WAI guidelines in the development of e-learning resources.

This paper, however, argues that although the WAI guidelines should have a strong influence of the approaches to the development of e-learning resources, there is a need for a wider perspective. There is a need, for example, to recognise the limitations of WAI's guidelines and of the difficulties in implementing the guidelines. In addition there is a need to acknowledge that WAI has been successful in raising awareness of the importance of accessibility of digital resources, and that the IT sector has responded to this by ensuring that proprietary formats and operating systems which may have been previously inaccessible are now increasingly being made accessible. Finally there is a need to recognise that, just as IT has been used to provide accessible simulations of inaccessible real world learning, so too can accessible real world learning resources be used as a replacement for e-learning resources, which may be inaccessible.

The paper is based on the experiences of the authors who work in the UK Higher Education community in the development of e-learning resources and supporting e-learning developers. Although the paper describes experiences within the UK, the issues addressed and the solution proposed will have wider applicability.

Related Work

The Web Accessibility Initiative

The World Wide Web Consortium (W3C) is the body responsible for the coordination of developments to Web standards. W3C seeks to develop standards, which can provide universal access to digital resources. From the outset W3C has sought to ensure that this mission embraced the needs of people with disabilities. As stated by Berners-Lee, "The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect" (Berners-Lee, n.d., 1).

The W3C established the Web Accessibility Initiative (WAI) with a remit to lead the Web to its full potential with a particular reference to promoting a high degree of accessibility for people with disabilities. Within a short period of time WAI proved to be tremendously successful in raising awareness of the importance of Web accessibility and in developing a framework, which can help organisations to develop accessible Web resources. This framework provides a set of guidelines, which can be used to ensure that Web resources will be widely accessible. Of particular relevance to developers of Web resources is the Web Content Accessibility Guidelines, often referred to as WCAG (WAI, 1999). W3C WAI has been successful in promoting the WCAG guidelines around the world. The guidelines have been adopted by many organisations and are increasingly being adopted at a national level, as documented in WAI's list of policies relating to Web accessibility (WAI, 2004a).

Related Activities

W3C WAI's success in developing guidelines for accessibility has led to the need for tools, which Web

developers can use to check that their Web resources comply with WAI's accessibility guidelines. A variety of checking tools are now available, such as Bobby (Watchfire, n.d.) and The WAVE (Webaim, n.d.). Such tools have their limitations (for example they can determine if an image contains an ALT attribute but not if the attribute provides a meaningful description of the image). However they do have a valuable role to play if used in conjunction with manual checking of the accessibility of Web resources.

In Canada the Adaptive Technology Resource Centre of the University of Toronto has developed the A-Prompt Web accessibility verifier (A-Prompt, n.d.). The A-Prompt software tool examines Web pages for barriers to accessibility, performs automatic repairs when possible, and assists the author in manual repairs when necessary. A summary of Web accessibility validation and repair tools has been published by the Adaptive Technology Resource Centre, University of Toronto (Harrison & O'Grady, 2003).

Although the accessibility checking tools are mainly used by Web developers to spot problems on their own Web sites, the tools can be used to benchmark compliance with accessibility guidelines across Web sites. Schmetzke provides links Web accessibility surveys, which have been carried out, primarily in North America but also elsewhere (Schmetzke, 2004).

These auditing and, in the case of A-Prompt, repair tools seek to measure compliance with WAI's accessibility guidelines. Such tools tend to treat the guidelines as definitive. However in this paper we are developing a model, which makes use of WAI guidelines in a wider context. An example of a related approach is the Accessibility of Campus Computers: Disability Services Scale (ACCDss) developed by Fossey, Fichten, Robbiland, and Asuncio (2001). This checklist summarises the issues, which need to be addressed in order to ensure that a campus provides an accessible IT infrastructure. As well as ensuring that appropriate accessibility aids are available the checklist also addresses related support issues, such as training and support.

The UK Context

In 2001 the UK Government introduced the Special Educational Needs and Disability Act (HMSOnline, 2001), bringing the previously excluded elements of the education sector within the remit of existing antidiscrimination legislation. The legislation means that disabled students cannot be treated in a less favourable way and that institutions must make anticipatory reasonable adjustments to ensure that disabled students are not placed at a substantial disadvantage. In the same year JISC, the UK's Joint Information Systems Committee, established the TechDis service, with a remit for all aspects of technology and disability within education. Since 2001 the service has been working with other intermediaries to try and understand the ramifications of the legislation on, amongst other things, e-learning.

An excellent overview of the legislation highlighting many of the issues that would be affected by the legislation is given in (Willder, 2002). However, she concludes that until the legislation is tested it will be difficult to draw conclusions. Using experiences from other countries, some of which may be used as supporting evidence in the UK, Sloan, suggests that there is little doubt that e-learning will be within the scope of UK legislation:

> ... it can be seen that there is likely to be a duty on higher and further education institutions to ensure that their online teaching resources and VLEs are provided in a form accessible to disabled students. Further, institutions will be expected to make 'reasonable adjustments' to overcome these problems and are unlikely to be able to justify continuing discrimination. (Sloan, 2002, 20)

Over a period of 18 months the authors have been working together with academic staff and individuals working in the policy area to better understand how standards and guidelines fit together with UK legislation and how that then transposes onto the learning experience of a disabled student in the UK. In working with learning technologists, disability staff and lecturers, the authors and others acknowledged in this paper have come to some interesting conclusions and challenges to those who are working in the field of accessibility.

This paper addresses some of these issues, discussing the work of standards organisations, exploring the nature of e-learning as both an isolated delivery method and a blended learning experience and how that can impact on disabled students. Furthermore we discuss the use of quality assurance framework for policies and compliance checking. The paper concludes with a discussion of the approach agreed by several of the academic organisations involved in supporting e-learning and disability.

Experiences of Wai Guidelines

Surveys of Compliance With Wai Wcag Guidelines

Web accessibility testing tools such as Bobby have been used to monitor partial compliance with the W3C WAI Web Content Accessibility Guidelines across a range of Web sites in order to gain an understanding of how successful communities are in complying with these guidelines and to gain an awareness of common problems. Such an automated approach cannot establish if a Web site is actually accessible, as manual testing is needed for this purpose. However automated tools can establish if Web sites are not accessible (or, more strictly, if Web sites comply with guidelines which can be tested with automated tools). Use of automated tools is a reasonable approach if resources are limited and a wide-scale survey is required.

A number of accessibility surveys have been carried out across the UK Higher Education community using an automated accessibility-testing tool in order to profile the community and to gain an understanding of common accessibility problem areas. A survey of over 50 project Web sites funded by the JISC's 5/99 digital library programme was carried out in 2002 (Kelly, 2002a). The JISC 5/99 digital library programme has funded projects, which provide online teaching and learning resources in a range of subject areas. Despite projects having a contractual agreement to support a number of open standards and best practices (which includes WAI WCAG) the findings showed that 46% of the project home pages failed to comply with WCAG 1.0 guidelines, based on the automated detection of errors. The actual percentage of pages, which fail to comply with WCAG guidelines, may well be worse if a manual analysis of the accessibility of the resources was implemented.

A similar survey was carried out in August 2002 of the home page for over 160 UK University corporate Web sites. The survey was carried out shortly before the Special Educational Needs and Disability Act (SENDA) legislation became law, which extended accessibility legislation to include the education sector. Similar findings were found, with 57% failing WCAG 1.0 guidelines (Kelly, 2002b).

More recently the Disability Rights Commission (DRC) published a high profile report on the accessibility of 1,000 Web sites in the UK (Disability Rights Commission, 2004). The survey revealed that 81% of Web sites failed to meet minimum standards for disabled Web access. Moreover at a press conference revealing the findings it was distressing to see that sites highlighted by the DRC as exemplars of good practice also failed to meet the minimum standards.

Discussion of Findings

These findings seem depressing, particularly in light of the publicity given to the SENDA legislation across the community, the activities of support bodies such as TechDis and UKOLN and the level of awareness and support for WAI activities across the UK Higher Education sector.

The publication of the survey of the accessibility of UK University entry points led to interesting discussions on some of the difficulties of complying with the WAI WCAG guidelines and some concerns over the relevance of the guidelines. Areas of concern which have been raised include:

1. **Difficulties in understanding the guidelines:** There was a feeling that the guidelines were difficult to understand, leading to the guidelines being rewritten in many places, with dangers that differences in interpretation would arise.

2. **Conflicts between accessibility and usability:** It was reported that there are occasions in which complying with accessibility guidelines may conflict with the usability of the page or require undesirable changes to the page appearance.
3. **Poor browser support for standards:** The poor support for standards such as CSS in browsers such as Netscape 4 leads to uncertainty in the deployment of technologies such as CSS.
4. **Guidelines too theoretical:** There was a feeling that some of the guidelines were too theoretical, promoting emerging Web standards, which have not yet been widely deployed or accepted within the marketplace.
5. **Need to make use of existing proprietary solutions:** There was a feeling that, although the W3C approach of developing open standards should be supported, there is still a need to provide access to proprietary formats, which support users' needs.
6. **Dependencies on other W3C formats:** Checkpoint 11.1 of the WCAG 1.0 guidelines requires "Use W3C technologies when they are available and appropriate for a task and use the latest versions when supported". Although this can be a useful guideline, if an organisation is committed to implementing this guideline (which is required in order to claim WAI AA compliance) it would appear the RDF metadata format and the PNG graphics format need to be used, despite the very limited uptake of these technologies. In addition a strict interpretation of this guideline would result in an accessible Web site which complies with WAI AA falling overnight from AA to A compliance on the day a new version of the HTML specification is released.
7. **Failure to recognise other IT developments:** The WCAG guidelines do not acknowledge the developments in making proprietary formats more accessible, either through enhancements to the formats themselves or to operating systems.

Although implementation of the WCAG guidelines may not always be easy, it should be acknowledged that the guidelines have been developed in good faith, and that implementation of the guidelines can help to make Web resources accessible. The over-ambitious nature of the guidelines has been observed in other areas: the initial version often seeks to address too many issues with subsequent versions having more realistic aims. It should be noted that WAI are currently developing version 2 of the WCAG guidelines (WAI, 2004b), which may address some of these concerns.

Technical Factors Affecting E-Learning Accessibility

E-Learning Technologies

We have introduced the work of the W3C WAI and discussed the difficulties, which organisations appear to have in complying with the WAI guidelines. We will now consider some of the particular challenges learning technologists face in developing accessible e-learning resources.

E-learning can be an enriching and stimulating environment within which learning can take place. While the pedagogy employed within a course or unit must be at the heart of the experience, the technology employed also has an impact, both negative and positive, on the experience for the student.

E-learning covers a broad range of activities which involve the embedding or adaptation of information technologies within the learning process. These technologies can be diverse as a Web-based Virtual Learning Environment (VLE), use of email or the use of dedicated software.

Students often have their first experiences of e-learning using an institution's Virtual Learning Environment. Brown and Jenkins (2003) reported that 86% of UK Higher Educational Institutes (HEIs) are using a VLE to deliver a degree programme, a course, or part thereof. Of these higher educational institutes, Blackboard and WebCT are used in 43% and 34% respectively. Several reports (Pearson & Koppi, 2002; Cann, Ball, & Sutherland, 2003) have highlighted various accessibility issues with certain VLEs. However, it should be noted that with the introduction of Section 508 within the USA both companies that develop these systems have had to make further adjustments to the products (Dunn, 2003).

For a substantial number of academics, using a VLE is their first venture into the e-learning arena. Not only are there issues with VLEs with respect to how accessible they are but some VLEs have a prescribed and somewhat limited pedagogical model; primarily to provide content in a *transmissive* model and provide less opportunity for academics to cater to students' different learning styles.

Even for those academics who wish to eschew VLEs and develop their own e-learning resources, attempting to adhere to the W3C WAI WCAG guidelines can be a daunting task when browser implementation of standards is not consistent (for example with regards to CSS 2.0). At present, following best practice can be a challenge when development tools and browsers have still yet to accommodate the easier development of appropriate CSS.

Use of Proprietary Formats

Reference has already been made to the WAI WCAG guidelines and their lack of inclusion of proprietary formats. One technology that has great appeal with the e-learning community is Macromedia Flash, which is very versatile for producing animations, simulations, and movies for students to interact with. Flash can be a tempting product to use when one compares it with the limited number of authoring tools and limited browser support for SMIL and SVG, the open formats developed by W3C which provide similar functionality to Flash.

It is pleasing to observe that Macromedia have addressed the importance of accessibility by providing enhanced support for the development of accessible resources using Flash (Macromedia, 2004). Although there are still some limitations with the accessibility support for Flash, such as the need to upgrade to new versions of the player software, it should be acknowledged that there will also be a need to install plug-in technologies to support W3C's SMIL and SVG technologies.

Managing an Institutional IT Environment

As well as the tensions between use of proprietary versus open formats and mature technologies versus emerging technologies, there are also tensions between the management of an institution's IT service and providing flexibility of the end user's environment. IT Service departments will aim to provide a secure, robust managed environment. This may conflict with the flexibility many end users would like. This is another area in which there is unlikely to be a universal solution; individual institutions will have their own policies, which will be based on the institutions' technical environment, supported and provided application and security policy.

Pedagogic Issues Affecting E-Learning Accessibility

E-learning is a process not an event. There is a common misconception that putting traditional lectures notes online or emulating what happens in a lecture theatre on the Web constitutes e-learning. While such content can form part of the e-learning experience, e-learning is much more.

At the heart of any e-learning experience is the pedagogy that drives it, the learning outcomes, the content, which illustrates those learning outcomes, the context in which the content is presented and the activities a student completes to aid his/her understanding of the learning outcomes. This can mean that a traditional course often has to be entirely re-engineered either for a wholly online experience or a hybrid approach of online and offline activities.

One of e-learning's advantages is the capability to provide for flexible learning suited for students with a range of different needs. An example of this is problem-based learning whereby the content is selectively released to students as they work their way through a series of problems, allowing them to solve the problems at their own pace. Another example is resource-based learning where students are given a collection of resources. By setting questions to guide their mining of the resources, students can search the resources according to their own needs, e.g. some may prefer text-based materials, others graphical or media based. Indeed they may have the opportunity to add some of their own materials to the resource collection.

The components that together constitute the content of an e-learning process are often referred to

as *learning objects*. Although the WAI WAIG guidelines can be used to ensure that learning objects are accessible this may not always be desirable from a pedagogic standpoint. The following is an illustration of the type of scenario that can be encountered.

In our case study a course was split into two and a computer-aided assessment used as a learning tool to bring together the two sections of the course. The assessment consisted of a series of questions, each question consisting of two images relating to the two different sections of the course. Students were required to identify the images and then select a connecting phrase for a large list of possible options. Thus the image recognition required the students to demonstrate knowledge of certain facts (the images) and then the selection of the appropriate connecting phrase meant that they had to apply their understanding of the whole course to the two images demonstrating two levels on Bloom's taxonomy of learning; knowledge and application (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956).

If we were to comply with the WAI WCAG guidelines to this particular assessment it would have been necessary to amend the assessment to add ALT text to the images. However doing so would have changed the pedagogic purpose of the assessment and would not have tested that the students have acquired the stated learning outcomes.

this case, for a student with visual impairments, a computer-aided assessment may not have been appropriate. Using the SENDA requirement to make reasonable adjustment rather than complying with the WAI WCAG guidelines a more appropriate solution could have involved providing an alternative form of assessment, such as an oral examination.

It is this balance between accessible formats and reasonable adjustment, which academic staff must resolve. In teaching students decisions need to be made about what we are asking of them academically: are we testing a student's knowledge and understanding or are we testing a student's ability to be tested. In some cases the student's participation in a process will be important, for example the ability to carry out a chemical experiment. However, the lecturer needs to decide whether or not the process or the learning outcome is important. A judgement can then be made on how the student is assessed.

In should also be noted that e-learning environments are not always based purely on use of the Web. An e-learning developer may wish to make use of traditional Web resources, e.g. Java applets, Flash animation, simulations developed in Microsoft Excel. The resources may be delivered across a campus LAN or on CD-ROM as well as across Web protocols. The challenge for the teacher is to make use of the learning resources in a form, which is appropriate to the learning outcomes and the particular learning style of the student.

A Holistic Approach

The Need for a Holistic Approach

Much emphasis is now placed on accessibility in education; generally this has come to be synonymous with Web accessibility or the accessibility of e-learning. However to staff who are just starting out in educational development or using technology in a very iterative way with students the application of these standards and guidelines can be at best a discouragement or at worst damaging, preventing staff from exploring the potential of e-learning.

This approach also ignores a major facet of the educational experience: it is holistic. Students attend an institution and partake of a range of facilities and activities—some they will not relate to, others they will. Because a disabled student cannot access one type of assessment that happens to be delivered via a Web browser, it does not mean they cannot instead do an oral examination in a one-to-one situation. The current accessibility paradigm places emphasis on total online access, or if materials cannot be

made accessible, then providing an equivalent online experience. This can be damaging to the educational experience of attending an institution, ignoring the fact that institutions and their staff deploy a range of learning methods, some of which will suit all students; others will not. The only way to judge the accessibility of an institution is to assess it holistically and not judge it by a single method of delivery.

We will now review a number of approaches, which can be used in a holistic approach to the development of e-learning resources.

Usability Model

The Disability Rights Commission's report highlighted the importance of Web site usability for people with disabilities. The report pointed out that "45% of [585 accessibility and usability] problems were not a violation of any [WAI WCAG] Checkpoint and could therefore have been present on any WAI-conformant site regardless of rating" (Disability Rights Commission, 2004, p. 12). This point illustrates a limitation of the WAI WCAG guidelines. It should be self-evident that quality e-learning Web resources should be usable and not just accessible. However the strong emphasis given to accessibility, especially with concerns sometimes expressed that failure to comply with W3C WAI WCAG guidelines could lead to legal action, can lead to failure to give equal weight to usability issues.

Although it might appear desirable to simply include usability alongside accessibility there is a need to be aware of potential conflicts. This may be partly due to poor support for Web standards in browsers. However in addition to this factor, users may express preferences for e-learning resources, which have conflict with accessibility guidelines. The proprietary Flash format is widely used for the development of interactive e-learning resources and on-line games. Such resources may be accessible. The RNIB (Royal National Institute of the Blind), for example, has encouraged the development of accessible Flash resources, such as the RNIB Blind Date game (RNIB, n.d.). The RNIB also provide advice on the development of accessible Flash resources (RNIB, 2004). Although resources such as the RNIB Blind Date game may be usable and accessible, they would not comply with the WAI WCAG guidelines as they make use of a proprietary file format.

A QA Model

In "Developing a Quality Culture for Digital Library Programmes," Kelly, Guy, and James (2003) described a quality assurance model for the development of functional, interoperable and widely accessible digital library services. The model is based on well-established quality assurance principles: documented policies and systematic procedures for ensuring compliance with the procedures. The authors feel this model is well-suited for the development of accessible e-learning resources. We feel that the policies should be informed by the WAI WCAG guidelines, but should also address a broader range of issues including usability, user requirements and fitness for purpose.

In "Ideology or Pragmatism? Open Standards and Cultural Heritage Web Sites" Kelly, Dunning, Guy, and Phipps (2003) developed their quality assurance model and described a matrix for selection of standards. The authors argue that although use of open standards is highly desirable, it is important to be aware of the dangers of a blinkered approach to use of open standards. The authors point out that some open standards may fail to be accepted within the marketplace or may be too complex or expensive to deploy. In order to ensure that public sector bodies make effective use of their resources there is a need to adopt a pragmatic approach to the selection of standards. We feel that this approach needs to be taken not only when choosing open standards but also when selecting guidelines, such as those developed by W3C WAI.

Accessible E-Learning or Accessible Learning?

In our holistic approach to accessible e-learning we feel there is a need to provide accessible *learning* experiences, and not necessarily an accessible *e-learning* experience.

As an example, consider an e-learning environment, which provides a highly interactive 3D visualisation of a molecule. Such an environment is likely to be very difficult to make accessible to a visually impaired student or a student with impaired motor skills. Rather than seeking to develop an accessible version of such an environment, which, if possible to do, may prove very costly, without any guarantee that the accessible equivalent will be usable by the student with disabilities, we argue that the teacher should consider the learning experience provided by the e-learning resources and seek to develop an alternative, which provides an equivalent learning experience. In many cases it should be possible to find an acceptable equivalent learning experience, such as the e-learning resources used prior to the development of the e-learning resource (for example, a physical representation of a molecule).

This approach may also be used when a real-world learning experience is not accessible. As an example consider a field trip for a geography student, which requires climbing a mountain or other terrain unsuited for a student in a wheelchair or with similar physical disabilities, which could include an overweight student or a heavy smoker who finds physical exertions difficult. A blinkered approach would be to seek to make the mountain accessible by building a ramp or by cancelling the field trip for everybody. However using our model the teacher would identify the learning experiences (perhaps selection of minerals in their natural environment and working in a team) and seek equivalent learning experiences (perhaps providing the student with 3G phone technologies, videos, for use in selecting the mineral, followed by team-building activities back at the base camp).

This holistic approach to accessible learning has been accepted in a number of academic disciplines. For example the Virtual Field Course Web site (VFC, n.d.) describes several approaches to support field studies for students with disabilities.

Accessible Courses

This holistic approach encourages a more bird's eye view of the learning experience encountered by disabled students. The learning path that the student chooses to follow should be accessible while individual online components or learning objects may not. To provide another example consider a blind student who wishes to take a degree in biochemistry. When choosing a course the student should be advised on course modules which the student's disability may make it difficult for the student to pass (such as options which require a student to peer through a microscope and describe what they see). Although such courses may not be possible for a blind student to take, the department could seek to provide accessible alternative course options, which would still allow the student to be awarded a degree.

Adapting to Individual, Local, Political and Cultural Factors

The final component of our holistic model for e-learning accessibility is to argue for an approach, which takes into account individual needs and local cultural, political and social factors. Since accessibility is primarily about people and not about technologies we feel it is inappropriate to seek a universal solution. We feel that in seeking to provide accessible learning experiences it will be necessary to take into account the individual's specific needs, institutional factors, the subject discipline and the broader cultural and political factors.

Rather than aiming to provide an e-learning resource, which is accessible to everyone we argue there

can be advantages in providing resources, which are tailored for the student's particular needs. The Tate Gallery, for example, have developed a service known as i-Map (i-Map, n.d.), which provides an e-learning experience for paintings by Picasso and Matisse. I-map has been developed specifically for the needs of the visually impaired, including the congenitally blind. This service is based on inclusive design rather than universal design as its underlying principle for this service.

Our Proposed Holistic Model

The holistic model for e-learning accessibility, which the authors have proposed is illustrated in Figure 1.

Figure 1: Holistic Model for E-Learning Accessibility

Rather than relying purely on the guidelines developed by W3C WAI, the authors feel that these guidelines should form part of a broader approach to the provision of accessible e-learning resources. There is a need to address the usability of e-learning resources, the pedagogic aims of the e-learning resources, infrastructural and resources issues and to provide solutions, which are appropriate to the needs of the learner. We feel that a quality assurance framework is needed to support this model, which ensures that documented policies are provided and systematic procedures for ensuring compliance with the policies are implemented.

Discussion of Our Model

It could be argued that this approach has limitations compared with the W3C WAI guidelines. The WAI guidelines can appear easier to implement as they provides a series of checklists. However we feel that this checklist approach is, in fact, counter-productive as it encourages developers to prioritise the objective areas which testing tools can easily report on.

Another limitation of our approach may be its lack of a universal model, which is implicit in its inclusion

of institutional and local factors. This criticism may, in fact, be regarded in some quarters as a strength of the model, as it does not seek to mandate a single global solution, but rather welcomes diversity and a learner-centric approach to e-learning

Our work is still in its early stages. There is still a need to refine our model and to provide examples of how it could be applied in a variety of circumstances, including differing learning environments, students with a variety of disabilities, use of various technologies and in a variety of different organisations.

Conclusions

In this paper we have argued that although the W3C WAI guidelines for content accessibility are valuable, they should not be regarded as the only set of criteria, which developers of e-learning resources need to consider. Not only is there a need to address a wider set of issues than those addressed in the WAI guidelines, there are also other factors which need to be addressed, some of which may conflict with WAI guidelines. In addition there is a need to place the learner at the centre of development process. This approach focuses on the broad learning outcomes and recognises that inaccessible e-learning resources may be deployed provided that alternative accessible learning resources are available.

We have acknowledged that, in some quarters, these ideas made be regarded as controversial, especially in organisations which have defined e-learning accessibility policies solely using the WAI guidelines. We recognise that there is still an on-going debate to be held. The authors welcome comments on our input to this debate.

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