



ASSISTIVE TECHNOLOGY FOR EDUCATING PERSONS WITH INTELLECTUAL DISABILITY

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Abstract:

Technology has changed and continues to change the way people manage things in their lives and it is analogous in the life of Persons with Disabilities (PwDs) through the integration of technology in education. Meaningful inclusive education can be made possible with the help of Assistive Technology (AT) since it helps in identifying and overcoming all barriers for effective, continuous and quality participation of all PwDs including those with intellectual disabilities in education. This article attempts to put forward few measures that provide effective education to Persons with Intellectual Disability through the support of assistive technology specifically designed by understanding their educational needs in order to maximize their academic success. Assistive technology pertinent to various domains of education and developmental areas with appropriate examples and case study is also being illustrated. Barriers to access assistive technology and recommendations to remediate it are also discussed in comprehensive manner.

Keywords: assistive technology; education; persons with intellectual disability

1. Introduction

According to World Health Organization (WHO) (2012), nearly 15% of the world's population has different disabilities. Between 110-190 million of them have disabilities

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that cause significant difficulties in functioning. Disability is not a fault and people with disabilities are a part of our community and have equal rights with us.

According to United Nations Convention on the Rights of Persons with Disabilities (CRPD) (2006), providing assistance to people with disabilities to maximize functioning, support independence and, participate in the community is the duty of governments. However, the World Report on Disability (2011) mentions that many of these people with disabilities do not have equal chance to access education, health care and employment opportunities. Many people with disabilities need assistance and support to go on their daily life and participate in social and economic life. But, they could not achieve these goals, due to lack of assistive services. Moreover, people with disabilities experience worse socioeconomic conditions and poverty than people without disabilities.

Technology has changed and continues to change the way people manage things in their lives, both in private and in practical life, so the natural extension of that is to see the impact and the integration of technology in education for students with disabilities in the same way it has been in other areas of life. Using technology can help students with disabilities to enhance and improve their independence in academic and employment tasks and their participation in classroom discussions, to gain access to peers and teachers along with helping them to accomplish some difficult academic tasks (Burgstahler, 2003). Thus it is a tool in the hands of Persons with Disabilities (PwDs) in gaining autonomy and independence in daily life as well as the ability to perform in the spheres of education and employment.

Additionally, only with the help of ATs meaningful inclusive education can be made possible because it can help us in identifying and overcoming all barriers for effective, continuous and quality participation of all PwDs including those with intellectual disabilities in education.

2. Intellectual Disability

The American Association for Intellectual and Developmental Disabilities (AAIDD) has defined Intellectual Disability in 2008 as below:

“Intellectual disability is a disability characterized by significant limitations both in intellectual functioning and in adaptive behaviour, which covers many everyday social and practical skills. This disability originates before the age of 18 years”.

Intellectual functioning also called intelligence refers to general mental capacity, such as learning, reasoning, problem solving, and so on.

One criterion to measure intellectual functioning is an IQ test. Generally, an IQ test score of around 70 or as high as 75 indicates a limitation in intellectual functioning. Standardized intelligence tests can also determine limitations in **adaptive behaviour**, which comprises of three skill types:

- **Conceptual Skills** - language and literacy; money, time, and number concepts; and self-direction.
- **Social Skills** - interpersonal skills, social responsibility, self-esteem, gullibility, naïveté (i.e., wariness), social problem solving, and the ability to follow rules/obey laws and to avoid being victimized.
- **Practical Skills** - activities of daily living (personal care), occupational skills, healthcare, travel/transportation, schedules/routines, safety, use of money, use of the telephone.

3. What is Assistive Technology?

Assistive technology (AT) is used as an umbrella term for both assistive products and related services. Assistive products are also known as assistive devices. Assistive devices and technologies (ATs) are those whose primary purpose is to maintain or improve an individual's functioning and independence to facilitate participation and to enhance overall well-being.

The International Classification of Functioning, Disability and Health (ICF) has defined assistive products and technology as:

“Any product, instrument, equipment or technology adapted or specially designed for improving the functioning of a person with a disability”.

In addition, the British Assistive Technology Association (BATA, 2011) focusing on assistive technology for enabling persons with disabilities in all spheres of life, proposed the following definition:

“AT is any item, equipment, hardware, software, product or service which maintains, increases or improves the functional capabilities of individuals of any age, especially those with disabilities, and enables them more easily to communicate, learn, enjoy and live better, more independent lives.”

The International Organization for Standardization (ISO) explicated assistive products more broadly such as:

“Any product, especially produced or generally available, that is used by or for persons with disability: for participation; to protect, support, train, measure or substitute for body functions/structures and activities; or to prevent impairments, activity limitations or participation restrictions. This includes devices, equipment, instruments and software”.

Assistive technology plays a vital role in the lives of human beings because of its diversified use like; to access information, participate in different activities, or complete a task independently or with minimal assistance. Mastery of assistive technology

contributes to the development of literacy and academic success, social interaction among peers, independence and the potential of future employment (Hatlen, 1996). Access to assistive technology should be a right and not a privilege. Assistive technology is designed to create a user-friendly environment for students who receive special education services and has the ability to maximize students' academic success. Furthermore, AT can be used to increase equitable access to academic, social, and extracurricular activities for students with learning disabilities (Dyal, Carpenter, & Wright, 2009).

In recent years, the field of assistive technology has expanded to include high-tech devices such as computers and accompanying software. Assistive technology facilitates students who have cognitive disabilities to compensate for specific deficits (Cook & Hussey, 2002).

Table 1: Assistive Product Illustrations for Various Categories of Person with Disabilities

Category	Product Examples
Mobility	<ul style="list-style-type: none"> • Walking stick, crutch, walking frame, manual and powered wheelchair, tricycle • Artificial leg or hand, leg or hand splint, clubfoot brace • Corner chair, supportive seat, standing frame • Adapted cutlery and cooking utensils, dressing stick, shower seat, toilet seat, toilet frame, feeding robot
Vision	<ul style="list-style-type: none"> • Eyeglasses, magnifier, magnifying software for computer • White cane, GPS-based navigation device • Braille systems for reading and writing, screen reader for computer, talking book player, audio recorder and player • Braille chess, balls that emit sound
Hearing	<ul style="list-style-type: none"> • Headphone, hearing aid • Amplified telephone, hearing loop
Communication	<ul style="list-style-type: none"> • Communication cards with texts, communication board with letters, symbols or pictures • Electronic communication device with recorded or synthetic speech

Source: Assistive Technology for Children with Disabilities: Creating Opportunities for Education, Inclusion and Participation: A discussion paper, World Health Organization, 2015.

4. Universal Design for Learning and Assistive Technology

Universal Design for Learning is a theoretical framework developed by Centre for Applied Special Technology (CAST) to guide the development of curricula that are flexible and supportive of all students (Dolan & Hall, 2001; Meyer & Rose, 1998; Pisha & Coyne, 2001; Rose, 2001; Rose & Dolan, 2000; Rose & Meyer, 2000a, 2000b, 2002; Rose, Sethuraman, & Meo, 2000).

Universally designed structures are indeed more usable by individuals with disabilities, but uniquely, UDL calls for the design of curricula with the needs of all students in mind, so that methods, materials, and assessment are usable by all. The UDL framework guides the development of adaptable curricula by means of 3 principles. These three principles parallel three fundamentally important learning components and three distinct learning networks in the brain: recognition, strategy, and

affect (Rose & Meyer, 2002). The common recommendation of these three principles is to select goals, methods, assessment and materials in a way that will minimize barriers and maximize flexibility.

These principles focus on the need to include:

1. Diverse recognition networks and provides multiple means of representation.
2. Diverse strategic networks and provide multiple means of action and expression.
3. Diverse affective networks and provide multiple means of engagement.

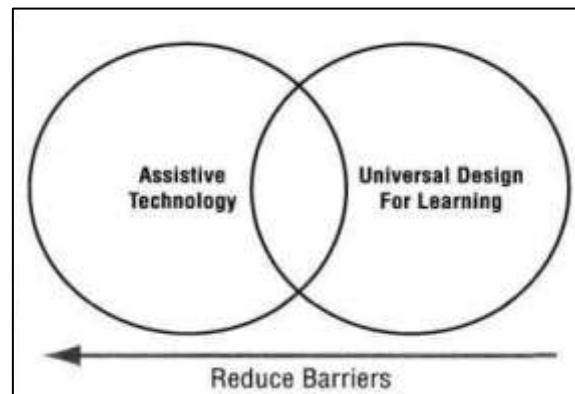


Figure 1: The Relationship Between AT and UDL

Source: D. H. Rose, Hasselbring, et al., (2005)

Technology-enhanced, UDL-aligned curricular materials can include authentic problems that mirror students' with intellectual disability daily experiences. For example, to enhance recognition learning, digital text can be incorporated to create readability levels that match students' ability levels (Jackson, 2004). The UDL framework helps educators transition from a one-size-fits-all model of instruction to a diverse learning community that maximizes educational benefits in diverse classrooms (Bouck, Courtad, Heutsche, Okolo, & Englert, 2009; Curry, Cohen, & Lightbody, 2006; Rappolt-Schlichtmann et al., 2013).

Technology can support teaching through the UDL framework because it can increase access to learning and reduce barriers if effectively used. Technology is a powerful tool for reducing barriers to learning and increasing meaningful access and engagement (Rappolt-Schlichtmann et al., 2013). Appropriate use of technology can enhance teaching and learning through the UDL framework. Additionally, there is a close relationship between AT and UDL because they are all designed to promote the access, participation, and progress of students with disabilities in schools (Silver-Pacuilla, 2006).

Shippenet al., (2012) pointed out that technology-based interventions allow teachers to customize the learning materials so that students can receive individualized instruction even while they are participating in a class where students exhibit a wide range of variability in their skills.

4.1 Universal Design of Learning and Assistive Technology in Academic Learning

Table 2: Teaching through UDL for Children with Intellectual Disability

Approaches in Teaching	Learning Objectives	Teaching Learning Materials	Accessibility Features
<p>Recognition</p> <ul style="list-style-type: none"> • Basic principles: mastery learning; progression from simple to complex • Explicit teaching of contents <p>Strategic</p> <ul style="list-style-type: none"> • Independent and guided practice <p>Affective</p> <ul style="list-style-type: none"> • Direct Instruction and participation with teacher's tool kit comprising of variety of experiences 	<p>Recognition</p> <ul style="list-style-type: none"> • Mastery of content <p>Strategic</p> <ul style="list-style-type: none"> • Academic achievement <p>Affective</p> <ul style="list-style-type: none"> • Acquiring learning strategies • (engagement) 	<ul style="list-style-type: none"> • Computers, Mobile learning devices, Interactive whiteboards • A teacher's toolkit with images, captioned videos, simulations, games, virtual museums. 	<ul style="list-style-type: none"> • Overcomes reading difficulties • Reduces cognitive load • Supports problem solving • Provides methods to understand complex instructional content.

4.2 Learning Style of Persons with Intellectual Disability

A Learning Style is a person's characteristic or preferred method of understanding, acquiring, processing, storing and recalling information in learning situations. Persons with an intellectual disability need to 'learn, learn and over learn'. This means that they may require many opportunities to practice concepts and skills in order for them to understand and retain the information to draw upon into the future. Sensory Learning is essentially the ability to incorporate different senses such as Vision, Smell, Hearing, Taste and Touch either alone or in combination to heighten and reinforce the learning process. Multisensory learning happens when more than one sense is used to acquire and retain information. By combining the visual-auditory kinesthetic (VAK) aspects the child is provided with three avenues to understand, remember, and recall information. This will give the child's brain tactile and kinesthetic memories to hang on to, as well as the visual and auditory ones.

- Visual: learning based on observation and seeing. Visual learners think in pictures and prefer to learn through what they see (visual aids such as diagrams, hand-outs, pictures, flashcards, videos, mind maps etc.).
- Auditory: learning based on listening to instructions/information. Auditory learners learn best through what they hear (listening to lectures, discussions, tapes, etc.).
- Kinesthetic: learning based on hands-on work and engaging in activities. Tactile/kinesthetic learners prefer to learn through moving, touching, and doing (active exploration of the world; projects; assignments, collection of items relevant to content of learning etc.).

Multisensory learning helps students clarify their thoughts, organize and analyze information, integrate new knowledge and think critically students of all ages how to think and how to learn. Assistive technology materials/ products with SOMA (Specific, Observable, Measurable and Achievable learning outcomes) features and multi-sensory environments will benefit the students with intellectual disability to learn and retain the concepts.

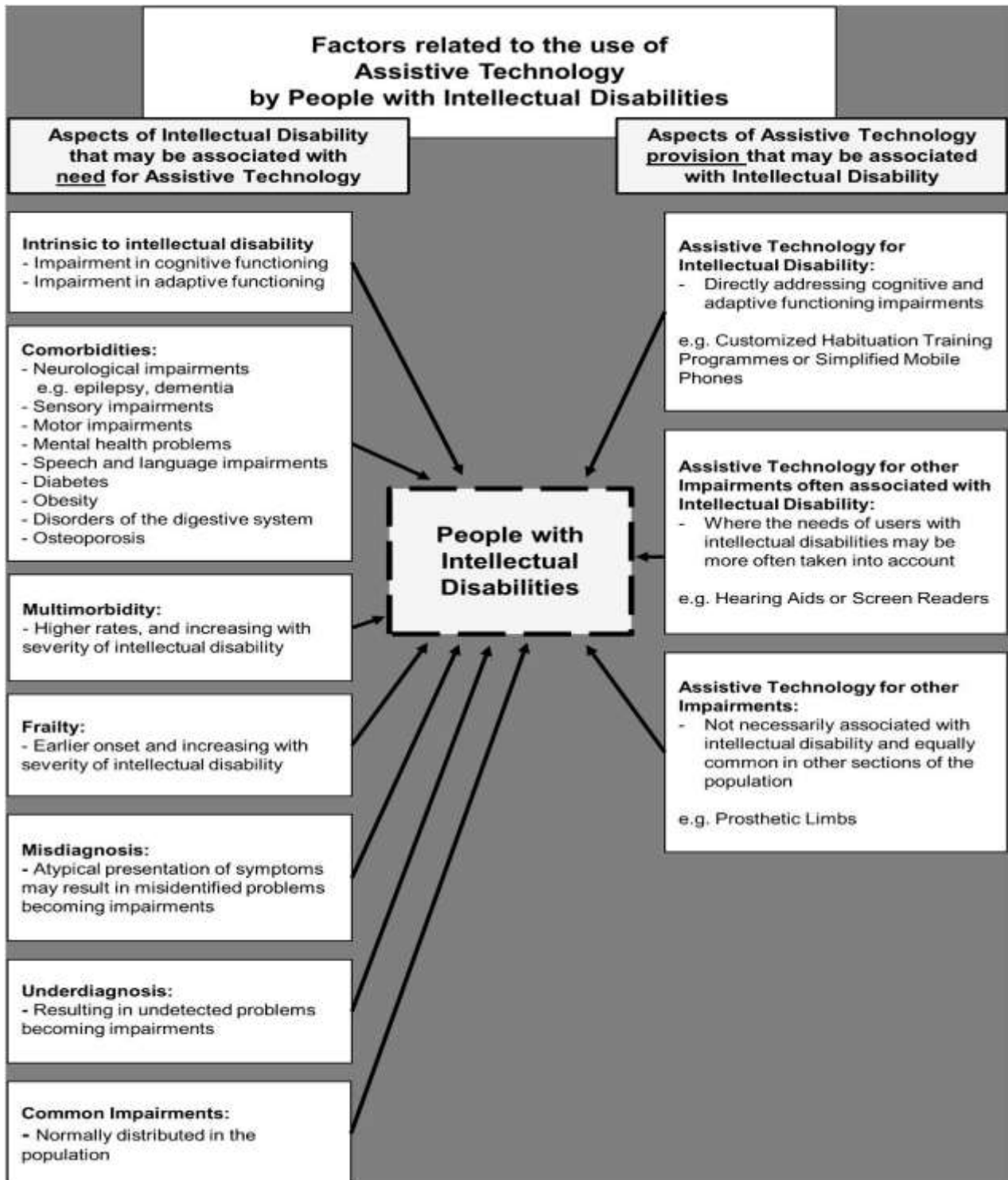
Studies have already proven that blended learning, a mixture of online lessons and real teaching, can improve student performance significantly. Likewise for special-needs students who find learning via e-readers, computers and software to be more engaging. And because lessons through such devices can be personalized for the students rather than a single lesson for the whole class, children with Intellectual disabilities find themselves able to handle even advanced lessons and reach their fullest potential. Technologies such as voice recognition applications, mobile devices, symbol-based interaction and virtual reality may be used to support persons with different educational needs during their education process (McKnight & Davies, 2013). A range of technologies can be used to support students in reading, writing, walking, sitting, seeing and hearing and in fostering communication skills and participation in activities (Reed, 2007).

**Table 3: Assistive Technology Products for Persons
with Intellectual Disability in Various Domains**

Sample List of Assistive Technology for Persons with Intellectual Disability in Various Domains	
Mobility	Well-designed wheel chair with cushion seat to relieve pressure for persons with intellectual disability associated with motor difficulties.
	Ramps and Handle bars for independent movement for persons with intellectual disability who have issues in maintaining balance.
	Vehicles with adaptations such as broaden entrance with steps fixed at low level to facilitate entry of persons with crutches, splint, artificial leg etc and doors to facilitate entry of wheel chair and space inside to accommodate wheel chair.
Positioning/ Seating	Adaptation in chair and desk to suit height of persons with individual disability made with non-slippery material.
	Alternative chairs/ space in front row to accommodate wheel chair.
Reading	Visual schedules instead of textual formats for visual learners.
	Pictorial representation of content replacing textual presentation.
	Text-to-speech (TTS) software can be used to provide help to children who have difficulties reading print materials.
	Adapted text - magnified font size, highlighting font colour, huge space between lines.
Writing	Apps related to academics can be developed and installed in smart phones to assist learning of concepts.
	Audio recorder to facilitate learning and retention of concepts and reminders to initiate and complete tasks.
	Pencil grips and letter detectors to facilitate writing.
	Graphic Organizers- Available in a wide range of models with different features, the main purpose of a graphic organizer is to enable special needs students to better organize their thoughts as they write.
	Adapted pens, seating.
Mathematics	Pens/computers with word prediction.
	Computers with voice recognition software can be used in education of writing skills (Word prediction software).
	Symbolic representation of numbers in figures to do math problems.
	Calculators /audio calculators.
	Pictorial worksheets in replacement of figures.

	Communication board/pictures can support a child with speech difficulties to express their ideas and feeling.
Communication	Speech generating devices.
	Picture exchange communication system.
	Smart Phones with speech apps.
Recreation	Online and virtual recreational experiences can be used for the recreation and leisure skills - computer games, puzzles.
Assessment and Evaluation	Alternative assessment and evaluation procedures such as oral / written/ pictorial mode depending on the need of the child.

Figure 2: Factors Related to the Use of Assistive Technology by People with Intellectual Disability



4.3 Selection of Assistive Devices

First step in selection of assistive technology is to plan about the most appropriate technology to suit the individual specific need based on the characteristics of person with intellectual disability.

Second step is to analyze whether the selected technology will meet out the expected outcomes and accessibility of person with intellectual disability.

Third step is to look out for the ability of person with intellectual disability and independence

Fourth step is to make use of trained professionals in usage of assistive technology.

4.4 Assistive Technology and Disability-Understanding the Need

Assistive Technology (AT) is used to increase, maintain, or improve the capabilities of persons with disability (Dell, Newton, & Petroff, 2012). Assistive Technology as an educational aid helps the students with disabilities involve in the regular curriculum, academic assessments and accomplish their educational goals at ease like their counterparts. Assistive technology is the key to making educational environments inclusive and enabling for individuals with significant disabilities. This type of technology is considered a powerful tool for inclusion. This statement is also supported by Rocklage, Gillett, Peschong, and Delhorey (1995), when they submitted that: *"...technology in the area of assistive technology is critical and can facilitate the support and full participation of an individual in daily tasks and activities."*

The primary aim should be to allow persons with disabilities access to assistive technology which meets their needs and provides for maximum participation in social and educational environments (Wilds, 1989). Without technological supports and accommodations, many students with significant disabilities cannot take full advantage of their education in inclusive set-ups and without the opportunities for interactions found in inclusive set-ups; students cannot truly demonstrate their abilities (Rocklage, Gillett, Peschong, and Delohery, 1995). Thus, assistive technology and inclusion go hand in hand.

Furthermore, the need and effectiveness of using assistive technologies with students with disabilities to foster academic success and independence is stressed in many researches (Olson, Foltz & Wise, 1986; MacArthur, Schwartz & Graham, 1991; Bryant, Smith & Carter, 1997; Bryant & Seay, 1998). It was also found that assistive technologies are not only used for remediation but also these technologies can provide compensatory alternatives which circumvent deficits while capitalizing on an individual's strengths (Garner & Campbell, 1987; McGregor & Pachuski, 1996; Bryant & Bryant, 1998). The diverse need and importance of AT for promoting inclusive education for students with intellectual disabilities are highlighted below:

- 1) Providing assistive technology to children as early as possible will facilitate their development in all the areas. Timely acquisition and use of assistive technology devices is very crucial.

- 2) Children with severe Intellectual disabilities who are unable to attend school can access education from home and communicate with others with the help of assistive technologies, accessible information and communication technologies (ICTs).
- 3) Persons with Intellectual Disability have limited processing skills which was supplemented by assistive technology to complete tasks on par with his peers.
- 4) Teachers often find that most students with intellectual disabilities, who are drawn to assistive technology and devices, are more motivated and confident to work as they get to use a technology device in the classroom.
- 5) Technology can be the great equalizer in a classroom for students with intellectual disabilities. Even the parents of students with intellectual disabilities reported that when their children with challenges or disabilities use technology, they are seen as more capable by peers.
- 6) AT helps teachers to adapt instruction for every individual by changing one or more aspects of the material being taught, such as the method, amount, evaluation, assistance, environment, and material. Thus AT enables teachers to meet the instructional needs of each learner and work with more numbers of students with disabilities at one time in classroom more effectively.
- 7) AT helps students with intellectual disabilities learn and grow along with others and give them the ability to experience much of what would be impossible without it. Technology makes everyone's lives easier, but for students with intellectual disabilities, assistive technology can make learning more engaging and effective than ever thought possible.
- 8) Students with intellectual disabilities who spend time in mainstream classrooms can use assistive technology to meet the expectations and demands of classroom teachers.
- 9) Assistive technologies enable teachers to present the leaning contents through multiple ways before the students and provide students multiple opportunities to express their leanings or knowledge for evolution and it ensure students' active engagement in class with varied means. Thus, AT helps to implement the principles of universal design for learning in classroom which is essential for the successful implementation of inclusive education.
- 10) Around 15 to 20 percent of total general population needs some types of cognitive task assistance. A large population of "at risk" students are in need of cognitive assistance. They do not any extra receive assistance because they do not easily fit into any diagnostic profile. If AT is made available to everyone, these students belonging to "at risk" groups will be benefited along with the students with intellectual disabilities in all the areas of school activities.

4.5 Case study

Shristi 10 year old girl with Intellectual Disability was mainstreamed in inclusive school after developing prerequisite skills in academics and mobility in special school from age 3. She was provided with front row seating, highlighted texts to read and wide spaced

note books to write. She was also allowed to use calculators during mathematics class and aided with lot of worksheets in pictorial format. Her performance was evaluated using separate question papers with pictorial content. Her communication with peers was facilitated through communication board as she had difficulty in speech and this improved her socialization with peer group. Although Shristi's academics were taken care by teachers and peer group it was very difficult for her to access school premises. Ramps in the school were without rails and classrooms were not supported by computer and projector. All these obstacles were overcome with the help of Headmaster and School Management Committee by mobilizing funds from community. Even though presently Shristi encounters few problems now and then in new situation she has learnt to manage it with her supportive peers, teachers and school management. She set out to be a good role model to continue her education in inclusive school with technological support which is supposed to be her right to enjoy all these mandatory benefits.

5. Barriers to Access Assistive Technology

Only 10% of the people who are in need of ATs actually have access to them, despite such access being claimed to be a human right (WHO, 2016). However, barriers that people with intellectual disabilities experience in accessing ATs have not yet been sufficiently considered. All over the world, people with intellectual disabilities are generally considered as a devalued and stigmatized group, and at least part of their relatively poor health status is due to health inequities. People with intellectual disabilities are still often disadvantaged when attempting to access or secure health services and assistive products (WHO, 2000; Hatton & Emerson, 2015). It is still unknown what proportion of people with intellectual disabilities globally has actually access to appropriate ATs. It has been suggested that for people with intellectual disabilities there is a high rate of under-diagnosis and misdiagnosis; so that too often they do not receive the correct treatment and that the need for rehabilitation arises as a result of absent or ineffective health care (Marks, Sisirak, & Hsieh, 2008). The atypical presentation of symptoms by people with intellectual disabilities is often a challenge for their care system. With accurate assessment and appropriate interventions, the use of ATs can be not only enabling and empowering, but also transformative in facilitating new life skills and opportunities for people with intellectual disabilities in all realms.

The potential barriers that people with intellectual disabilities experience in accessing ATs are highlighted below.

- 1) Lack of awareness among parents, teachers and families about assistive technology and its utility.
- 2) Lack of products - production and availability of products to suit individual specific need of persons with intellectual disability.
- 3) High-priced devices - most of the assistive devices are not locally produced and hence cost effectiveness in procurement of those devices is limited.

- 4) Lack of services - trained professionals to train in appropriate usage of assistive devices is limited.
- 5) Availability is another potential barrier to use of assistive technology. Technology can be costly for both schools and students with intellectual disability.
- 6) One of the major barriers to assistive technology use is the lack of information about the availability of assistive technology and devices (Wehmeyer, 1998) for students with intellectual disability.
- 7) In India, there is no production of assistive products- or production occurs on a small scale. It is small not only in terms of quantity, but also in terms of the range of types, models and sizes of the products. Limited access to the materials and equipment needed to produce assistive products hampers production. Market-related factors also set limit to its production. Limited awareness of AT or purchasing capacity leads to a limited demand. This results in few incentives to engage in production. Local production may not be cost-effective where local markets are small. Moreover, duty and import taxes associated with assistive technology also discourage production and use of AT.
- 8) Even though it is the goal of most technology development efforts to incorporate the principles of universal design, 'Cognitive Access' is not carefully considered while developing AT for persons with disabilities. Thus, most of ATs fail to meet the needs of persons with intellectual disabilities.
- 9) One of the most important barriers to ATs use is its complexity. Due to the complexity of AT persons with intellectual disability often face problem in using ATs without any assistance from others.
- 10) Lack of proper legislations, policies, and strategies is another hindrance to ATs use for students with intellectual disabilities in schools.

6. Recommendations

- 1) Awareness about usage of assistive technology is to be increased among parents and persons with intellectual disability.
- 2) Cost effective adaptive devices appropriate to persons with intellectual disability as the available devices in market do not focus much upon their needs.
- 3) The funding of assistive technology is a key issue. Funding options to support production and maintenance of assistive devices should be potential.
- 4) Integrate content-specific technologies with students' career goals and transition plans.
- 5) Identify student-specific barriers that occur during content instruction and assessment that can be remedied through technology.
- 6) Critically analyze and select technologies based on student strengths and needs, content objectives, and learning barriers.
- 7) Include assistive technology for persons with disability policy, strategies, programmes and plans of action.

- 8) Procure priority assistive technology products and ensure they reach with intellectual disabilities.
- 9) Invest in assistive technology programmes for persons with intellectual with disabilities.
- 10) Improve human resource capacity in the provision of assistive technology for persons with intellectual disabilities.
- 11) Provide adequate funding to improve availability and affordability of assistive technology for persons with intellectual disabilities.
- 12) Improve data collection and support research on assistive technology for persons with intellectual disabilities.
- 13) Where applicable, develop a multi-sectoral taskforce across Ministries of education, health and social welfare (or similar) to ensure that children with disabilities have access to appropriate assistive technology.
- 14) Creating awareness and sensitization among persons with intellectual disabilities, their parents, teachers and other support service providers about the benefits and sources of available ATs for persons with intellectual disabilities.
- 15) Giving appropriate training about usage of assistive technology and devices to all the professionals who are working for improvement of lives of PwDs.
- 16) Usage of the Assistive Technologies is a requirement to Countries signed the United Nation's Convention on the Rights of Persons with Disabilities (CRPD). Therefore, Govt. of India should take initiatives to ensure access to ATs among all PwDs. In addition, supplying the ATs to PwDs is a national responsibility as well as an international responsibility.
- 17) The principle of non-discrimination suggests that all people with disabilities have a right to demand available and affordable ATs to assure their enjoyment of all human rights. Thus it becomes essential for school/public institutes to support usage of AT among all PwDs including persons with intellectual disabilities.

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