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RESEARCH REPORT

Learning by E-Learning for Visually Impaired Students: opportunities or again marginalisation?

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ABSTRACT In recent years, e-learning has become a valuable tool for an increasing number of visually impaired (VI) learners. The benefits of this technology include: (1) remote learning for VI students; (2) the possibility for teachers living far from schools or universities to provide remote instructional assistance to VI students; and (3) continuing education for VI adults. A number of studies confirm that VI students appreciate the advantages of e-learning systems, but they also have to face several challenges in pursuing their education through the e-learning mode. E-learning can be a valuable opportunity for VI users if suitable education methods and appropriate technologies are used. Hence, it is crucial to identify the needs and requirements of the target community in order to create a system that fulfils their expectations. This article describes the experiences of Indian VI learners with e-learning, throws light on the problems often encountered by them when using assistive technology and proposes guidelines for designers in order to develop more accessible e-learning systems.

Introduction

Visually impaired (VI) youth in India today are conquering various non-traditional fields of knowledge with great conviction and a winning attitude. They have correctly realised that only the right kind of education and training will enable them to be capable members of the wider socio-economic arena. Fortunately, the positive inclusive societal attitude, conducive political wheel and accommodative social responsiveness of the job market have created a favourable environment for the development of VI youth. Many Indian and foreign universities have opened their doors wide for these students through their synchronous and asynchronous channels of learning. Various online educational programmes have taken bold and decisive steps towards bridging the knowledge divide for these self-determined and passionate knowledge lovers. Today, more and more Indian VI students are enrolling on such online courses for their self-development and empowerment. However, this is the right time to pause for a while and reflect upon whether these online courses are really a solution for their educational problems. Are these courses really accessible or, in reality, are they leading to a new form of digital marginalisation? This article is an attempt to understand the actual experiences of Indian VI students with e-learning in online courses and suggests some recommendations to make this option of knowledge acquisition work.

Before starting the discussion, we offer a brief definition and explanation of visual impairment in order to enhance understanding of it. The term 'visual impairment' covers a wide variety of conditions, some of which have been present since birth and some of which result from gradual deterioration of sight. Visual impairments include low vision and blindness, but there are many aspects of seeing. 'Low vision' is used to describe a loss of visual acuity while retaining some vision.

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'Blindness', on the other hand, 'usually refers to a complete lack of vision. People who are considered legally blind may have some useful vision' (Disabilities, Opportunities, Internetworking, and Technology, 2005).

From the above definition, it is understood that in order to qualify as VI, an individual does not necessarily need to be blind or have a really severe loss of vision. These VI people, therefore, depend more on receiving information from sources other than their sight.

Rationale

Web-enhanced instruction is a common practice for delivering academic programmes using course management systems. The central premise of this research is that VI people are not effective participants in online learning due to challenges interacting with learning tools. Approximately 45 million people around the world lack the functional vision to read from a computer screen. These individuals interact with the Web by listening to screen-reader software or using screen-magnifying software. Web-based systems, including course management systems, lack the accessibility and usability needed for such speech-based interaction. A lack of accessibility and usability is undesirable for all, and it creates additional challenges for VI learners in performing online tasks (Correani et al, 2004). This has a negative impact on their learning outcomes in online learning, where interaction with course management systems is necessary to accomplish coursework.

The focus of future research should therefore be on improving web interfaces for screen-reader access and compliance with design standards such as the 'Web Content Accessibility Guidelines'. Consequently, the need of the hour is to investigate the e-learning experiences in online education of VI users. Without an understanding of the nature of the problems VI users face in interacting with e-learning educational tools, we cannot create an accessible and usable e-learning environment where VI users can enjoy equal learning opportunities. Therefore it is essential to study the actual experiences of VI learners with e-learning in online educational programmes.

E-Learning Defined

E-learning encompasses a broad range of mediums and technologies. Definitions of e-learning range from those that are broad in scope, as in 'includes all forms of organised interaction between people, using computers or networks as the medium of communication' (Muwanguzi & Lin, 2010, p. 44), to the very specific, as in 'teaching and learning through the primary medium of Web-based computer resources, minimally including hyperlinks and/or the Internet and synchronous and/or asynchronous communication' (Kinash et al, 2012, p. 2). In the context of this study, we define e-learning as the delivery of a learning, training or education programme by electronic means covering a wide set of applications and processes, such as web-based learning, computer-based learning, virtual classrooms and digital collaboration. It includes the delivery of content via the Internet, intranet/extranet, audio- and videotape, satellite broadcasts, interactive television and CD-ROM.

What Does Research Say about E-Learning for VI Learners?

Several research studies indicate that while there has been a great improvement in universal access to technology, VI individuals still struggle with poorly designed computer interfaces that continue to lag behind in some web design features (Craven & Brophy, 2003; Gerber, 2003; Irwin & Gerke, 2004; Leporini & Paterno, 2004; Salampasis et al, 2005). Gerber (2003) and Craven and Brophy (2003) further mention that most of the adaptive technologies used by VI individuals only help them to navigate the Internet in a linear and serial pattern. Yet, web designs are increasingly incorporating Java-based hypermedia and multimedia elements with various sophisticated visual elements such as graphics, hyperlinks and pop-up windows.

The conflicts between the linear navigation of adaptive software and the trend of non-linear web designs limit VI users from accessing and using information, which sometimes forces VI users to abandon their educational pursuits. Undoubtedly, most web content developers, page authors,

and site and tool navigation designers try to follow the World Wide Web Consortium's accessibility and usability guidelines, which recommend procedures to ensure universal accessibility to web content (Web Accessibility Initiative, 1999). More emphasis, however, is placed on web accessibility at the expense of usability concerns for people with disabilities. Leporini and Paterno (2004) view the concepts of accessibility and usability as closely related, but describe accessibility as focused on making a website available to a wider user population and usability as aimed at making users' experiences with the website more efficient and satisfying. Leporini and Paterno (2004) state that: 'often, when designers consider people with special needs, they tend to address only accessibility issues, and ignore the equally important usability dimension of e-learning tools'.

Consequently, very scant research investigates the online learning experiences of VI users. This creates a gap in the literature about a clear understanding of the problem from the perspective of VI users. Without an understanding of the nature of the problems VI users face in interacting with e-learning tools, we cannot create an accessible and usable environment where VI users can enjoy equal learning opportunities. This article attempts to fill this gap in research, especially in the Indian context. The purpose of this study, therefore, was to examine the accessibility and usability challenges of online learning systems that are experienced by Indian VI learners pursuing tertiary education. Through this examination, we hope to better understand the impact of online learning systems on VI students' pursuit of their academic goals.

Method

Purpose

The purpose of this study was to explore the learning experiences of 10 VI online students by using an exploratory case study design to understand their perspectives of the online learning environment. The goal of an exploratory case study is 'not to conclude a study but to develop ideas for further study' (Yin, 2003). A case study provides descriptions of a case, a group, a situation, or an event and examines the details of a setting, subject or particular event (Merriam, 1988; Stake, 1995; Yin, 2003). We examined the relationships between the research participants' available assistive technology and their online learning experiences in order to provide a comprehensive view and broader insight into the multifaceted phenomenon.

We have adopted a cognitive and user-centred approach to develop understanding about this relationship. A cognitive view helps us understand VI students' thought processes in the event of a difficulty. A user-centred view presents the problem from the perspective of VI students' needs and abilities in online interactions.

Research Questions

This study addressed the following two research questions:

1. How do VI students perceive their learning in the online courses?
2. What are the challenges the VI students had to face in the online learning environment?

Participants

The participants in the study included 12 VI learners who had had experience of online learning. Of the 12 participants, two had completed online programmes offered by institutions promoting tertiary education among VI people. As a result, these programmes were very accessible for the learners. We have therefore omitted the data of these two students from our study and only analysed the data of the other 10 participants.

In order to invite participation, a contact letter was sent through three e-groups of VI people. Twelve volunteered to participate in the study but, as already mentioned, two were omitted after learning about their credentials. All 10 participants were male and their ages ranged from 20 to 49 (one was between 20 and 29; 8 were between 30 and 39; and one was between 40 and 49). Nine of the ten participants were employed, while one was pursuing higher education. The participants

represented a variety of backgrounds in terms of first language, state of origin, previous educational experiences, work experience, English-language proficiency, types of employment, access to learning technologies, technical expertise and reasons for enrolling on the online courses.

Eight of the participants were graduates, while two were postgraduates. Nine of the participants had completed their graduation through formal educational colleges, while one had obtained his degree from an open university. Nine of the participants had used English for academic purposes since the higher secondary level of education and only one had pursued his entire education through the medium of English. The number of online courses they had completed ranged from a minimum of two to a maximum of 13. All the participants had completed at least one course in information technology. None of them had chosen the courses because of job aspirations. Most of them were pursuing their online education merely to gain new knowledge, update their existing knowledge or to keep pace with the world.

Of the 10 participants, eight were totally blind, while two had low vision; as a result, eight of them were using screen-reading software, while two were using screen-magnifying software. All of the participants had their own computer and Internet connectivity. Most of the participants were located in metropolitan cities like Delhi, Mumbai or Bangalore, while one lived in a small town. Additional information about the participants has been omitted in order to protect their privacy.

Data Collection

The data was collected through the use of an online survey, email interviews and telephone interviews. The online survey was used to collect demographic data, such as age, access to the Internet, educational background, English proficiency, gender and the type of online course enrolled on or completed. The email interview questions were generated on the basis of the survey results and then sent to the participants individually. We asked the participants about their social and technical conditions of learning and any modifications they made for the course. Further, semi-structured interviews were conducted by telephone in order to obtain an in-depth understanding of the participants' perspectives of online learning and their experiences in an online learning environment.

Data Analysis

The research data was analysed in order to understand the participants' learning experiences in an online learning environment, and how their available assistive technology and visual impairment conditions affected their participation in the learning process. The analysis was carried out using multiple methods to code the data. After reading all the notes from the email questionnaires and the telephone interview transcripts, we first used open coding (Creswell, 2003) to mark the participants' opinion with regard to: (a) what kind of tasks they need to perform in online learning; (b) their concerns while performing these tasks; (c) their perceived differences between the online and face-to-face mode in the formal educational set-up; (d) challenges they faced in online learning; and (e) their suggestions for improving the problematic features of e-learning systems for VI learners.

Next, we used a holistic coding approach (Spatariu et al, 2004) in order to analyse the interview transcripts, looking at the most frequently used keywords and key terms (for example, 'challenge', 'frustration', 'accessibility', 'usability', 'technical knowledge' and 'benefits'). Finally, we identified themes related to the research questions and looked for relationships to the key concepts of learning experiences and accessibility and usability conditions as they emerged from the data and as they were associated with the literature reviewed.

Findings

Learning Activities That VI Students Perform

The participants generally did activities related to their studies like any other student without a visual disability. In general, they did study activities daily at home. The minimum they did every

day was connect to the virtual campus to check the communication spaces. If they had more time, they read or listened to the learning content, did project work, converted learning content to audio form to carry with them while commuting, referred to complementary content material, etc.

Most of the students took advantage of different situations to do activities related to their study – for example, they used commuting time to listen to DAISY (Digitally Accessible Information System) materials or MP3s, or to read with the aid of a magnifying glass; used their free time at work to read (with a screen reader or with screen magnifiers, or even with the help of low-vision aids), listen to the learning content, prepare for tests and written assignments, or reply to the forum; and used waiting time to read or listen with a laptop or even a mobile phone to the learning content and take notes on it.

On average, all the participants spent one to two hours daily on their study. All of them had very conducive and supportive home environments to pursue their education. Nevertheless, they had several concerns about their participation in online course activities.

Concerns of VI Students about Participation in Online Learning Tasks

Although all of the participants valued the e-learning mode in online courses, they did mention several concerns about their participation and performance in the online courses. They agreed that the e-learning mode helped them to make available online course notes, work at their own pace, learn from home, get online course materials/resources other than notes, get information anywhere and at any time, feel more independent, save time and money, allow the use of adaptive technology, and be anonymous and reduce social anxiety. At the same time, all of them were not fully satisfied with their participation in the e-learning activities. Some of their reactions are described in what follows.

Eight participants felt that the relationship between students and professors is warmer in face-to-face mode. Three of them missed the actual interactions with classmates and professors in the classroom. One participant mentioned that: 'When I am online, I feel very lonely'. Another mentioned that:

> In this online setting, you say something, either you get some responses and you don't know what are the emotions behind it, or you do not get any response, and what does that mean? ... So, I sometimes decided to have less contributions.

Due to their visual impairment, nine of the participants used to miss the lively nature of the formal classroom (non-verbal cues, movements, actions and the gestures of other students and professors). They used to be very often the silent listeners in the classroom. They were also very rare participants in the discussions and debates that took place in the classroom. As a result of a lack of exposure to active involvement, they tended to remain passive, even during online discussions. As one participant expressed it: 'I was scared, if I say something' and that these people think that 'He is an idiot'.

Very often the VI students felt very much obliged for the help of their sighted peers and professors. As a result, they tended to be submissive and non-argumentative with others. The same behaviour persisted in the online discussion forums or chats, as can be seen in the following reaction of one of the participants: 'One of the main reasons I did not seem to be as active as many other online course students was that I was reluctant to argue with my peers'. This type of reaction may be the result of their previous educational experiences. As mentioned earlier, nine of the participants had completed their graduation through the formal educational mode. Although the tenth participant had completed his graduation through the distance mode, it was not an online course and his undergraduate diploma was done again via the formal mode.

Eight out of the ten participants had pursued their elementary education in vernacular-medium special schools (most often special schools exclusively use the vernacular) and their secondary education, again, in vernacular-medium integrated schools. The lack of adequate proficiency in English also created barriers in their active participation in online activities. For example, one participant said that:

> I again and again spell-check and proofread the messages before posting it on the discussion forum. I am worried that my peers might refuse to work with me in group activities if they judged my English proficiency as poor.

Another participant mentioned that:

> It was difficult for me to understand my peers' postings, especially if informal language, slangs were used, and the language barrier kept me from responding to others' postings. I thought others may not understand what I mean.

But one participant also mentioned something different:

> It was easier to communicate in the online learning environment because, compared with face-to-face courses, the online environment made me feel less stressed or embarrassed when communicating with classmates in English. Here the anonymity helps to hide the identity.

Another set of reactions may not be specifically due to their visual impairment, but can be attributed to the hierarchical, authoritative structure of pedagogy and the transmission approach to teaching and learning in the Indian education system, and VI students are also part of the same system. Here are two examples of such reactions, highlighting further causes of anxiety:

> In our colleges, professors try to push the matter in our brain and here we have to learn on our own. Of course, the moderators, online instructors are there, but we have to wait for their support.

> In our education, we concentrate on exams and test marks, but here we have to take part in discussions, real-time chat, online conferencing, etc. and it is not always possible.

Challenges Associated with the Accessibility and Usability of E-Learning Systems

As mentioned earlier, all the participants used assistive technology (either screen-reading software or screen-enlargement software) to access the e-learning systems. Here arise many challenges with regard to the accessibility of e-learning tools and usability of assistive technology. Of those participants who reported the type of assistive technology they used to access online educational tools, eight reported that they used some type of screen-reading software and two used some type of screen-magnifying software. Of the eight screen-reading-software users, six found its use possible but that it required patience and effort, while two found it to be inconsistent. However, one of the two screen-magnifier-software users found that it was fairly usable and one found it to be difficult and unreliable. The participants showed, therefore, that those using screen-magnifying software were more inclined to have a less successful experience accessing online educational tools than those using screen-reading software.

The main problems they mentioned with regard to screen readers were that it is difficult to interpret graphics (including photographs, drawings and image maps) unless text descriptions are provided. Scanned printed materials, videos, PowerPoint presentations and other visual materials (such as tables, graphs or figures) also created access challenges for them. With regard to screen magnifiers, learners see only a small portion of a web page at a time. Consequently, they become confused when web pages are cluttered and when layouts change from page to page. One participant, who was also colour-blind, could not navigate web pages that required the user to distinguish between colours.

The data in Table I shows that the participants predominantly found the following features of e-learning tools to be problematic: assignments, the real-time chat feature, the discussion board, email, graphics, navigation and videos. Both types of assistive technology users (screen-reading-software users and screen-magnifying-software users) had to face these challenges of the accessibility of e-learning tools and usability of assistive technology to their successful participation in the e-learning process.

Problems	Total number of VI students facing the problem	Screen-reading-software users	Screen-magnifying-software users
Assignments	8	7	1
Real-time chat feature	7	6	1
Colour contrast	1	0	1
Discussion board	6	5	1
Email	5	5	0
Graphics	9	8	1
Videos	9	8	1
Timed graded activities	9	7	2
Training	9	7	2
Navigation	4	3	1
Sighted assistance required	9	8	1
Technical support required	9	8	1

Table I. The problematic features of e-learning tools perceived by the participants.

Apart from the above-mentioned challenges, the participants commented on some concrete problematic instances which really indicated their anxiety, and sometimes even frustration:

Accessing course content.

> Generally, the course coordinators host course content outside of ANGEL on a separate server, with links inside ANGEL pointing to that content. Upon the advice of the instructor, I had set ANGEL to use the accessible view. Still the link to content residing on a different server did not work. I was unsure where to access the course.

Formats of the course materials.

> Very often the textbooks are made available in scanned forms or in text forms which pose problems in accessing the headings, pages, etc.

Assessment.

> The course website hosts learning objectives, chapter quizzes, PowerPoints, web links, and allows the user to customise a profile such that quiz results may be saved by the user and submitted to an instructor. The site content is set up within multiple frames. The VI student like me, navigating the site using the links provided via JAWS [Job Access with Speech], have lots of difficulties obtaining and accessing the files.

Working with learning management system tools.

> In online programmes, we are required to use the learning management system [LMS] to submit various items, and to interact with the instructor and other students. Within the LMS, tools are available such as email, discussion boards, quizzes, drop boxes, a grade book and more. But in the first semester, I was unable to use the email tool within the LMS. But after requesting, they arranged for me and the instructor to communicate via email external to the LMS.

Discussion board.

> I encountered barriers in posting to the discussion boards, but toward the end of the course somehow managed to do so. Through the course my peers must have seen my name for the first time. I could not even access their responses to my posting. Then the online professor forwarded them to me.

Exams.

> The LMS has a window within which it times out, so the exam automatically 'saved' every 15 minutes or so. Each time it saved, I was sent back up to the very top of the exam and needed to

> reorient and navigate back down to the question I had been working on. After working on the exam for three hours, I was too tired and could not even review my answers before submission.

Group work.

> In an activity where group communications were required, I worked alone. I wanted to interact with my peers but somehow could not: 'I want to be like EVERYONE ELSE and not different from them!'

Timed assessments. This was the reaction of one respondent who used screen-magnifying software to access an online educational tool:

> Timed tests were difficult to use for a few reasons. The screen did not magnify very well. It took me a long time to find everything on the screen to read and choose from. By the time everything was read and answered, the time was severely lessened. When I was not being timed, the programme was not as difficult to use because I could take my own time.

Suggestions Given by the Participants

The suggestions given by the participants for how to deal with the most problematic features of online educational tools for people with vision loss are presented below:

- The online course providers should compile the content – lesson by lesson – into individual files, label graphics with alternative text tags and send the files to the student by email, preferably in a Microsoft Word document.
- Chat features and assessments which involve matching are not compatible with the access software. Until this situation is remedied, online learning designers should plan courses so that students only use features that are truly accessible and, in doing so, do not use synchronous chat rooms or assessments that involve matching. Only asynchronous features should be used, as well as assessments that do not involve matching.
- Timed assessments should be given only when necessary. The VI students should be asked to do the timed assignments only if it is really required and even then they should be provided extended time for the submissions of their assignments.
- Online learning designers should use consistent designs, proper headings, fewer frames, contrasting colours and accessible graphics, as well as accessible formats of materials to make the features of online learning tools more accessible for students using assistive technology.
- Instructors should post all materials as Microsoft Word documents and avoid PDF files.
- Instructors should be adequately trained to cater for the online learning challenges of VI students.
- Instructors should ask students to share accessibility concerns so that the instructors can attempt to remedy the concerns.
- Educational programmes should hire consultants to try out any new features or versions in order to try to anticipate problems and solutions.
- Online systems should have regular maintenance and students should be updated about it immediately.
- Assistive technology specialists should be included when educational programmes make decisions about online learning systems.
- Whenever possible, VI online learners should frequently save their work in computer programmes and documents that are independent of the online course. This is in an effort to back up and retrieve work which may get lost due to the inaccessibility of the submission process.
- The direct emailing of assignments, projects and other postings to instructors, rather than from within the email feature of the online educational tools, should be allowed.
- VI students should be well versed in the short-cut keystrokes for certain online educational tools. It will be beneficial for students using access software.
- VI students should keep their access software as up to date as possible, so that the latest updates are available to them.

In spite of several concerns about and challenges they have had to face in the e-learning mode, all the participants considered e-learning to be a great opportunity for their educational development. One participant said very emotionally that: 'This is God's grace that we can get education without depending on others, I feel so empowered. The technology has given us new vision in our dark lives'. All of the participants expressed their desire to pursue their further education through online courses to quench their thirst for knowledge. They also advised other VI youth to try this option to pursue their education and keep pace with the world.

Discussion and Conclusion

Overall, the results of this small case study demonstrate that VI learners are looking at e-learning as an alternative for their educational development. But they do have several concerns which create emotional blocks in their minds against participating confidently in e-learning systems. The accessibility challenges in e-learning tools and the usability limitations of assistive technology further aggravate the situation. The suggestions given by these participants about how best to accommodate for many of the most problematic features of online learning systems should be considered by online course developers. We feel that adhering to these suggestions could give VI students a better chance for successful access with the usable features of online education until the problematic features are remedied by experts. We also feel that adhering to these suggestions could give all students a better opportunity for successful online education experiences. Efforts to remedy the situation should be grounded in bettering the problematic features that prevent full and equal access for VI learners. The technological accessibility barriers are unacceptable in this time of technological prominence, when computers have the capacity to bridge the digital divide.

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