

Empowering Visually Impaired Students through E-Learning at Higher Education: Problems and Solutions

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ABSTRACT: This paper primarily deals with inadequacies in learning environments and services for visually impaired students using ICT in an educational context. It is designed to identify, elucidate problems and raise issues concerning visually challenged students in the course of their post-secondary education through e-learning in Delhi. It considers and illustrates the experience of these students in pursuing higher education through responses in a structured questionnaire. It gives recommendations for designing in e-learning systems to make the education more inclusive. The study confirms that e-learning is a significant opportunity for such students but there are umpteen issues which still need to be addressed as the problems of availability, accessibility in holistic way (technological and pedagogical), efficacy and utility of the system etc. The aspect that is not intricate is the affordability of E-Systems but availability of online e-learning facilities, accessibility of websites, availability of books in all formats, description of pictures along with images, good screen readers for all languages and affordability of original software are some of the problems areas that continue to bother these students. The paper provides some operational suggestions to overcome the same.

Key Words: E-learning, Visual-impairment, Higher Education, Assistive Technology

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I. INTRODUCTION

One of the imperatives of inclusive growth is progressive inclusion of disabled students that is the marginalized section of the society at higher level of education. It is a necessary step to insure full participation and stability in life. In the era of technology enhanced learning, e-learning (online learning, web-based training and technology-delivered instruction) plays a critical role in reducing the learning difficulties and differences of disabled students.

In recent past numerous initiatives have been taken in terms of making the environment disabled friendly such as the provision of elevators, ramps, wheel chair access and support workers. Although these haven't directed to the eradication of digital divide. Some form of impairments such as dyslexia and dyscalculia makes higher education a great challenge for these students. Similarly, people with poor/ no vision till date lack appropriate technologies such as screen readers, magnifiers, etc to access e-content.

It has been noted that students with visual impairments appear to be more disadvantaged than students with other disabilities that puts them at a stumbling position. It calls for the implementation of assistive technologies to facilitate learning by reducing the learning complexities. These assistive technologies do enable disabled people to access e-learning content yet it has still not proved to be completely successful for all. Additionally, these are not always available at low cost. Therefore, these may not be affordable by some disabled students.

Moreover, the designing of learning system doesn't substantially consider the specific needs of disabled students. Hence, we can't take them as disability-aware e-learning systems. Depending on the disability, individuals will need personalized information in specific formats that is one needs to design assistive and adaptive technology to have universal access to knowledge. Therefore, this paper mainly deals with inadequacies in learning environments and services for disabled students especially visually challenged using

ICT in an educational context. Broadly, it examines issues and problems related to disability and e-learning accessibility in a higher education context, highlight the significance of accessibility in a holistic way (technological and pedagogical); explore and describe the experience of students with special education needs in e-learning academic courses and develop recommendations for designing disability-aware e-learning courses from the perspective of visually impaired students which will make the system more inclusive.

After this introductory Section, the present paper is divided into five Sections. Section II provides literature review. Section III presents research objectives. Section IV discusses the research methodology. Section V elaborated on the findings and discussion. Section VI gives an insight on the conclusion and recommendations.

II. LITERATURE REVIEW

Different Scholars have evaluated the issues and problems of disabled students in different countries in recent years. Some of the studies have been briefly reviewed hereunder.

According to Kim-Rupnow, Dowrick and Burke (2001), “during the past decade, there has been tremendous growth in the number of online distance education courses offered by postsecondary institutions. Does this growth imply better access to higher education for individuals with disabilities? They probed individual and institutional case studies identified through a search of Education Resources Information Center (ERIC) and other major databases.” Their findings suggest that distance education has substantially improved the access of disabled for higher education, they would not be have otherwise sought for higher education opportunities.

A survey was conducted by Corn and Wall (2002) on the use of technology and multimedia presentations by 410 teachers of students with visual impairments and observed that their teachers were more comfortable with general technology than with technology designed specifically for visually impaired students. The teachers had tendency to use less complex technical solutions when they adapted traditional materials, even when they were not entirely appropriate. Major recommendations derived from this survey were as follows: (1) Define and disseminate the components of an appropriate assistive technology assessment for students with visual impairments and provide guidelines for conducting these assessments. (2) Make a concerted effort to ensure that all students with visual impairments receive assistive technology assessments. (3) Initiate local, state, and national efforts to ensure that teachers of visually impaired students have opportunities to update their skills in order to access technology smoothly. (4) Identify the basic knowledge and skills in general and access technology that all teachers of visually impaired students must possess. (5) Support efforts to create universal designs in hardware and software. (6) Ensure that students’ use of assistive technology in schools prepares them to use technology in employment or higher education settings. (7) Funding streams ensure that access technology will be available to students on the basis of their assessed needs. (8) Review the impact of the size of caseloads on teachers of visually impaired students and his/her freedom to update their knowledge and skills and provide instruction in the use of access technology. (9) Conduct more narrow studies of the factors that influence the use of technology. (10) Fund research on the efficacy of intervention strategies for increasing the inclusion of students with visual impairments in computer courses, the interaction of these intervention strategies with students’ demographic variables, introduce ways to increase students’ use of access technology and special instruction for independent access to multimedia presentations. Ultimately, authors conclude that books are no longer exclusively black and white, printed on paper, or held in hand, rather now they are composed of electronic images, moving pictures and interactive experiences. Whether students with visual impairments read traditional books with printed words or account multimedia presentations, they need a means to access the information.

Abner and Lahm (2002) surveyed teachers for students with visual impairments in Kentucky. They found, “only half of the students used available technologies despite the fact their teachers had access and used computer based technology themselves but lacked skills to teach their students. It raises the question whether teachers need strong skills in basic technologies applications and assistive technology. It's evident that university training and other professional development programs should address competence in higher level technology”.

Wolfe et al. (2002) described the results of a qualitative study that the teachers do not uniformly provide the quality and quantity of disability-specific services that are deemed appropriate for educating such students based on researchers’ observations of teachers of students with visual impairments, their interaction in the classroom based on the types of training and services being provided to students, inclusive of instruction in areas of disability-specific skills training.

The four focus groups of computer users were studied by Gerber (2003) to understand how blind or visually impaired individuals gather information about assistive technology (AT) and the kind of information-based needs they have. He highlighted the importance of accessibility and usability in crucial concepts for establishing the role of technology in people's lives.

Kinash, Crichton and Kim-Rupnow (2004) reviewed the 2000-2003 literature at the intersection of online learning and disability. They hold an opinion that online learning and disability can be classified into didactic, descriptive, research, and opinion pieces. Two research pieces surveying the literature are examined in their paper. The resonant theme throughout the literature is that if improvements are made in the accessibility of online learning for students with disabilities, it will promote best practices in online learning for all students.

There is no denying the fact that importance of accessibility to digital resources is now widely acknowledged (Kelly et al., 2004). A crucial role has been played by the World Wide Web Consortium Web Accessibility Initiative (W3C WAI) in promoting the importance of accessibility and developing a framework for accessible web resources. Kelly et al. (2004) argue that there is a requirement for a more sophisticated model to address e-learning accessibility that considers 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 integrated model for the development of accessible e-learning resources.

Burgstahler, Corrigan and McCarter (2005) stated that, “the internet opens unparalleled opportunities for people around the globe to gain knowledge and learn new skills. However, some with disabilities can't optimally participate as instructors or students in existing distance learning courses because of the inaccessible design structure of these courses”. The University of Washington (UW) Distance Learning program teamed up with UW Accessible Technology Services and Outreach in a project identified and implemented systemic changes in policies and procedures in order to improve the accessibility of the UW Distance Learning courses. It was found that such changes in policies and procedures made these e-learning programs more accessible and adaptable to students and instructors with disabilities.

A online study was conducted in Canadian colleges and universities by Fichten et al. (2009) and they inspected e-learning problems and solutions reported by 223 students with disabilities, 58 campus disability service providers, 28 professors, and 33 e-learning professionals. Their major findings are, “All the groups indicated problems with – accessibility of websites and course/learning management systems (CMS), accessibility of digital audio and video, time limits built into online exams that are inflexible, PowerPoint/data projection during lectures, course materials in PDF, and adaptive technologies. Students also mentioned technical difficulties while using e-learning and connecting to websites and CMS, problems downloading and opening files, issues with web pages that would not load, video clips that take too long to download, poor use of e-learning by professors and their own lack of knowledge working with e-learning. Disability service providers mentioned the disappointing use of e-learning by professors as well as poor accessibility of course notes and materials in many formats. E-learning professionals noted difficulties with course notes and materials accessibility. Professors primarily identified problems raised by the other groups. Sixty- seven per cent of students, 53% of service providers, 36% of e-learning professionals and 35% of professors indicated that at least one of their three e-learning problems remained unresolved”. The authors discussed how the different roles and perspectives of the four participant groups influenced their views, and addressing identified common e-learning problems recommend training and adopting e-learning accessibility guidelines as possible suggestions. They further cautioned in the end by stating “how is this impacting on the ability of students with disabilities to succeed academically and to compete and participate on a level playing field with their non-disabled peers? Why do problems remain unresolved? Is it the reluctance of institutions to take steps to make accessibility a requirement for professors? Is it poor accessibility of the products produced by e-vendors, such as software developers and book publishers? Or is there a knowledge gap that needs to be closed? These are fundamental questions that postsecondary institutions have a shared responsibility to answer.”

Crow (2008) helped the designers and developers of online learning materials to have better understanding of some of the issues and challenges faced by online learners with disabilities- visual impairments, hearing impairments, motor impairments and cognitive impairments. He discussed the use of assistive technologies and universal designs in order to make online learning materials more accessible.

Fichten et al. (2009) presented the results of two studies on the accessibility of e-learning materials, other information and computer and communication technologies for 143 Canadian college and university students with low vision and 29 who were blind. The results show that, “Most of the problems with e-learning materials reported by the participants remained unresolved, with approximately half the participants in both groups indicating that at least one of their three most prominent problems with e-learning was unsettled. Solving an e-learning problem with a non-e-learning solution (such as a student's husband reading materials aloud), devoting more time and effort and obtaining additional adaptive technologies were also favoured solutions, suggesting that students with visual impairments have a long way to go before they can function independently in an educational environment that uses e-learning materials. This study implies that to support the academic success of students with visual impairments the colleges, universities along with rehabilitating professionals and educators need to identify and assess what training they currently provide to students in the use of computer technologies. They ought to fill any kind of existing gaps especially those pointed out by the students themselves. Students, of course need to be proactive in managing their own learning experiences. They need to

work over certain areas like gather insight on what are the kinds of adaptations that are available to aid them in the usage of e-learning materials effectively, learn to use adaptive technologies that can help them access e-learning materials, request accommodations that they require and ask for assistance. Thus, the authors offer recommendations for enhancing access, creating new learning opportunities and eliminating obstacles by advancing the accessibility of e-learning through universal instructional design and providing needed technology, training to students with visual impairments especially those who are blind. This will result in fewer unresolved accessibility problems. It will also equip students with visual impairments with the skills they need to succeed in an increasingly technology-driven multimedia world”.

A descriptive survey study in public schools in three municipalities of the state of Sao Paulo, Brazil was conducted by Alves et al. (2009) to verify the application of assistive technology especially information technology in the education of blind and low-vision students based on the perceptions of their teachers. The sample comprised 134 teachers. Results reveal that, “according to the teachers' opinion, there are differences in the specificities and applicability of assistive technology for blind and low-vision students for whom specific computer programs are vital. Information technology enhances reading and writing skills, as well as communication with the world on an equal basis thereby enhancing the quality of life and facilitating the learning process. The main reason for not using information technology is the lack of planning courses. The main requirements for the use of information technology in schools are adequate number of computers for all students, advisers to assist and guide the teachers and pedagogical support”.

Kelly and Smith (2011) examined the research literature from 1965 to 2009 on the assistive technology that is used by individuals with visual impairments. They strongly stated that the current body of literature enables the effective use of assistive technology. The authors uncovered and reviewed 256 articles for evidence-based research on assistive technology that had a positive impact on educational performance out of which only 2 provided promising evidence-based practices.

This literature review has been of paramount assistance for us to understand the status and problems in the context of higher education for visually impaired students in a global context.

III. RESEARCH OBJECTIVES

The objectives of the study are:

- To examine availability of the E-learning systems for visually impaired students.
- To check sufficiency of E-learning systems for the visually impaired students.
- To discern efficacy of the E-learning systems for the visually impaired students.
- To judge utility of E-learning systems for visually impaired students.
- To analyze the need to develop appropriate E-learning systems for visually impaired students and make suitable recommendations therefrom.

IV. RESEARCH METHODOLOGY

For the purpose of this exploratory study, higher education means students enrolled at undergraduate or postgraduate courses in colleges of Delhi during 2015-16. Although debatableness exists around the concept of disability but this study focuses only on visually impaired students. Here e learning refers to use of facilities created by educational systems such as university websites, library databases; technology driven instructions through PPT, PDF documents, video conferencing through PCs or mobile phones/tablets etc. A structured questionnaire has been designed with a composition of open ended and close-ended questions. The responses to the questions were filled personally through interaction /online by ten undergraduate students. In all 271 responses were collected through convenient and random sampling. In order to dwell into intricacies of the visually impaired students, interaction with technologists in this field was conducted. Besides, responses were also fetched from some of the visually impaired teachers to get a strong grip of the problem. A special emphasis was placed on the problems of inclusion and integration of e-learning in deliberations with these experts. Simple statistical averages and Microsoft Excel Worksheet have been used for the purposes of analysis and drawing conclusions.

V. FINDINGS AND DISCUSSION

The findings have been discussed in three parts: (i) problems of e-learning systems (ii) suggestions for improving the use of e-learning systems and (iii) comments of technical expert with regard to e-learning at higher education for visually impaired students:

V.1 Problems of E-learning

Table 1: Problems faced by visually challenged students while using e-learning systems

Problems of E-learning	No. of Respondents	Per Cent
1. Lack of Knowledge or Awareness for using e-learning systems /poor understanding of English.	5	1.85
2. Problem of Availability: Non-availability of good screen readers in Hindi or regional languages, Braille books and audio books at higher education, non-coverage of full syllabus in e-text or e-learning sources on internet, lack of facility to understand diagrams, pictures, graphs handwriting, etc.; delay in getting books in desired formats.	181	66.79
3. Problem of Affordability: Costly original software and assistive technology.	6	2.21
4. Problem of Accessibility: Screen readers are not accessible on all the web pages and websites; inaccessibility of Hindi reading software, lack of specially designed accessible websites; inaccessibility of images, graphs, captures, maps, handwriting etc.; lack of voice clarity; hanging of system or software; problems of net connectivity, downloading, convertibility of PDF into text, etc.	153	56.46
5. Problem of Efficacy: Frequent shutting down and hanging of system and screen reader; opening of extra windows; non-functional keys; slowing down of system; fast typing not supported by screen reader; problem of voice clarity and pronunciation, etc.	126	46.49
6. Problem of Sufficiency: Lack of Hindi reading software, short hand supporting software and specially designed e-learning sources.	138	50.92
7. Problem of Utility: Problem of jumping or moving away of cursor; deletion of data; not able to read some symbols; scanned documents are needed to be edited; opening of extra files and then not closing, problems in using PowerPoint especially reading charts, pictures, images, graphs, etc.; inability to use camera in laptops and mobiles; problems in downloading music, on-line shopping, creating email-id, filling on line forms and so on.	175	64.58

Various problems related to e-learning systems encountered by visually challenged students are listed in Table

1. The details of the findings are discussed as under:

1. **Lack of Knowledge or Awareness Problem:** A very few of the students (1.85 per cent) responded that they lack knowledge to use e-learning systems for education. Moreover, even if they are aware of e-learning systems, some of the students are not able to comprehend because of poor understanding of English.

2. **Problem of Availability:** Nearly two-thirds of the students' highlighted problem of availability. Though many screen reading software, i.e., JAWS, NVDA, Eloquence, etc. are available for English but good software for Hindi and other regional languages is not available. Even if available, i.e., SAFA for Hindi does not prove to be a very good solution. No solution is available to describe pictures and images. Moreover, no software is available to read handwriting. Sometimes, e-text and audio books are not available in time. Even required content is often missing. At higher education, limited braille books are available and e-text and audio books are not available in a very clear voice. Non-availability of notes in Hindi also poses a serious problem. Neither full course nor syllabus is available in e-text or audio books form nor is college study material provided in e-text. Reading portal do not support hand written material. Moreover, conversion process of books into desired format takes a long time. Though, JAWS is generally used but JAWS is not foolproof.

3. **Problem of Affordability:** Around two per cent of the students find original softwares such as screen readers, anti-virus softwares too costly to be bought and hence, have to use pirated versions. In general, the software which are affordable can meet only basic requirements.

4. **Problem of Accessibility:** More than half of the respondents stated that screen readers like JAWS are not accessible on all the websites. Border of the pages are left unread by the screen readers. The entire text is not accessible in word, PDF and DAISY. They also complained that PDF to text converter is not accessible for most of them. Further, they find it difficult to convert PDF into audio. Hindi and regional languages are not still properly accessible by the screen reading software. Moreover, screenshots, maps, graphs, captures and images are still inaccessible for them. In the words of one of the participants, "JAWS is not able to read everything, SAFA is not easily accessible, SAFA cannot read properly and graphs and pictures cannot be read". Voice clarity, hanging of the system and software, virus and net connectivity are the other operational problems in

downloading or accessibility of study material. Moreover, difficulty of accessibility has been stated with regard to size of digital content also. There is no particular website specially meant for them.

5. Problem of Efficacy: Nearly half of the students complained of shutting down of the systems while working and they are not able to know the reason. At times, system hangs because of incompetent screen readers. Sometimes screen readers do not speak; extra windows are opened that hamper the speed and becomes difficult to manage. Occasionally, while writing shift key does not work. Poor voice quality, language quality and pronunciation of the screen readers are other problems. JAWS does not support fast typing and commits error. Eloquence cannot read UC browser. Websites are not designed as per UNO guidelines that also curbs efficient use of internet by screen readers.

6. Problem of Sufficiency: Around half of the students complained that sufficient screen readers are not available for Hindi and regional languages. Hindi needs good software. JAWS is not meant for Hindi. SAFA that is meant for Hindi hangs and voice is also not clear. While typing, one does not know what is being written. Short hand supporting software is required. Specially designed e-learning sources are not known or available.

7. Problem of Utility: Nearly two-thirds of the students are facing problems in using E-Systems while working on systems with the help of screen readers; cursor moves away from its place while typing. Accidentally, data gets deleted sometimes. Pictures are not read by screen readers. While working on EXCEL, formula signs get dropped. Signs like \$, -, +, () etc. are not read by the software and taking it as blank. When content is converted into e-text through scanning; some characters are removed in the document. It needs to be edited by some sighted person as a visually disabled cannot do it on his own. Audio books often hang and going back to pages becomes difficult. Hanging of JAWS or other software, low battery and voice clarity also pose problems. Software like JAWS does not read every website and is difficult to use. These students cannot identify which photo is displayed. This software even does not read content of pictures. It is difficult to use camera in laptops, mobiles or computers for visually disabled students. Scrolling is also found to be tough by some of them. They are not able to operate mouse. Color recognition on word files is another issue for them. There are problems with downloading as many options open and files are saved at wrong or unwanted place. There is a problem in creating an ID account on a social networking site or filling an online form as it needs diagrammatic check for authentication. JAWS and other screen readers cannot read it and make logging a difficult task.

In spite of the many problems identified by the respondents, e-learning has made higher education possible for visually impaired students

V.2 Suggestions for overcoming the problems of E-learning

Table 2: Suggestions to overcome problems of using E-Learning systems

Suggestions	Number of Respondents	Per Cent
Availability: Improved systems and screen readers specially for Hindi and regional languages; image description; software to understand handwriting; availability of the on-line study material, e-texts, audio books and braille books; 24 hours helpline; specially designed websites; Bluetooth in every device; efficient scanners, keyboards operated devices and long-term antivirus.	195	71.96
Affordability: Screen readers and other disabled friendly softwares, e-learning devices and free registration	7	2.58
Accessibility: Voice clarity; MS Access friendly JAWS, photographs and diagrams, certificates reading, dragging and dropping pictures; improved websites; e-portals compatible in Hindi; e-books in national library for disabled; participation of disabled in designing e-learning systems; etc.	201	74.91
Efficacy: screen readers with Voice clarity; multi-lingual facility; correct pronunciation; fast speed; picture description and work without hanging; devices with good battery life; cursor setting; etc.	201	74.91
Utility: easy download and convenient use of e-learning systems; preparing PowerPoint presentations, pictures and diagrams with readable captions, photo recognition; creating email id and filling on-line forms, guide to use camera; language translation; easy and short ways of reading taking care of punctuations; guidelines for usage and content development following W3C web content guidelines; section for users' feedback, provision for catering demand for books, government investment in content creation digital libraries in Universities.	235	86.72
Training for E-learning: Government literacy programs, extensive one to one sessions both tailor made and demand based tutorials and face to face sessions.	34	12.55

The respondents gave the following suggestions for solving the problems related to e-learning at higher education as discussed in Table 2.

1. Making Technology Available: More than seven-tenths of the participants have suggested to upgrade technology. Some of the respondents are in favor of removing mouse for blind as it obstructs typing and learning process. While others suggest that mouse should have a speaker to facilitate the working. Software to understand handwriting is also demanded. Improvement in JAWS is also suggested, as it is the only one widely known. Need more primary software apart from JAWS, that is, alternative of JAWS should be available in attractive and clear voice with perfection which does not stuck-up. Audio should be available to describe the images. A way to read and understand diagrams is needed to be developed. Moreover, software for Hindi and other regional languages like Sanskrit should be developed which helps in downloading and has voice clarity. It also suggested that all the academic material should be in e-text format and available on-line. At last but not least, a 24 hours helpline should be made available for visually challenged students using e-learning systems. One of the respondent said, "I would help in making 24 hours helpline which solves the problems of the students while studying content through these E-learning Systems". This is needed along with better technology and better user interface; it has been suggested to check information available at different sources so that nothing is missed in e-learning systems. Some special websites for visually impaired persons should be developed. Blue tooth should be installed in every device. Anti-virus should be provided for a long period of time.

2. Affordability: Affordability does not seem to pose a serious problem as they use pirated versions. Further, registration if required for use should not be chargeable.

3. Accessibility: Nearly three-fourths of the participants have suggested to improve accessibility. They demand voice clarity. For others, accessibility of JAWS with MS Access should be ensured. Photograph description should be made better. Facility of graphical pronunciation, certificates reading software is required. They should be able to drag and drop pictures on their own. Visual-graphics should be added in description by software to make it more understandable. Capture codes of some websites should be improved for use. Images should be described on e-learning portals. Moreover, search information should be accessible in Hindi language on web pages. All the websites should be accessible that is, screen readers should be 100% accessible on all the websites and internet content. Material available in PDF form should be specially made accessible on websites. Designing of e-learning systems should include suggestions and test by disabled people. Provision of national library for all the books should also be made. Books published should be sold in soft copies for visually impaired. Hindi books should be converted into e-text and SAFA software for Hindi should be upgraded.

4. Efficacy: Similarly, three-fourths of the students call for improving the efficiency and effectiveness of e-learning Systems. For efficient use of e-learning, respondents suggest that software like JAWS should work without hanging with clarity of voice and correct pronunciation. Cursor should not move away from appropriate place. Devices should have good battery life. Hindi and Internet adaptability of screen readers should be increased with accuracy. E-learning systems should be more user friendly. Software should have fast speed with ease of access. It should not only be accessible but be ready to use and not keep the users waiting. Thus, any screen reader should have facility of voice clarity, impeccable speaking quality, multi-lingual and picture readability.

5. Utility: There is a strong demand for enhancing the usefulness of e-learning systems as around nine-tenths of the participants have provided suggestions to improve its utility. They suggest that software should be easy to understand and use. Screen readers should be able to read all the languages and facilitate putting up graphs, pictures, etc. and easy use of PowerPoint presentations. Every photo that comes on screen must have a caption which can be read by JAWS or any other screen reader. Creating an email id and filling an on-line form should be made easy. Proper guidance for use of application such as camera should be there. A way should be devised to explain diagram in e-learning system for better visualization. Language translation should be there and graphs and diagrams should be readable. Large text in text books will be helpful for students with low-vision. Easiest ways, short ways, voice clarity and punctuation should be taken care of by the screen readers, as flow is not good when it comes to commas and full stops. Facility to read e-newspaper should be improved. Provision of easy download by system is also suggested. All the books in e-format and photo recognition facility should be there. Audio-video, every format should be readable by the system. E-text should be fully covered and facility of switching from English to Hindi medium should be there on E-Systems. They also suggest to have proper guidelines for usage, to follow WC3 web content guidelines, to have Section for user feedback and provision for catering to User demand for books. Moreover, Government investment in content creation and digital Libraries in University and colleges have been some other important suggestions.

6. Training for E-learning: Not more than one-eighth of the students feel that there is need of training for e-learning. They advocate government literacy programs to learn about e-learning systems. Tailor made and demands based sessions are suggested to help visually challenged students to overcome the hindrances in learning. Some of them have demanded tutorials and face-to-face sessions to improve their understanding. Thus, number of suggestions has been made by participants to facilitate better learning through E-Systems.

V.3 Comments of Technical Expert

When the problems and suggestions stated by the visually challenged students were discussed with technical expert, Mr. Prashant Ranjan Verma¹; some observations and clarifications were put forth:

1. Statements like JAWS does not read x or y is wrong. The problem is not in the screen reader like JAWS or NVDA but in the documents or websites. Most of the digital publications are not prepared as per international standards.
2. JAWS does not read picture or handwriting, etc. JAWS or for that matter any other screen reader is not supposed to read graphical content. The people who prepare the content should provide image descriptions in text.
3. SAFA is too old and has been shelved. It is better to use the generic word Screen Reader and when needed mention examples - JAWS, NVDA and SAFA
4. Problems like system hangs because of JAWS have been wrongly mentioned. The fact is that JAWS or other screen readers do not cause these problems. When the computer is not in perfect working condition, these issues occur. Many such issues are because of lack of operational knowledge about computers.

Therefore, the problems should be classified in the following four categories:

1. Kit

The blind students do not have the appropriate equipment and the technology to read e-Learning material. This includes lack of TTS (computer voice) in Indian languages, high cost of computer / smart phone, no software to scan Hindi or Indian language, lack of tools to read and write maths and science content, etc.

2. Content

The reading material is not available in formats that are easy to read for the blind e.g. eBook or audio book. This problem includes the lack of books in digital format. Some books are in digital format but not in Unicode font which makes it incompatible with screen reading software.

The book conversion process takes lot of time and books are received very late by the blind. Many organizations that create digital books for the blind do not maintain good quality - this includes the mistakes in text, audio quality, etc.

3. Confidence

The blind learners do not have sufficient training and knowledge to use e-Learning content and tools. Because of this they are not able to use computers, smart phones and eBook readers with confidence. They make mistakes but take it as incompetence/inadequacy of the system. This problem is due to lack of training centers for the blind and also because they are not provided technology training at an early age - in school.

4. Carrier

There is a lack of distribution channels for e-Learning material. There is no online library or a single repository of all books. Students have to search for books at different places. Books cannot be easily transferred to devices available with students - for example book is on CD but student has a smart phone to read books and not computer. Moreover, internet connectivity and speeds are insufficient.

VI. CONCLUSION AND RECOMMENDATIONS

The present paper aimed at identifying problems in dissemination of knowledge to students in higher education through e-learning and locating some plausible solutions for these. Though e-learning has become a blessing for visually impaired students at higher education level, it is at the same time plagued with problems of availability, accessibility, efficacy, sufficiency and utility of e-learning systems

The technical experts have observed that most of the problems faced by these students are only due to lack of knowledge or proper training, i.e., for example moving away of cursor from appropriate place can be resolved by a simple key board command by deactivating mouse pad while typing. Lack of on-line e-learning sources, better accessibility of websites, availability of books in all formats, description of pictures and images, good screen readers for Hindi and other regional languages, lack of knowledge or proper training, affordability of original software are some of the examples of problems which are still needed to be addressed. Some operational suggestions have been drawn from the aforesaid analysis, which if acted upon may facilitate better e-learning:

- Government literacy programs for e-learning of visually impaired students are desirable at all levels of education, i.e., primary to post-secondary. Proper training will help in minimizing problems of accessibility, utility and efficacy to an extent.
- It must be made mandatory to design websites in accordance with international standards so that screen reader users are benefitted.
- All the books must be available in all the digital formats to facilitate e-learning for students. For this, creating on-line libraries should strengthen distribution channel for e-learning material and setting up institutions to

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convert books in e-text, audio books and braille books, which should be available at one single repository. Moreover, specially designed e-learning sources are also needed to be developed.

- It should be made legal to create digital books in Unicode font to support screen readers.
- Testing of e-learning systems should be done by the disabled to make the system more effective. The website should also be able to take the feedback from these users.
- Some quality norms must be prescribed for the institutions already engaged in book conversion process, i.e., proper editing after scanning the book and maintaining audio quality. Moreover, provisions for making the book available in desired format in reasonable time are also needed.
- Provision of twenty-four hours helpline for visually impaired students should be made to bridge the gap of inadequate training and resolve their queries at hand.
- Screen readers in Indian voice and software compatible to Indian languages are needed to be designed.
- Technology facilitating visually impaired students should be available to them at reasonable price so that they are not required to use pirated versions and.
- Proper description of the images, graphs, diagrams, photographs etc. should be provided while preparing e-learning material.

Let us realize the visually impaired students are equal citizens of India and enjoy equal rights to education. They are an invaluable resource, which has made spectacular contribution in various fields. At the same time, they are a disadvantaged group. We have to go an extra mile to create an appropriate infrastructure, which facilitates overcoming impediments in their way. Provision of modern amenities in education to them should be accepted as national duty and a challenge.

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