ICT as a Tool for Teaching and Learning in Respect of Learner with Disability

By

M.P.Mishra
Assistant Professor, School of Computer and Information Sciences
Indira Gandhi National Open University, New Delhi, INDIA
Email: mpmishra@ignou.ac.in,

Vinay Kumar Sharma, MCA Candidate
School of Computer and Information Sciences
Indira Gandhi National Open University, New Delhi, INDIA
Email: mca.vsharma@gmail.com,
and
R.C.Tripathi
Assistant Professor, SIMS, Ghaziabad, INDIA
Email: ramesh_c_tripathi@yahoo.co.in

Theme: Social Justice
Sub Theme: Education & Employment of Persons with Disabilities

1. Introduction

The ICT stands for Information and Communication Technologies and is defined as a *"Diverse set of Technological tools and resources used to communicate, and to create, disseminate, store and manage information"* **[9].** ICT has become a very important part of the educational delivery and management processes. ICT to a great extent facilitates the acquisition and absorption of knowledge, and hence can provide extraordinary opportunities to developing countries for enhancing their educational systems particularly for the *underprivileged constituency*, and thereby for raising the level of quality of life of their people. The new communications technologies promise to reduce the sense of isolation, and open access to knowledge in ways unthinkable, not long ago.

ICT is changing processes of teaching and learning by adding elements of vitality to learning environments including virtual environments for the purpose. New technologies make it possible for complicated collaborative activities of teaching and learning by dividing it in space and time, with seamless connectivity between them. Due to its capability to offer anytime and anywhere, access to remote learning resources, ICT is a potentially powerful tool for offering educational opportunities, both to previously underserved constituencies including persons with disabilities, as well as all others who for reasons of cost or because of time constraints are unable to register for on campus programs.

The new digital ICT is not single technology but combination of hardware, software, multimedia, and delivery systems. Today, ICT in education encompasses a great range of rapidly evolving technologies such as desktop, notebook, and handheld computers, digital cameras, local area networking, Bluetooth, the Internet, cloud computing, the World Wide Web, streaming, and DVDs; and applications such as word processors, spreadsheets, tutorials, simulations, email, digital libraries, computer-mediated conferencing, videoconferencing, virtual environment, simulator, emulator etc. It is important to mention that t use of newer ICT is being integrated with use of older technologies, enabling the existing resources and services to be continuous use.

Today ICT is being used as a tool for improving the quality of life by improved efficiency and enhanced effectiveness. Different types of ICT tools assist the people with disabilities by providing them with learning opportunities, capabilities and also increase potential of the disabled in different walks of life. ICT makes them capable by providing the ability to access knowledge with the help of suitable digital media. ICT is playing very important role in communicating with peers, thereby promoting collaborative and social learning environment. ICT also helps disabled students in reading, writing, hearing and seeing process [10].

ICT is proving very effective in delivering learning to the disabled. An illustrious example in this respect is that of Stephen Hawking, the world renowned astrophysicist, who cannot even move any of his limbs and hardly can utter some words, contributing significantly at the highest level to the world of knowledge and research. It became possible due to the ICT device developed for him to communicate his ideas to the world.

Till the recent past, the usual interface between an assistive device and an ICT system was hard wired. With the development in wireless systems, now the potential for new types of communication services which may assist different kind of disabled are emerging. For example, disabled people may communicate to applications using wireless devices for locating (for blind) and communicating with the terminals. Developments in infrared links make it feasible for a disabled user to have a hand control unit with an infrared link to the terminal.

In this paper we will explore the accessibility problems faced by different types of disabled learners and the solutions provided by ICT for them. From this point onward we have used word *learner* and *student* interchangeably.

This paper is organized as follows. Section 2 mentions about different types of disabled learners and use of ICT for assisting their learning. Section 3 briefly explains about W3C accessibility recommendations. Section 4 introduces some applications for assisting different types of disabled. Section 5 brief about the gap between state of art technologies and the required ones to make effective the learning process for disabled. Finally section 6 concludes the paper.

2. Types of Disability and ICT

The word *disability* indicates human limitation of one kind or other, in performing various tasks performed by other human being in general. It may be one or more of the kind of physical, mental or sensory one including visual and hearing. Generally people with disability automatically become underprivileged, because they may not have proper access to the recourses, accessible otherwise. Persons with disabilities include those who have long-term physical, mental, intellectual or sensory impairments, which, in interaction with various barriers, may hinder their full and effective participation in society on an equal basis with others.

2.1 Types of Disability

Disability as shown in figure 1, is generally seen as one or more of the types as given below:

Vision Impairments: The term "vision impairment" is used to describe many degrees of vision loss, such as low vision, legally blind, and totally blind.

Hearing Impairments: Hearing impairments vary greatly from mild hearing loss to deep deafness. The term "hard-of-hearing" describes those who have mild to moderate hearing loss. People with hearing impairments are generally dependent on visual cues for communication.

Physical Impairments: The term "Physical impairments" is used to describe numerous disabling conditions which affect movement and functioning of limbs. Physical   impairment includes cerebral palsy, loss of limbs, arthritis etc.

Cognitive Impairments: It is used to describe those conditions that affect, or appear to affect, the mental and/or physical development of individuals. Also it is known as "developmental disability" and includes mental retardation, cerebral palsy, autism epilepsy, and learning disability. A learning disability, as defined by the National Center for Learning Disabilities [24] is *"a neurological disorder that interferes with a person's ability to store, process, or produce information, and creates a "gap"* between one's ability and performance. Dyslexia is one example of a learning disability. The characteristics of dyslexia may include severe difficulty in remembering a printed word or symbol, improper letter sequencing or reversal of letters, unusual spelling errors, and illegible handwriting. Individuals with learning disabilities can learn; however, they need to be taught in a variety of ways that allows them to use their abilities to compensate for their weaknesses. This is one reason why it is important to incorporate hands-on activities including computer game and simulated learning environment using ICT.
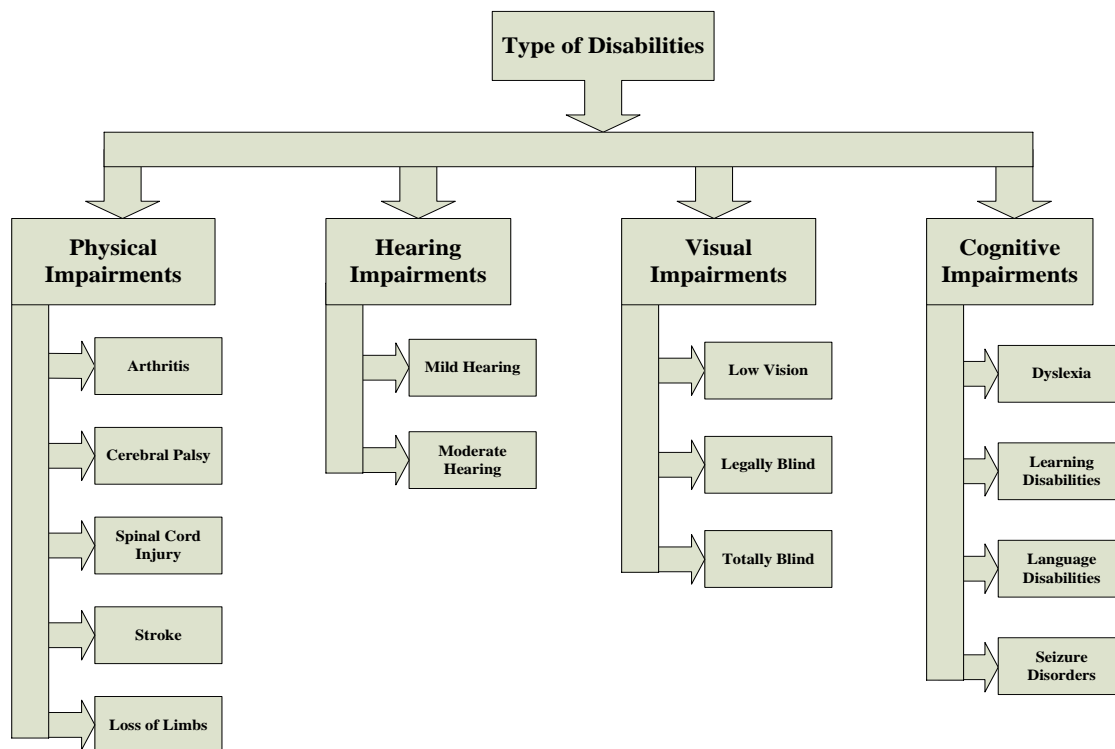
Figure1: Types of Tools for Disabilities

2.2 Difficulties of Disabled in using ICT

Due to different kind of limitations , disabled people may not be able to use ICT applications and devices with ease , as it may be used by others. Some of the difficulties which are generally faced by different types of a disabled are:

- A physical impaired user may have difficulties in using input devices.
- A visual impaired user may have difficulties in seeing display devices.
- A hearing impaired user may have difficulties in hearing audio information.

- A person with learning/cognitive disability may have problem in understanding system operations.

To solve above mentioned problems assistive technologies are used. Assistive technologies usually refer to those products, devices or equipment's, which are used to increase or improve the functional capacities of individuals with disabilities. Some of the assistive technologies such as touch screen interface can be beneficial to those who have difficulty in *using input devices* such as a mouse or keyboard. When it is used in combination with software such as on-screen keyboards, or other assistive technology, they make computing facility more accessible to people who are having difficulty in using computers. ICT usually improves the efficiency and effectiveness of a common individual learner, but for a disabled learner it represents more than this. ICT for them is a sort of extension of their physical body part and provides an opportunity to communicate, gain access to education services and become gainfully employed.

2.3 How Can ICT Help to Disabled in Learning

ICT have the potential for reducing discrimination and providing more opportunities to engage people with disabilities in all aspects of life including teaching and learning. ICT offers a range of specialized software and hardware solutions for communicating, accessing and inputting data/information to/from web applications. Following are some of the ICT tools/applications for assisting different kind of disabled learners:

- ICT bases specialized vocational training to perform functions within abilities
- Specialized Keyboards, such as Braille
- Braille Printer
- Conversion of local language to Braille
- Screen Readers
- Touch Screens
- Eye Tracking
- Talking word processors
- Screen Magnifiers

2. Accessibility and W3C Recommendations:

Accessibility is the quality of a system that makes it easy to learn, easy to use, easy to remember, error tolerant, and subjectively pleasing. [**12**]. Content and tools included in the LMS should also be accessible, i.e., that people with disabilities should be able to use and access all the information provided for the learning experience, regardless of the type or degree of disability they suffer.

Web Accessibility Initiative (WAI) guidelines are the result of the negotiations that the World Wide Web Consortium (W3C) adopted for promoting the use of ICT for people with disabilities. These guidelines are published and broadly used guidelines for W3C Web Accessibility Initiative [14].

Web Content Accessibility Guidelines (WCAG) 2.0 has given wide range of recommendations for making Web content more accessible to a wider range of people with disabilities, including blindness and low vision, deafness and hearing loss, learning disabilities, cognitive limitations, limited movement, speech disabilities, photosensitivity and combinations of these web applications developed using these guidelines often make Web content more usable to users in general. Web Content Accessibility Guidelines 2.0. (WCAG) explains in detail how to make a Web site accessible for people with a variety of disabilities some of the key points of WCAG2.0 are:

- Provide text alternatives for any non-text content

- Provide alternatives for time-based media.
- Create content that can be presented in different ways without losing information or structure.
- Make it easier for users to see and hear.
- Make all functionality available from a keyboard.
- Provide users enough time to read and use content.
- Make text content readable and understandable.
- Help users avoid and correct mistakes.
- Maximize compatibility with current and future user agents, including assistive technologies.

User Agent Accessibility Guidelines (UAAG) 2.0 [15] for software developers, explains how to make accessible browsers, multimedia players, and assistive technologies that interface with these.

4. Some Assistive Technologies Software:

Assistive technologies are used for helping the disable people for studying and gaining knowledge with the ICT; we briefly discuss abut some of the softwares used by different types of disabled people including physically impaired, visually impaired and hearing impaired.

Window-Eyes [16] is one of the most established and powerful screen reader tools available today. This tool gives total control over what you hear and how you hear it. It also provides enhanced Braille support. Window-Eyes provides key to opening the doors of unlimited information, to the visually impaired. Window-Eye application converts components of the Windows operating system into synthesized speech, allowing for complete and total access to Windows based computer systems to the visually impaired. Window-Eyes integrated into Windows provides seamless instant access to the operating system without having to learn a complicated set of keystrokes.

JAWS [17] is a powerful accessibility solution for visually impaired, that reads information on computer screen using synthesized speech. It provides many useful commands that make it easier to use programs, edit documents, and read Web pages. With a refreshable braille display, JAWS can also provide braille output in addition to, or instead of, speech. JAWS cab be customized as per individual needs and preferences.

TOBII Eye Tracking System [18] is a specialized eye tracking and eye control technology. This technology makes it possible for computer to know exactly where users are looking. Tobii's eye tracking technology work on principles of advanced image processing of a person's face, by using eyes and reflections in the eyes of near-infrared reference lights to accurately estimates the 3D position in space of each eye. It finds the precise target to which each eye gaze is directed towards. It is a fully automatic eye tracking technology with high tracking accuracy and tolerance of head-motion.

ICommunicator [19] is an assistive tool for the people with hearing impairments. It assists in dependent communication for persons who are deaf or hard-of-hearing .It translates contents in real-time, like Speech to Text, Speech/Text to Video Sign-Language and Speech/Text to Computer Generated Voice. Content once translated can be used by the user for obtaining definitions, synonyms and antonyms, with the help of inbuilt dictionary in the system.

Head-Mouse Extreme [20] is an innovative solution for wireless head-pointing on personal computers, Macintosh systems, and Alternative and Augmentative Communication (AAC) devices. The Head-Mouse

Extreme replaces the standard computer mouse for people who cannot use or have limited use of their hands when controlling a computer or augmentative communication devices. The Head-Mouse translates natural movements of a user's head into directly proportional movements of the computer mouse pointer. The Head-Mouse has a wireless optical sensor which tracks a tiny disposable target that is conveniently placed on the user's forehead, glasses, hat, etc. It works just like a computer mouse, with the mouse pointer being moved by the motion of the users head. It is very useful for disabled suffering with arthritis, spinal cord injury as well.

Math Daisy [21] [22] is an application developed for making math accessible to the student with disabilities. It enables us to save documents in the DAISY Digital Talking Book format with accessible math. The students can use Math Player™-enabled DAISY player software to read classroom materials in the manner that suits to the disabled learners.

Text Help System [23] provides literacy software solutions. This software is developed to help struggling readers and writers, those with literacy difficulties, learning disabilities such as dyslexia, mild visual impairments, and also those for whom English is a second language. It helps to improve users reading, writing and research skills at school, in the workplace, and at home.

5. Scope for Future Development in Disabled Friendly ICT

Despite all the progress in the designing and development in the area of assistive technologies, the growth in technological development and use of ICT at different levels including teaching and learning, for assisting disabled still suffers from limitations.

5.1 Limitations in Using ICT for Disabled

- Lack of specialized disabled friendly teacher training
- Limited flexibility in training options for people with disability
- Limited availability of specialized disabled friendly hardware and software resources, due to business constrains
- Lack of formal involvement of the government organizations and support structure for ICT for the disabled
- Attitude barriers towards people with disability
- Lack of appropriate disabled friendly policies and their implementation
- Limitation of finances

5.2 Recommendations for Improvement

Below are some recommendations which we strongly believe that, if taken care of, while suggesting, planning, using, developing tools, applications and infrastructure for people with disability, will have impact in imparting assistive teaching and learning**:**

- Improvement of networking facilities to allow more effective co-operation between institutions and telecentres to assist all types of disabled people using online network.
- Adaptation of standard software to the needs of learners with intellectual impairment.
- Creation of virtual environment for supporting different types of disabled learners
- Customization of workspace setup to fit a wheelchair
- Development of user-friendly multiple types of user interfaces for the same devise\application for facilitating different types of disables , to increase their ability to use the services

- Making of people with disabilities as part of the decision making and planning effort alongside disability experts in projects related to disabled users
- Making tools used by disabled, to create, check and validate educational content , in such a way so that it should be accessible for teachers and system administrators with disabilities
- Providing consistency in the layout of keypads at least for blind learners
- Enabling hearing impaired person with access to audio output with proper volume control
- Advocating and supporting of more open source applications development for people with disabilities.

6. Conclusion

ICT means new digital technologies (hardware and software) and of course new hope for people with disabilities for their teaching and learning. ICTs can be a powerful tool in supporting education and inclusiveness of the people with disability. The learning resources must be developed to meet the requirements of all disabled people by overcoming the traditional barriers to mobility and geographic distance. Designers and developer of ICT applications do not have to forget usability, and must adhere to the conformance all accessibility guidelines in their applications.

Acknowledgements

References

1. Becky Gibson, "*Enabling an Accessible Web 2.0*", ACM International Conference Proceedings of the international cross-disciplinary conference on Web accessibility (W4A), 2007, Vol. 225.
2. Rehema Baguma, Jude T. Lubega, "*A web design framework for improved accessibility for people with disabilities (WDFAD)*", ACM International Conference Proceedings of the International cross-disciplinary conference on Web accessibility (W4A), 2008, Vol. 317.
3. Luis Anido-Rifón, "Accessibility and Supporting Technologies in M-Learning Standardization", Proceedings of the Third International Conference on Systems, 2008.
4. "*Software for people with disability*", http://www.e-bility.com/links/software.php Last Visited on 22-06-2010
5. I4D Magazine "*ICT for disabled*", http://www.i4donline.net/download.asp?id=nov06/nov06.pdf, Last visited on 15-07-2010
6. "*The Type of Disabilities*", http://www.parks.ca.gov/pages/735/files/AVW-02-Types%20of%20Disabilities.pdf, visited on 04th August 2010
7. Microsoft Accessibility Technology for Everyone "*Types of Assistive Technology Products*" http://www.microsoft.com/enable/at/types.aspx, Last Retrieved on 20-06-2010.
8. RNIB Digital Accessibility, "*Assistive Technology*", http://www.tiresias.org/accessible_ict/at.htm#cognitive, last visited on 15-06-2010.
9. Blurton, C.; "*New Directions of ICT-Use in Education*", http://www.unesco.org/education/educprog/lwf/dl/edict.pdf; UNESCO World Communication and Information Report,1999,Last Visited on 11-06-2010
10. Lasa Information Systems Team, "*Making Computers Accessible for Disabled People*", http://www.ictknowledgebase.org.uk/computeraccessibilitytips, Last visited on 20-07-2010.
11. Dr M V Ananthakrishnan, "*ICT tools for Disabled and Underprivileged*", http://www.i4donline.net/articles/currentarticle.asp?articleid=1809&typ=Features, Last Visited on 07-06-2010.
12. Jakob Nielsen's Website, "*Usable Information Technology*", http: //www.useit.com, Last Visited on 23-07-2010.
13. Leporini, B., Paternò, F., "*Criteria for Usability of Accessible Web Sites*", Proceedings 4th Edition User Interface for All, Springer Verlag
14. W3C, "*Web Accessibility Initiative*", http://www.w3c.org/wai, last visited on 17-06-2010.
15. W3C, "*User Agent Accessibility Guidelines 2.0*", http://www.w3.org/TR/UAAG20, last visited on 17-06-2010.
16. GW-Micro, "*Window-Eyes*", http://www.gwmicro.com/Window-Eyes/, last visited on 06-07-2010.
17. Freedom Scientific, "*JAWS*", http://www.freedomscientific.com/jaws-hq.asp, last visited on 06-07-2010.
18. Tobli Technology, "*TOBII EYE TRACKING*", http://www.tobii.com/corporate/eye_ tracking/our_technology.asp, last visited on 07-07-2010.
19. ICommunicator, "*ICommunicator*", http://www.icommunicator.com/productinfo/, last visited on 07-07-2010.
20. Origin Instruments, "*Head-Mouse® Extreme*", http://orin.com/access/headmouse/index.htm, last visited on 10-07-2010.

21. Design Science, "*Math Daisy*", http://www.dessci.com/en/products/mathdaisy/default.htm, last visited on 15-07-2010.
22. Design Science, "*Math Daisy*", http://www.dessci.com/en/support/mathdaisy/tsn/tsnmd01.htm, last visited on 15-07-2010.
23. Text Help Systems Ltd., "*TextHelp System*", http://www.texthelp.com/, visited on 11-07-2010.
24. "National *Center for Learning Disabilities*" , http://www.ncld.org/, last visited on 27-06-2010.
25. Mari Luz Guenaga, Dominique Burger and Javier Oliver, *"Accessibility for e-Learning Environments*", Computer Helping People with Special Needs, Lecture Notes in Computer Science, Volume 3118/2004, 626, 2004.
26. José Luis González, Marcelino J. Cabrera and Francisco L. Gutiérrez, "*Using Videogames in Special Education*" Computer Aided System Theory-EUROCAST, Lecture Notes in Computer Science, Volume 4739/2007, 360-367, 2007.