Use of Assistive Technology in Inclusive Education: Making Room for Diverse Learning Needs

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Introduction

The concept of inclusive education has brought with itself the much needed share of equality in approach for the education of the 'disabled' by giving them a leveled field to rightly exhibit their differential abilities, proving themselves capable enough to learn and perform together, at par with their non-disabled peers. And with this shift in approach, there also emerges the need and challenge to tailor the teaching strategies or the means of instructional delivery in the inclusive classrooms, to address the diverse learning needs of all learners in an equitable manner. Acknowledging the capabilities or 'differential abilities' of all learners, the education of children with special needs in inclusive schools becomes more of a shared responsibility between the different stakeholders involved (Ahmad, 2015a; Praisner, 2003); demanding a shift in attitude, availability and accessibility of infrastructure, pedagogy, need-based methods and materials for instructional delivery, assessment and evaluation; and the much evident issue of acceptance and accommodation at all levels in the education system (Ahmad, 2014; 2015b; Stainback and Stainback, 1984). Addressing the individual learning needs of all children, youth and adults, with a specific focus on those vulnerable to marginalization and exclusion; inclusive education as an approach implies all learners, with or without disabilities, to be able to learn together through access to common pre-school provisions, schools and community educational setting with an appropriate network of support services, which can be possible only in a flexible education system that assimilates the needs of diverse learners and adapts itself to meet these needs, ensuring that all stakeholders in the system are comfortable with diversity and see it as a challenge rather than a problem.

Researches on inclusive education, have predominantly focused on the success stories of inclusion in developed countries in North America and the Western Europe, that have made significant progress in inclusive education (Arnsen and Lundahl, 2006; Ferguson, 2008; Grönlund et al., 2010; Kearney and Kane, 2006; Meijer et al., 2007; Norwich, 2008); however, the status of inclusive education in the developing countries in Africa, Asia and the Eastern Europe, typically highlights difficulties in the implementation of inclusive education (Charema, 2007; Chitiyo and Chitiyo, 2007; Singal, 2006). Among the prevalent barriers to the successful implementation of inclusive education like - limited governmental support, ineffective policies and legislation, inadequate funding, insufficient trained teachers and support staff, political instability, and economic crisis; the ineffective and inefficient use of assistive technologies is seen to be a major obstacle hindering inclusion (Chitiyo, 2007; Ellsworth and Zhang, 2007; Grönlund et al., 2010; Singal, 2008).

Students with disabilities are found to be frequently trapped in a vicious cycle of exclusion from education, society and mainstream development programmes due to lack of necessary support and the means for equal participation (Ahmad, 2015a). Effective technology integration can help provide all learners the ability to access the general education curriculum, offering them multiple means to complete their work with greater ease and independence in performing tasks that they were formerly unable to accomplish, or had great difficulty in accomplishing (Roberts et al., 2008;

Van, 2007); thus addressing the 'functional barriers' by increasing, maintaining, or improving their learning outcomes in a diverse world of abilities and expectations.

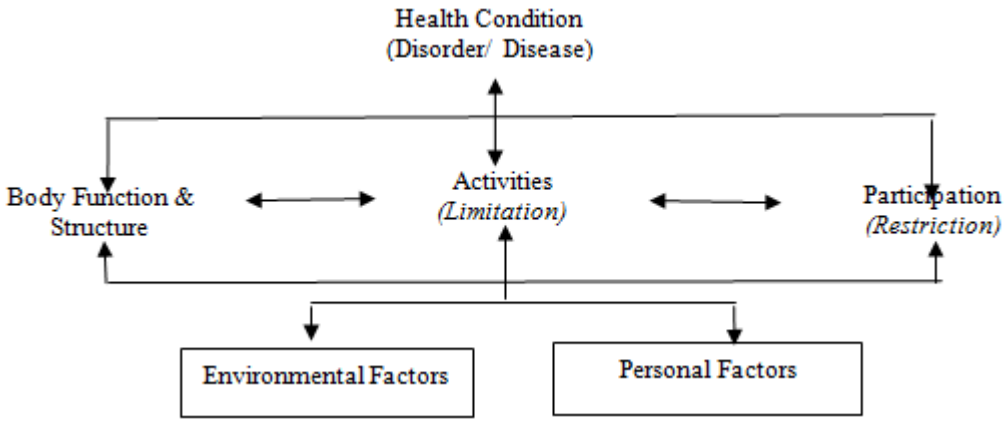
Addressing Diversity in Inclusive Education

Education is the most essential ingredient in the development and empowerment of individuals, and inclusion in education irrespective of the varied socio-economic differences and the differences in 'abilities' and 'disabilities' (Praisner, 2003), undoubtedly makes this foundation much stronger (Ahmad, 2014). A school system emphasizing education for all should ensure the right of all children to a meaningful education based on individual needs and abilities (Johnson, 2002). Any child may experience a special need during the course of his educational years (UNESCO, 1994), and as a result, some children feel 'left-outs' and never enter school or enter only for a few years and, as repeaters, or become 'drop-outs' or 'pushed-outs', without their needs having been met. These children are a vivid illustration of the failure of schools to teach rather than their own failure to learn (Lindsey, 2007; Norwich, 2008). The geographical and social segregation of students with 'disabilities', from their 'non-disabled' peers, in learning and development, is further a failure of meaningfully integrating students in mainstream schools (Singh, n.d.).

Inclusive education, more than mainstreaming the learners with special needs, is also concerned with identifying and overcoming all barriers for effective, continuous and quality participation of all in education (Ramchand and Dummugudem, 2014; Ahmad, 2015a), and providing a 'least restrictive environment' (LRE) to satisfactorily afford children with disabilities a meaningful educational benefit, together with others, in an accessible physical and human environment (ICF, 2001; Gal et al., 2010). Overtime, there has been a considerable shift in the understanding of 'disability', from the earlier medical interpretations of seeing 'disability' as a 'deficit' within the individual, to the concept of human rights and equitable opportunities for participation of all individuals (Wolery, 2000). The social model of disability sees the systemic barriers, negative attitudes and exclusion by society (purposely or inadvertently) as the ultimate factors defining disability. This explains 'disability' as resulting from the interaction of an individual's 'functional status' with the physical, cultural, and policy environments (Shakespeare and Watson, 1997), where if the environment is designed for the full range of human functioning and incorporates appropriate accommodations and supports, then individuals with functional limitations would not be 'disabled' and can actively participate in the society (Lang, 2001). Interventions, to be inclusive, should therefore not only be at the individual level, like medical rehabilitation, but also at the societal level, with provision of necessary support services, a universal design to make infrastructure more accessible, and a change in attitude and perception regarding disability; promoting inclusive education systems and community awareness programs to combat stigma.

The International Classification of Functioning, Disability and Health (ICF) developed by the World Health Organization (WHO), uses the term 'participation' rather than 'inclusion' (ICF, 2001; Simeonsson et al., 2003), and acknowledges the many barriers faced by children with disabilities in their educational experience. It shifts the debate, which traditionally was much child-oriented, to become more focused on environmental factors that both affect and potentially facilitate children's participation in their everyday lives (ICF, 2001; Simeonsson et al., 2003; Gal et al., 2010). 'Functioning' and 'disability' are therefore seen as 'multi-dimensional' concepts relating to the body functions and structures of individuals, the activities people do and the life areas in which they participate, and the factors in their environment that affect these experiences. The 'activities' are basic actions deliberately undertaken in order to accomplish a task by an individual, as opposed to particular body functions or structures; while 'participation' implies the activities that are integral to economic and social life and the social roles that accom-

Figure 1: ***The ICF Model (2001)***



plish that life, like being able to attend the school. An individual's ability to function is affected by the environment they face, and a given level of impairment in the body function domain does not necessarily translate into an activity or participation limitation, if the environment accommodates an individual's different functional status. Disability, hence, is seen to arise out of 'activity limitations' and 'restrictions' placed upon 'participation' that are resulted from the interaction between the body structure and function limitation, and an unaccommodating environment (Gal et al., 2010).

Within the spectrum of 'impairment', 'disability', and 'handicap'; the 'handicap' is what results from an 'impairment' or a 'disability', and limits or prevents the fulfillment of a role considered normal (depending on age, sex, social and cultural factors) for that individual (WHO, 1980). Assistive technology devices, here, aid in reducing, if not eliminating the handicap, and circumvent the deficit to help the individual participate in learning and related tasks, reducing barriers and promoting accessibility with considerable ease and efficiency, which otherwise might not have been possible.

'Assistive Technology' broadly spells out a continuum of tools, strategies, and services that match a person's needs, abilities and tasks, and includes evaluation of the needs of an individual with a disability, a functional evaluation of the individual in the individual's customary environment, and the selection, designing, fitting, customization, adaption, application, maintenance, repair, and replacement of assistive technology services, and their coordination with the existing education and rehabilitation plans and programs for inclusive development.

Use of Assistive Technology in Inclusive Education - Making Room for Diverse Learning Needs

"The real miracle of technology may be the capacity it has to remove previously insurmountable barriers faced by persons with disabilities" (Simon, 1991).

Technology has great potential in providing access for all learners, and the ability to access the general education curriculum. Assistive technology is a generic term that includes assistive, adaptive, and rehabilitative devices for individuals with disabilities and includes 'virtually anything that might be used to compensate for lack of certain abilities' (Reed and Bowser, 2005), ranging from low-tech devices like crutches or a special grip for a pen, to more advanced items like

hearing aids and glasses, to high-tech devices such as computers with specialized software for helping dyslexics to read (WHO, 2009). Also known as 'technical aids', or 'assistive equipment', including information and communication technologies (ICT), universally designed technologies, educational technologies, emerging and innovative technologies, and accessible technologies; they can be 'any item, piece of equipment or product system that is used to increase, maintain, or improve the functional capabilities of individuals with disabilities, and help them to work around or compensate for a disability' (Goddard, 2004: p.2), in order to participate in the activities of daily life. From a simple device like a magnifying glass, to a complex computerized communication system; depending on their nature of use and application, assistive technology devices can be used by students with disabilities on their own or with assistance, in and outside the learning setup. Some of the examples of assistive technology devices are - touch control devices, alternative keyboards and mouse, speech-to-text word recognition tools, word prediction programs, word processors, grammar checkers, scanners, compact disc recording (CD-R and CD-RW) drives and spell checkers (Petty, 2012).

Approaches in the use of assistive technology in inclusive education focus on using technology to train or rehearse, and to assist and enable learning. A large population of 'at risk' students are seen to need assistance, but since they often don't easily fit into a diagnostic profile, they often lack assistance. Assistive technology serves in bridging this gap by 'assisting' in the practice of educating children in the same classroom, including children with physical, mental and developmental disabilities (Smith et al., 2005); helping them to learn the material in a way that they can understand, by eliminating barriers that had been preventing them from being at the same level as their peers.

Offering practical tools for application of the principles of cognitive theory to teaching and learning, assistive technology connects a student's cognitive abilities to an educational opportunity that may not be accessible due to a disability; like a student facing difficulty in decoding text can make use of a text-to-speech screen reader as a 'bridge' between the written text and the ability to process the information aurally and cognitively; while a student who has difficulty sequencing thoughts in text can use graphic outlining software as a bridge to visual processing skills (Hernández, 2003). Hence, with effective integration of assistive technology into the regular classroom, students can have the provision of multiple means to complete their work, with greater independence in performing tasks that they were formerly unable to accomplish or could accomplish with great difficulty; through suitable enhancements or changed methods of interaction with the technology, needed to accomplish such tasks.

Table 1: ***Use and Application of Assistive Technology in Education***

CATEGORY/ AREA OF FUNCTION	**ASSISTIVE TECHNOLOGY APPLICATIONS**	**NEED AND RELEVANCE IN CLASSROOM LEARNING**
Reading	Electronic books, Book adapted for page turning, Single word scanners, Predictable texts, Tabs, Talking electronic devices/software, Speech Software	For students having difficulty in reading and understanding written text and in paying attention to the reading assigned.

Writing	Pen/Pencil grips, Templates, Word processors, Word card/book/wall, software, Spelling/Grammar checker, Adapted papers	For students having problem in writing or composition
Math	Calculators, Talking Clocks, Enlarged Worksheets, Voice Output Measuring Devices, Scientific Calculators	For students having computational problems and confusions, and finding it difficult to perform well in Math lessons
Vision	Eye glasses, Magnifier, Screen Magnification, Screen Reader, Braille Large Print Books, CCTV, Audio Lesson Tapes	For students who have difficulty in seeing or lack complete vision
Hearing	Hearing Aids, Pen and paper, Signaling Devices, Closed Captioning	For students who have difficulty in hearing or are absolute hearing impaired
Computer Access	Word prediction, Alternative Keyboards, Pointing Option, Switches, Voice recognition software	For students finding it difficult to access the computer in its standard form and have difficulty in performing academic tasks
Augmentative/ Alternative Communication	Communication Board, Device with speech synthesis for typing, Eye gaze board/ frame, Voice output device	For students having problems in comprehension of language, and lacking the ability to express it, or are unclear in speech and demonstrate delayed expressive language

Learning Disability and Attention Deficit Hyperactivity Disorder (ADHD)	Use of applications/devices depending upon the degree of disability/difficulty, in the area of reading and writing (Dyslexia), hand-eye coordination, written expression and composition (Dysgraphia), difficulty in fine motor skills, Coordination (Dyspraxia), Math (Dyscalculia) and Attention (ADHD) like - Talking electronic devices, Calculators, Electric Organizers, Highlighters, Pencil Grips, Post-its, Computers, Spelling/Grammar Checker, Electronic Organizers, Recorded materials, Hand held Scanners, Print or picture schedule, Electronic Diaries etc.	For Students having problem in language development, reading and writing (Dyslexia), hand-eye coordination, written expression and composition (Dysgraphia), difficulty in fine motor skills, Coordination (Dyspraxia), Math (Dyscalculia), and ADHD.

The success and applicability of an assistive technology device is measured by its actual usage, ease in accessibility by its users and in their satisfaction in interaction with their environment. It is essential to ensure that the assistive devices are need-based, inexpensive to produce, purchase and maintain, easy to use, and effective, which can be ensured by the direct involvement of the potential users at each stage of designing and development.

1. **Suitability to Users and their Environment** - The devices should be compatible with the users' aspirations, emotional needs, and ways of life, and with their culture and local customs; unobtrusive by local standards, and physically comfortable from users' perspectives. It should assure user safety, be useful in a variety of situations (Warger, 1998), and be durable, dependable and reliable especially in rural areas, remote areas and rugged conditions, and compatible with the ground surface and other conditions of a user's physical environment.

2. **Inexpensive and Easy to Purchase** - The devices should be low in purchase price. Government and/or NGOs can also support in the provision and purchase of the devices, free of charge or at subsidized rates. The devices should be easy and affordable to assemble or produce and maintain, so that keeping the devices in working order would require minimal resources and can be repaired with the use of locally available materials and technical skills.

3. **Easy-to-Use** - The devices should be easily understandable by users with limited exposure to technology, portable (easy to move from one place to another), and easy to operate without prolonged training or complex skills. Depending upon the differential abilities of the learners, and the context and feasibility of the approach, assistive provisions in education can help assist students with disabilities in learning, and a collaborative effort in the use of assistive devices, assistive technology, resource room support and innovative educational

strategies to promote and sustain inclusion can support these students to learn at par with their non disabled peers in inclusive educational settings (Ahmad, 2014).

Disability is seen to have more serious consequences for those students, who struggle with a 'dually-disadvantaged' life amidst additional handicapping conditions besides 'disability', like poverty, thereby having limited access to rehabilitation services and assistive devices. Trapped in a vicious cycle of exclusion from education, society and mainstream development programmes, without appropriate information, assistive devices and support services, such students lack the means for equal participation in education and development (Norwich, 2008). The resulting lack of skills is a barrier to meaningful employment opportunities later in life, further perpetuating the cumulative disadvantages. Assistive technology can help in meeting these 'disabling' needs by addressing the 'functional barriers' confronted by individuals with disabilities, including the sensory, cognitive, learning and physical disabilities.

Assistive Technology for Students with Mobility Impairments

Students having difficulty with fine motor skills may require larger keyboard while using a computer, an on-screen keyboard or speech recognition programs to coordinate with their learning tasks. The use of a standard keyboard in a computer with access to a 'mouth- or head-stick', where the keys can be pressed with the pointing device can help students with mobility impairments; while Track balls, head trackers and touch screens can serve as suitable alternatives to the computer mouse. Software utilities can create 'sticky keys' that electronically latch the SHIFT, CONTROL, and other keys to allow sequential keystrokes to input commands that normally require two or more keys to be pressed simultaneously.

Students with mobility impairments, using a wheel chair, may have their computer desks adjusted to a comfortable height, to pull up to the computer to work. Keyboard guards can be used by individuals with limited fine motor control, and repositioning the keyboard and monitor may help in enhancing accessibility; like mounting keyboards perpendicular to tables or wheelchair trays at head-height to assist individuals with limited mobility using pointing devices to press keys, and use of disk guides for inserting and removing diskettes. Left-handed and right-handed keyboards available for individuals who need to operate the computer with one hand, have the provision of more efficient key arrangements, than standard keyboards designed for two-handed users.

For users with severe mobility impairments, keyboard emulation, including scanning and Morse code input, can be used with special switches that make use of at least one muscle over which the individual has voluntary control like - head, finger, knee, or mouth. In scanning input, lights or cursors scan letters, and symbols are displayed on computer screens or external devices, where hundreds of switches tailor input devices to individual needs. Speech recognition systems allow users to control computers by speaking words and letters, where a particular system is 'trained' to recognize specific voices. Abbreviation expansion and word prediction software can also help in reducing input demands for commonly used text and keyboard commands; and on-screen help may assist in efficient access to user guides for individuals who are unable to turn pages in books.

Architectural or physical environmental barriers like the absence of ramps, elevators, automatic doors, Braille signage, and telecommunication devices, are also seen to deter and restrict the participation of students with disabilities. Therefore, infrastructural changes and adjustments in the schools and educational institutions (Campbell, 1989), like the availability of ramps; accessibility to classroom, workspace and labs through lifts; washrooms having counters and sinks with adjustable heights etc can be ensured through applicability of universal design for ease in accessibility, and can help address the hidden barriers preventing the equal access and participation of students with mobility impairments in education and social life.

Assistive Technology for Students with Visual Impairment/Blindness

Visually impaired students have difficulty accessing visual material in printed form or on the computer screen, where standard keyboards can aid in accessing Braille input devices, with Braille key labels assisting with the keyboard use. The OBR (Optical Braille Recognition) software can enable users having visual impairment to read Braille documents on a standard A4 scanner, scan the Braille document, analyze the dot pattern, translate the text, and present it on the computer screen. Refreshable Braille displays allow line-by-line translation of screen text into Braille, which can help in detailed editing. The Braille printers provide the 'hard copy' output for the visually impaired users. Scanners with optical character recognition can read printed material; which can then be stored electronically on computers, and be read using speech synthesis, or printed using Braille translation software and Braille printers. Such systems provide independent access to journals, syllabi, and homework assignments for the visually impaired students. Speech output systems can be used to read screen text, while the screen readers or the text-to-speech software like JAWS (Job Access with Speech) can help the user in adjusting the volume, pitch and speed of reading, and in choosing or adjusting to a male or female voice according to their preference. Screen readers including navigation tools allow users to skip from headline to headline, or category to category while reading. Using the synthetic speech, the computer can read text passages, analyze the phonetic structure of words and attempt re-constructing words by putting together a string of synthetic phonemes, ensuring easy understandability of the message by the student. The use of earphones for individuals using speech output systems can reduce and limit the distractions for other individuals present.

Audio materials like talking books and audio cassettes of recorded lessons can be used by students with visual impairment. The use of sophisticated audio devices, CD players, cassette players, and recording machines can be used to record lectures, books and other study materials and help students in submitting their assignments in audio formats. The descriptive video service with a narrative verbal description of the visual elements displayed on the screen enables the students to automatically hear the descriptions of all the visual elements, providing the students with visual impairment an opportunity for better socialization and knowledge building (Petty, 2012).

Assistive Technology for Students with Low Vision

Students with low vision may find the standard size of letters on the computer screen or printed documents too small to read, while some may also not be able to distinguish one color from another. Use of large print key labels, special equipment for the modification of display or printer output, computer-generated symbols, both text and graphics enlarged on the monitor or printer, can prove useful to students with low vision, especially in using standard word processing, electronic mail, spreadsheet, and other software applications. Adjusting the color of the monitor or changing the foreground and background colors, through special software like reversing the screen from black on white to white on black for individuals who are light sensitive, can help improve access and readability. Anti-glare screens can make screens easier to read, while voice output systems can also be used by people with low vision. The printed material can be read by scanners with optical character recognition and stored electronically on computers, where it can be read using speech synthesis or printed in large print. Assistive devices that are suitable for students with low vision may be used to aid in efficient learning like close circuit television, magnifying glasses and hand magnifiers, Braille language, talking calculators and tape recordings (Burgstahler, 1992).

Assistive Technology for Students with Hearing and/or Speech Impairments

Word processing and educational software may help hearing impaired students in developing writing skills. Alternatives to audio output can assist the hearing-impaired computer user, in place of using a standard keyboard and mouse. Advanced speech synthesizers may act as substitute voices, providing a compensatory tool for students who cannot communicate verbally. Students with portable systems can participate in class discussions once adapted computers provide them with intelligible speaking voices. Students with hearing and/or speech impairments can use standard written or on-screen documentation without difficulty, with the development of adequate speech and language patterns using supportive aids like recorded tapes, speech trainers, photo albums, articulation charts, concrete objects and other visual cues, for language learning, speech training, and speech correction. While 'text-telephones' can help in allowing phone conversations to be typed and read rather than be spoken and heard, the 'computerized speech recognition' software allows the computer to change a spoken message into a readable text document that can be easily read by the hearing impaired students.

Assistive Technology for Students with Specific Learning Disabilities

For students having Specific Learning Disabilities, educational software can help in skill building, by offering multisensory experiences, positive reinforcement, individualized instruction, and repetition. Students having difficulty processing written information can complete writing assignments and tutorial lessons with the aid of computers, like the standard word processor may prove a valuable tool for students with Dysgraphia, an inability to write legibly. Quiet work areas and ear protectors may make computer input easier for students who are hypersensitive to background noise and get easily distracted. Adaptive devices like large print displays, alternative colors on the computer screen, and voice output can help in compensating reading problems. 'Electronic Math Sheets' help in the organization, alignment and working of the Math problems on a computer screen, where the numbers appearing can be read aloud through the speech synthesizer, helping students facing difficulty in aligning Math problems using pencil and a paper. Software like 'Abbreviation expanders' can prove helpful with word processing to create, store, and re-use abbreviations for frequently used words or phrases, to ensure proper spellings for students who have difficulty in writing. The Paper-based Pen technology (Liao et al., n.d.), can record and link audio to what the student writes using the pen and the special paper, enabling note-taking while recording the teacher's lecture simultaneously, which the student can also listen to later by touching the pen to the corresponding handwriting or diagrams. This technology proves useful for students struggling with listening, writing, memory and reading skills. Students having difficulty interpreting visual material can improve comprehension and the ability to identify and correct errors when words are spoken or printed in large fonts. Computer documentation in electronic forms may be used with enlarged character and voice synthesis devices to ensure better accessibility to those with reading difficulties.

Assistive technology has a major role in remediating and compensating the performance deficits experienced by students, enhancing the students' performance; and ensuring effective evaluation as an accommodation during testing, offering adequate solutions when an extended evaluation is needed. Effective technology integration in education can therefore help in addressing the functional barriers experienced by students with disabilities, providing them with equitable learning opportunities and a leveled field to rightly exhibit their differential abilities, through provision of necessary support and an equally accessible learning environment to all.

Overcoming Barriers to Access and Success

With the emergence of the social model of disability, it is increasingly being argued that the greatest barriers to the inclusion of children with disabilities results from inaccessible environments (Gal et al., 2010). Besides, the attitude of teachers, and students, and their level of access and success with the technology use, the level of expertise and training of the teachers regarding the technology use and application; student perception, training and acceptance; and the curriculum adaptation and technology integration in the inclusive classrooms are some of the major challenges and decisive factors in the efficient use of assistive technology in inclusive education (Lang, 2001, Petty, 2012; Reed and Bowser, 2005).

Availability and Accessability of Technology

The appropriateness in the choice of technology is not governed by how expensive or complicated it is; but, by the optimum use of the technology, which can be ensured if the choice and design suits the lifestyle, culture and environment of the user, and is made to fit users and not vice versa, enabling students with disabilities to achieve their full potential. With particular emphasis on community-level innovation, community collaboration with disabled persons and researchers needs to be encouraged with timely training and follow-up to ensure the continued appropriateness of the devices for the users.

The assistive technology selected should be appropriate to the needs of the situation, to be accessible to the user. Also, the student's specific difficulty areas need to be determined (Praisner, 2003), and their strengths be identified by including them in the selection process, and then the options be narrowed down accordingly in the course of the selection. The acquisition of assistive technology should not be seen as a one-time expenditure since hardware and software may need upgradation. It is therefore necessary to plan and periodically evaluate the cost, access, time period needed for training, and the level of comfort of the student. The specific settings should be examined where the technology will be used, ensuring portability for ease and accessibility. Students should be encouraged and aided in assuming increased independence and responsibility in learning rather than being completely dependent on the aid.

Availability may prove another potential barrier to the use of assistive technology, besides it may appear costly for both the schools as well as the students. It is found that assistive technology such as screen readers, voice recognition software and joysticks remain out of reach for many individuals due to cost, lack of information and limited availability. The cost for technology, nevertheless, serves as an investment in helping students to achieve academic independence and success. There should be an effective liaison with agencies or service providers who can help students acquire the technology needed to enhance their learning. During implementation of the technology, it is essential to locate equipment where instruction and learning has to take place, preferably selecting low-tech applications, and the accessibility and integration of the use of technology into lessons should be ensured in a purposeful and meaningful way. The necessary training and technical support should be provided to classroom teachers and support staff, considering the initial fiscal and human resources as an investment and at the same time avoiding reinventing the wheel each year, preferring technology that is already in place whenever possible (Warger, 1998).

Attitudinal Barriers and Adaptation to Change

Attitudinal barriers are perceived to be the basis of all other environmental barriers, and are perhaps the most difficult to change (Pivik et al., 2002; Williams and Algozine, 1977). They are reflected in misconceptions, stereotypes, labeling, fear from the unknown, resistance, misunderstanding the rights and opportunities of individuals; and lead to the further isolation of children

with disabilities (Gal et al., 2010; Heyne, 2003; Odom, 2000; Parsarum, 2006). Teachers have an important role in supporting and promoting inclusion and their attitude has proved to be a crucial variable in the success of inclusion schemes (Chow and Winzer, 1992; Gal et al., 2010; Hastings and Graham, 1995; Hastings and Oakford, 2003; Hayes and Gunn, 1988); and it is observed that intentionally or not, but teachers themselves can sometimes prove to be obstacles in implementing assistive technology, when they consider using technology as an easy way out, or if being inflexible when there are difficulties with technology (Beh-Pajooh, 1991; Parasuram, 2006). Students with learning disabilities may resist the change and may not easily rely on assistive technology, while students with emotional disabilities may distance themselves from others, inhibit communication, interfere with activity performance and contribute to a negative self-image (Casey-Black and Knoblock, 1989). Teachers in such challenging situations need to embrace and encourage students to adapt to the change; and also should be open to experimenting, observing, and learning to adopt strategies that may work best with their students.

While strategies and supports for access, participation, and progress through technology may exist; the prevalence of 'administrative barriers' like - lack of funding, workload norms, absence or insufficient training staff, lack of adequate transportation, and insufficient funding for coordinated services and individual supports; and the 'programmatic barriers' like - the lack of knowledge and ability to assess and provide appropriate support for every individual's needs, lack of behavioral teaching techniques, and accommodations of equipment and activities suiting children with some types of disabilities, are some deterring factors observed which often hinder in technology integration and effective inclusion of students with disabilities (Jennings, 2007; Voorman et al, 2006).

Curriculum Adaptation and Technology Integration

Access to the general education curriculum involves the placement of students with disabilities in general education classrooms, which requires the adaptation of the curriculum content so that it proves meaningful to every student as an equal participant in the learning process.

Assistive and instructional technologies are a part of the larger research-based intervention strategies, that in terms of the accessibility to the general education curriculum, imply the modification of the classroom like equipping students with disabilities with graphic organizers or concept mapping software, or allowing students who have difficulty writing to respond verbally to a peer rather than producing a written assignment, use of talking text readers, or specific assistive technology communication devices designed for receptive and expressive communication to ease learning and equal participation of all students with differential abilities (Reed and Bowser, 2005; Van, 2007; Warger, 1998).

Assistive technology has the potential to augment abilities and bypass or compensate for barriers that disabilities create (Lewis, 1994). As educational reforms include the application of technology to support and expand classroom curricula, assistive technology can provide both routine and customized access to the general curricula for students with disabilities.

Training Students and Acknowledging Expectations/Attitudes

Students need to be supported in learning to use the technology to be able to successfully access it; otherwise the results may prove to be even worse than having no access to the technology at all. The western literature on the use of assistive technology (Katz and Mirenda, 2002; Reed and Bowser, 2005; Scherer, 2004; Stainback and Stainback, 1984) highlights the level of training for the students with disabilities being taken up by colleges and universities through courses in various software programs, provision of technology training in computer labs, or through explicit

assistive technology training through a support service office or assistive technology lab. It is therefore, up to the institution, to plan the setting in the implementation of the training, support and guidance as required. The perception and attitude of the students with disabilities regarding the assistive technology is one of the deciding factors in its selection and sustainable usage. And if the process is perceived by them to be too cumbersome and time-consuming, there are chances of considerable resistance from the students (Lyon et al., 2001), which with regular training should be positively modified to aid in efficient learning. An effective orientation to the functioning of the assistive technology; balanced exchange of opinions; discussion of the benefits, expectations and limitations, goals, and inhibitions about using the technology or the specific software should be planned, resolved and executed for a better inclination and motivation for the students. A system for referrals to local agencies or experts, besides the consulting support at schools and colleges, as well as considerable support from parents and educators should be ensured. Sufficient practice with apt applications to relevant tasks like assignments for classes should be planned, besides the necessary evaluation of the students, their environment and the available tools, to determine the appropriate assistive technology to use in any specific setting for the successful incorporation of technology. As far as possible, similar applications and adaptations of technology should be considered for students at both their school-setting as well as their home, taking the parents of students with disabilities as well as the students themselves as equal partners in the decision-making and implementation process.

Conclusion

Accessibility is a celebration of diversity, and a crucial factor in ensuring students' participation in the learning process. Access to information, awareness, mainstream education curriculum, learning materials, assistive devices and the necessary support services can help students with disabilities in learning at par with their non-disabled peers in the common classroom, breaking down all barriers which prevent them from having equal access to quality education. Researches confirm the positive outcomes of inclusion in education, which is found to promote effectiveness in educational practice, delivering positive educational outcomes for children with disabilities in inclusive settings (Katz and Mirenda, 2002). Regular schools with an inclusive orientation are found to be most effective in combating discriminatory attitudes, building an inclusive society and achieving education for all (UNESCO, 1994).

Assistive technology should not be viewed by educators within a 'rehabilitative' or 'remediative' context, but as a tool for accessing curriculum, and exploring out means to help students achieve positive outcomes (Warger, 1998). For the proper and optimum use of assistive devices, it is essential to ensure *need-based assessment* - considering the applicability of the technology and its effectiveness; *a sound development plan* - ensuring student centered goals and proper identification in the plan of the devices needed; *successful implementation* - through action oriented approach to check the feasibility and effectiveness of the technology, with *effective monitoring and periodic review*. There is a distinct need for researchers, practitioners, and other stakeholders in the system to identify ways to encourage the development of tools and strategies for technology integration, and strive to work together on issues surrounding the use of technology, for effective inclusion of students with disabilities within the general education environment, ensuring that they are entitled to the same high standards and effective instruction that is available to the non-disabled students. It is essential to focus and build on the strengths and capabilities of the students, with the necessary support and assistance, to give more room to their abilities in order to address their 'disabilities'.

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