WEB-BASED LEARNING ENVIRONMENTS FOR THE VISION IMPAIRED

Ruchi Permvattana*, Helen Armstrong* and Iain Murray**
*School of Information Systems, Curtin University - Perth, Western Australia
**Department of Electrical & Computer Engineering, Curtin University - Perth, Western Australia

ABSTRACT

Many web applications including online learning are not accessible to vision impaired students. This paper presents the details of research in designing accessible online IT learning environments for vision impaired students. The research investigates the features of currently available e-learning environments for the vision impaired, international standards and guidelines and theoretical models relating to accessibility of learning environments. The research also involves gathering data from interviews and observations from sighted and vision impaired teachers and students to identify characteristics of a range of vision disabilities and the needs associated with these. Eventually the research will deliver a model of an effective web-based learning environment for the vision impaired, thus providing assistance to those designing and developing such environments as well as the opportunity for vision impaired individuals to better equip themselves for employment. Although still a work in progress, the paper identifies characteristics that are desirable in an e-learning environment that empowers the vision impaired to achieve the course learning objectives.

KEYWORDS

Accessibility, Accessible online learning, Vision Impaired

1. INTRODUCTION

The Vision Impaired are those individuals who have low vision, colour blindness, or total blindness. About 314 million people are visually impaired worldwide, and 45 million of them are blind (World Health Organization 2009). In Australia unemployment figures for the vision impaired are far higher than those for able-bodied people as shown in a recent survey carried out by Vision Australia that reports 63% unemployment in the vision impaired respondents, as compared to 14% of able-bodied people (VisionAustralia 2007). In order to attain meaningful employment, vision impaired people benefit from access to training and education in areas relevant to roles they can undertake in the business world. Accessibility of the required education and training by the vision impaired is limited due to the visual nature of many courses currently on offer and the lack of accessibility of the related hardware and software. The Internet is also a key component in 21st century communications and learning environments.

The presentation of teaching and learning materials in electronic form and web-based delivery of learning have increasingly become mainstream in education environments. The offering of courses by remote learning is encouraged in order to ensure students located in remote communities have equal opportunity to participate. Accessibility has become an increasingly significant issue as more communications, educational content and services become available online and via the Internet. The vision impaired have needs that are unique and universal accessibility approaches have not yet been able to meet the needs of this group in conjunction with those designed to address other disabilities. The purpose of this study is to investigate possible ways to design accessible online IT learning environments specifically for the vision impaired. To achieve this aim, it is necessary to identify not only the needs of the target group but also the critical accessibility characteristics of online learning environments. The aims of the project are to investigate the features of effective online learning environments for vision impaired learners and build a conceptual model of an effective online learning environment in IT studies for the vision impaired appropriate to their disability.

2. ACCESSIBLE WEB-BASED LEARNING

Web-based learning, by its very nature, offers a range of advantages over traditional methods. Unlike traditional learning, it doesn't require physical access (Babu & Midha 2007). The provision of accessible information is vital to the pursuit of education for people with a vision impairment (Department of Training and Employment 2000). However, online learning environments are frequently criticized for their failure to make the most of the opportunities afforded by the new technologies. Too often the design of the settings is constrained by such practical factors as inflexible delivery systems and the quest to generate online courses from existing print based materials (Bates & Oliver 2002). Vision impaired students face unique problems in traditional and e-learning environments. The Blind and those with severe vision impairment often receive information from their computers via audio (speech) or touch (Braille) rather than sight, however some users with low vision can also modify their computer displays contrast, colour scheme and/or text size to suit their disability. Screen readers are applications that read materials on the computer screen and produce audio output, permitting vision impaired students to access electronic documents. In his investigation of problems faced by vision impaired students in advanced IT education Murray (2008) presents the following factors: blind students with mobility restrictions and isolated students cannot physically attend classes, blind students cannot see the whiteboard or overhead screens, sighted instructors are not cognizant of the needs of blind students, and finally, screen readers can only access text, in document or text files. They cannot access diagrams and images, pop-up and drag and drop facilities, simulation software and the Linux operating system.

Although much has been written regarding guidelines for accessible web pages (see Section 508 US Rehabilitation Act; W3C 2004; WebAIM 2010 and other national standards and laws), very little has been published on accessible advance IT e-leaning environments. Such environments need to include not only accessible curriculum, but fully accessible methods of instruction and assessment, accessible environments to carry out practical activities, accessible classrooms and teachers with appropriate skills and knowledge in vision disabilities.

Designing a curriculum for vision impaired learners is more comprehensive than curriculum for sighted learners in many ways. This is because vision impaired learners need to perform a greater number of tasks for every skill expected of a sighted learner. Although online learning has opened the doors of opportunities for people with disabilities, information access continues to create numerous challenges within the Internet community. According to Kelly et al. (2005) 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. One of e-learning's advantages is the capability to provide for flexible learning suited for learners with a range of different needs. An example of this is problem-based learning whereby the content is selectively released to learners as they work their way through a series of problems, allowing them to solve the problems at their own pace. Accessible curriculum is, however, only one part of the problem facing vision impaired students – they also need to be able to communicate with teachers and other students as if they were in the same room as well as access to all facilities needed to fulfill the learning objectives of the course. This requires the building of a learning environment specifically designed to meet the needs of the vision impaired.

3. RESEARCH METHOD AND DESIGN

The research involves an interpretive qualitative approach using the Design Science method. Based upon the work of Hevner et al. (2004) Venable (2006) presented a highly interactive design science model linking the elements of Problem Diagnosis, Theory Building, Technology Design/Invention and Technology Evaluation (see Figure 1). The Problem Diagnosis stage occurs early in the Design Science process and is initiated for a particular problem, as the perceived difference between the current situation and desired situation is a direct result of consulting stakeholders. The Theory Building activity is a key element of the research method, being centrally placed with links to all the surrounding activities. In this theory building activity the researcher attempts to establish, through research or their own experiences, a solution to a particular problem space. The solution can take the form of a new conceptual model, a methodology, or a physical object. The

theory building continues during the Technology Design/Invention stage of the project and is refined after the Evaluation stage. The Technology Design/Invention stage includes hypothesizing and designing solutions to address the problems identified in the problem space, and this stage may involve the enhancement of a method or technique. The Technology Evaluation stage influences the utility theories developed in the Theory Building activity. The new design is then tested and assessed with respect to how it addresses the problem identified in the problem space.

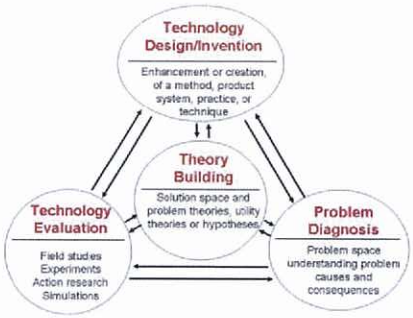

Figure 1. Design science research (Venable 2006)

The two-way arrows in Figure 1 show the Design Science method allows iterative action throughout the research process. This gives the researcher flexibility in the research process, allowing movement and interaction between the activities.

In order to achieve the research aims, the following steps are being carried out. Firstly, Understand the Problem: This involves studying the characteristics of vision impaired learners and their needs in relation to accessible e-learning in web-based environments. Approximately 100 adult vision impaired learners are being studied to understand the nature of their vision disabilities and their specific learning and accessibility needs. The data will be collected by observation of the learners in their learning environment and semi-structured interviews with the learners to identify their accessibility needs. Literature and models on accessible curriculum and learning environments are investigated to identify accessibility problems and needs for consideration in theory building for solution design.

Secondly, Design the Theory for a Solution: This involves investigating accessibility guidelines and legal and statutory requirements, and gathering information from stakeholders (vision impaired learners and teachers) regarding features of effective accessible e-learning environments. The guidelines include documentation and standards from Canada, EU, Australia New Zealand, and USA in order to fully comprehend an international perspective. Guidelines for the design and development of web-based materials are also under study. This stage also identifies the components required to effectively deliver IT curriculum in a web-based online environment for the vision impaired in order to achieve the learning objectives. These include defining the nature of teaching materials, format of learning material presentation for accessibility, delivery mechanisms, equipment, and skills required by teachers. Information will be collected from teachers and students via interviews and observations to identify necessary and desirable features for the proposed accessible e-learning environment model. The data collected will be analysed and theory forming the foundation of the new model will be generated.

Thirdly, Build and Evaluate the New Model: This involves analysing the relationships between the characteristics and needs of the learner, and the components of the learning environment and then synthesizing to build a conceptual model of an effective web-based learning environment for ICT curriculum that is totally accessible for the vision impaired that permits the achievement of the learning outcomes. The model will be evaluated by a group of vision impaired and sighted teachers and students who are experienced in delivering or undertaking e-learning courses.

4. PRELIMINARY FINDINGS

The interview data collected has demonstrated the components needed for effective web-based learning environments for the vision impaired learners include:

1. Accessible curriculum and learning materials. The learning materials should have file types such as word documents or accessible PDFs; all functionality must be available from the keyboard; minimum workarounds; standard formatting of web pages and accessible web pages with short text descriptions applied for non–text content such as images and materials presented via interactive media.
2. Accessible assessments. Assessment must be specifically designed for students with vision disabilities, ensuring all images have full textual descriptions, students must be able to revise their answers before submission and finally allow sufficient time for completion.
3. Teaching aids designed specifically for vision disabilities. These teaching aids will need to be developed by teachers in conjunction with instructional designers experience in the design of accessible materials, and will be discipline specific.
4. Accessible equipment and facilities to carry out practical work and application of theory being learned.
5. Virtual classroom environment where students and teachers can converse as if they are in the same physical room. Skills in using assistive technologies such as screen readers is a pre-requisite for vision impaired students who will require a sound working knowledge of these tools and their limitations. Being able to communicate with instructors and other students in a real-time and online environment via a virtual classroom is essential. Applications such as Ventrilo can provide a virtual classroom environment where teachers can broadcast lectures, take questions during the broadcast, and encourage student participation and discussion. In addition to classroom communications the vision impaired students need to be able to communicate with their tutor and other students on a one-to-one or group basis using free communication methods such as e-mail, Skype and social networking sites such as Facebook and MySpace.
6. Teachers require skills and expertise in teaching vision disabled students plus cognizance of problems face by these students. Teachers also need an in-depth knowledge of assistive technologies in order to aid the students complete learning tasks. Ideally instructors will be vision disabled themselves. It is important to employ the instructors who firstly understand vision disabilities and the barriers the students face on a daily basis in relation to their learning achievements and secondly being able to solve learning problems related to their disability. The vision impaired students and teachers interviewed so far have highlighted the need for vision impaired instructors who have already faced similar problems in their learning and who can provide important role models for students.

Building self-confidence is an important part of the student learning process and the employment of qualified vision impaired teachers and tutors provide encouragement for success. The environment must ensure the students feel part of a learning community and are able to share learning experiences, sources of information, inspiration and knowledge relating to the curriculum topics. In addition sufficient time to absorb new materials and complete learning tasks is required. The environment must, therefore, be designed not only to provide regular learning sessions based upon a schedule, but also permit sufficient time for the students to investigate and understand curriculum topics in their own time.

5. CONCLUSION

Data analysis of the results is underway, the components of effective online learning environments at this stage included the characteristics of accessible IT web-based learning and the needs of the vision impaired learners. The next step of the project is to build a conceptual model of an effective web-based learning environment for ICT curriculum. This model can then be used to improve the situation for vision impaired learners and provide guidance to those designing and developing effective accessible learning environments.

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