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Disability and Assistive Technology: Enhancing accessibility and inclusion of persons with disabilities

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Abstract: This paper explores the relationship between disability and assistive technology. It examines existing literature to identify how technology has impacted the lives of persons with disabilities. The paper highlights the various types of assistive technology available, including software and hardware. It underscores that assistive technology has made a significant contribution to the lives of persons with disabilities, by providing them with more autonomy, independence, and opportunities. It has also helped them to overcome physical, communication, and cognitive barriers, which had previously limited their participation in various aspects of life. However, the paper also acknowledges the challenges that come with the use of technology for persons with disabilities, such as accessibility issues, affordability, and the need for specialized training. It concludes by recommending the need for continued research and development in assistive technology to improve the quality of life for persons with disabilities.

Keywords: Disability, Assistive Technology, Persons with Disabilities, Challenges, Quality of Life.

Introduction

Disability is any physical, mental, or cognitive condition that limits a person's ability to perform everyday tasks. It can include sensory impairments, mobility limitations, developmental disabilities, and mental health conditions. The paper aims to explore the impact of assistive technology on the lives of people with disabilities.

Assistive Technology (AT) maintains or improves an individual's functioning and independence to facilitate participation and enhance overall well-being. Many persons with disabilities rely on AT services to carry out their daily activities. Assistive Technology has huge potential for reducing difficulties faced by persons with disabilities (PWDs) in their day-to-day lives. AT opens up opportunities that are closed to PWDs without AT services. Access to AT services is a fundamental human right, which is guaranteed by the UN through its Convention on the Rights of Persons with Disabilities (UNCRPD), which is a legally binding document that has described disability in a rights-based approach. The UNCRPD is considered to be a strong human right instrument that mandates the right of PWDs to have equitable access to mainstream programmes, social protection programmes and disability-specific programmes such as rehabilitation and AT. The UNCRPD has been ratified by India, committing by the Government to ensure the availability of AT services to those who need AT.

According to the World Health Organization (WHO), "Assistive technology is an umbrella term covering the systems and services related to the delivery of assistive products and services. Assistive products maintain or improve an individual's functioning and independence, thereby promoting their well-being. Hearing aids, wheelchairs, communication aids, spectacles, prostheses, pill organizers, and memory aids are all examples of assistive products". The use and benefit of these devices varies from person to person based on their personal aspirations and individual characteristics. WHO India's subnational rapid Assistive Technology Assessment

Survey in December 2021 found that the prevalence of need for assistive products was 24.5% across all ages, which translates to over 330 million people. It's in this context, WHO India is providing technical support to the NITI Aayog, Department of Empowerment of Persons with Disabilities, and Indian Council of Medical Research for improving access to assistive technologies.

According to the Global Report on Assistive Technology, 2.5 billion people need at least one assistive product. The demand is expected to go up to 3.5 billion by 2050. The requirement may range from a spectacle to highly advanced myoelectric hand or robotic exoskeletons. However, nearly nine out of 10 people who need assistive technology do not have access to it – this has an adverse impact on the education, livelihood, health, and well-being of individuals, families, communities, and societies. Assistive products are "any external products including devices, equipment, instruments or software specially produced or generally available, the primary purpose of which is to maintain or improve an individual's functioning and independence and thereby promote their wellbeing" (World Health Organization, 2016). Assistive technology is the application of organized knowledge and skills related to assistive products including systems and services. Attributable diseases (AD) are related to disabilities attributed to medical (chronic diseases) or non-medical reasons (war, rage, accidents) and can affect any age group. Besides disabilities, AD is used to overcome the functional loss related to senile changes such as a decrease in vision or hearing or locomotor disability in the human body (Grimmer et al., 2019). Most of the AD have focused on overcoming disabilities owing to intellectual or learning disabilities (Young, 2013). The assistive products are essential for compensating for impairment, minimizing the need for caregivers, lowering health, and welfare costs (Organization, 2016). The proportion of various disabilities in India in 2018 was only locomotor disability 1.2%, only visual disability 0.2%, only hearing disability 0.2%, only speech and language disability 0.1%, only mental retardation/ intellectual disability 0.1%, only mental illness 0.1%, multiple disabilities 0.2%, and disability 2.2% (Ministry of statistics and program implementation: National Statistical Office, 2018).

Assistive technology (AT) is an umbrella term, and the International Classification of Functioning, Disability, and Health (ICF) defines 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 (Ellis, 2016).AT refers to any device, software, or tool that helps people with disabilities to perform tasks that might be difficult or impossible for them otherwise. Here are some examples of assistive technology:

Aids for Daily Living: This covers self-help aids for use in activities such as eating, bathing, cooking, dressing, toileting, home maintenance, etc. These include modified eating utensils, adapted books, pencil holders, page-turners, dressing aids, and adapted personal hygiene aids.

Mobility Aids: Devices that help people move within their environment, electric or manual wheelchairs, modifications of vehicles for travel, scooters, crutches, canes, and walkers.

Home/workplace modifications: structural adaptations that remove or reduce physical barriers such as ramps, lifts, modification in the bathroom to make it accessible, automatic door openers and expanded doorways, etc.

Seating and Positioning: Adapted seating, cushions, standing tables, positioning belts, braces, and wedges to maintain posture and devices that provide body support to help people perform a range of daily tasks.

Alternative and augmentative communication devices (AAC): These devices help people with speech impairments or persons having low vocal volume to communicate such as speech-generating devices, voice amplification aids, and communication software. For visually impaired persons, devices as magnifiers, Braille or speech output devices, large print screens, closed circuit television for magnifying documents, etc.

Prosthetic and Orthotics: Replacement or augmentation of body parts with artificial limbs or other orthotic aids such as splints or braces. There are also prosthetics to assist with cognitive limitations or deficits, including audio tapes or pagers (that function as reminders).

Vehicle Modifications: Adaptive driving aids, hand controls, wheelchairs and other lifts, modified vans, or other motor vehicles used for personal transportation.

Sensory aids for vision/hearing impaired: such as magnifiers, large print screens, hearing aids, visualizing systems, Braille, and speech/telecommunication output devices;

Computer Access Aids: Headsticks, light pointers, modified or alternate keyboards, switches activated by pressure, sound or voice, touch screens, special software, voice-to-text software that enable persons with disabilities to use a computer. This category includes speech recognition software.

Recreational aids to enable participation in social/cultural events and sports: Devices to enable participation in sports, social and cultural events which include audio design for movies, adaptive controls for video games etc.

Environmental Controls: Electronic systems that help people control various appliances, switches for telephone, TV, or other appliances which are activated by pressure, eyebrows, or breath.

Adaptive software and hardware: These include software and hardware modifications that can help people with disabilities access computers, smartphones, and other digital devices.

Assistive listening devices: These devices can help people with hearing impairments to hear more clearly in noisy environments or from a distance.

Assistive technology and other environmental interventions can bridge a gap between environmental demands and an individual's capacity, where such a gap limits their opportunities for participation. The UN Convention on the Rights of Persons with Disabilities (CRPD) contains provisions for both assistive technology and accessibility, recognized as key factors in enabling full and effective participation of people with disability in society on an equal basis with others.

Assistive technology can greatly enhance the independence, productivity, and quality of life of people with disabilities. It is important to note that assistive technology needs to be matched to the individual needs and abilities of the person using it. Additionally, it is essential to ensure that assistive technology is accessible, affordable, and usable by all who need it. With advances in technology, there is an increasing range of options available to support people with disabilities, and it is essential to ensure that these tools are accessible and affordable to all who need them.

Methodology

This research paper aims to conduct a qualitative investigation into the relationship between disability and assistive technology. In this pursuit, analytical methods have been employed to understand data, facts, and information available in the form of books, journals, or magazines already available. The secondary sources of data used for this particular study include books, journals, magazines, periodicals, and online websites.

Theoretical Framework

Some important frameworks to understand disability are given below:

Social model of disability: This theory argues that disability is not an inherent characteristic of an individual, but rather a social construct that is created by the barriers and limitations imposed by society. The social model emphasizes the importance of removing environmental and social barriers to enable people with disabilities to fully participate in society, including access to technology.

Critical disability theory: This theory takes the social model further by analyzing the power relations that exist between people with disabilities and society, particularly in terms of how disability is constructed and represented. Critical disability theory also critiques the use of technology in perpetuating ableism and exclusion.

Actor-Network Theory: This theory emphasizes the role of technology in shaping social relationships and power dynamics. It suggests that people and technology are interconnected and mutually influential and that technology is not neutral but rather embedded in social and cultural contexts.

Cultural model of disability: This theory argues that disability is not solely a medical issue but is also shaped by cultural attitudes and beliefs about disability. The cultural model highlights the importance of understanding the diverse experiences and identities of people with disabilities, including how technology can both support and challenge cultural norms and expectations.

Social constructionist theory: This theory emphasizes the role of language and discourse in constructing the meaning of disability. It suggests that disability is not a fixed and objective reality, but rather a product of social interactions and interpretations. The social constructionist perspective also examines how technology can be used to shape and reinforce social meanings of disability.

Review of Literature

Assistive technology (AT) has been shown to have a positive impact on the lives of people with disabilities.

- A study by Hwang and Shin (2021) found that assistive technology can significantly improve the quality of life and functional ability of people with disabilities, particularly in the areas of communication, mobility, and activities of daily living.

- A systematic review by Silva et al. (2020) analyzed 43 studies on the impact of assistive technology on the lives of people with disabilities. The authors found that assistive technology can improve independence, social participation, and quality of life for people with disabilities. However, they also noted that barriers to accessing and using assistive technology still exist.

- A study by Sánchez et al. (2020) found that AT can help people with disabilities access and use digital technologies, reducing the digital divide and promoting social inclusion.

- A study by Lee et al, 2018, found that mild, moderate, and severe disabilities were 17%, 35% and 16% in India, 14%, 56% and 23% in Lao's people democratic republic and 24%, 25% and 8% in Tajikistan respectively. The PwDs (severe) using Assistive devices were 39% in India, 19% in Lao and 60% In Tajikistan. The reasons for not having assistive products were the complicacy of using the devices as per the Indian people besides the affordability of devices by the people of Loa's and the people of Tajikistan found the assistive devices not useful. (Borg,2019)

- A review by Trembley, P.F. et al. (2019) examined 27 studies on the impact of assistive technology on employment for people with disabilities. The authors found that assistive technology can improve employment outcomes for people with disabilities, such as job retention and job performance. However, they also noted that more research is needed on the effectiveness of specific types of assistive technology.

- A review by Lahiri U et al. (2018) found that assistive technology can improve cognitive functioning and independence for people with cognitive disabilities.

- A review by Gregg, Kim, and Stark (2017) found that access to AT is often limited by cost, lack of availability, and lack of knowledge among potential users and providers. Additionally, usability issues, such as difficulty with installation, maintenance, and training, can limit the effectiveness of AT.

- According to Standen et al. (2016) and Diehl, Schmitt, Villano, and Crowell (2012), humanoid robots have the potential to engage children with disabilities because robots can be used to provide safe, predictable responses that engage students. They point out that predictable responses by robots can be modified over time based on individual responses. Also, they suggest that humanoid robots can be used as diagnostic tools and then be reprogrammed to provide specific treatments based on individual children.

- A study by Lee and Ok (2016) found that the use of AT was positively associated with employment outcomes, including job retention and promotion, for people with disabilities.

- A study by Lui, Stanfield, and Trembath (2015) found that the use of AT was positively associated with greater levels of independence, community participation, and satisfaction with life for people with intellectual disability.

- A review by Burgstahler and Cory (2008) found that AT can improve academic performance, increase participation, and improve access to materials and resources for students with disabilities.

- Skylar (2007) agrees and points to virtual reality applications that provide simulated environments that help people experience situations that are too far away or not practical to physically access. For example, a virtual field trip to a geographical location to study flora and fauna could include various VR (Virtual Reality) environments, including biomes, such as deserts, rainforests, ocean shorelines, and estuaries. Skylar also suggests practical VR applications for people to learn how to travel city streets by learning how to ride a bus for transportation.

- A review by Demers, Weiss-Lambrou, and Ska (2002) found that AT can improve physical functioning, reduce pain and fatigue, and increase social participation and self-esteem for people with physical disabilities.

Overall, these studies suggest that AT can have a positive impact on the lives of people with disabilities in various domains, including independence, education, employment, health, and social inclusion. However, access to and usability of AT remain important challenges that need to be addressed to ensure that all who need AT can benefit from it.

Assistive technology (AT) helpful to Persons with Disabilities

AT proves to be helpful to people with disabilities in various ways such as:

Enhancing independence: AT can help people with disabilities to perform everyday tasks independently, such as cooking, dressing, and personal hygiene. For example, mobility aids such as wheelchairs, walkers, and scooters can help people with mobility limitations to move around and perform activities of daily living.

Improving communication: AT can help people with communication disabilities to express themselves and communicate with others. Communication devices such as speech-generating devices and Augmentative and Alternative Communication (AAC) systems can help people with communication disabilities to communicate more effectively.

Facilitating access to education: AT can help students with disabilities access educational materials and resources, participate in class, and complete assignments. For example, adaptive software and hardware can facilitate computer access and use for students with visual or motor impairments.

Increasing employment opportunities: AT can help people with disabilities overcome barriers to employment and succeed in the workplace. For example, hearing aids and communication devices can help people with hearing impairments to communicate with colleagues and clients, and mobility aids can facilitate access to workplaces.

Improving health and well-being: AT can help people with disabilities manage health conditions and improve their overall well-being. For example, prosthetic limbs and orthotic devices can improve mobility and reduce pain and fatigue, and environmental control systems can help people control their surroundings and promote comfort and safety.

Overall, AT can greatly enhance the independence, productivity, and quality of life of people with disabilities, enabling them to participate more fully in education, employment, and social activities. It is important to ensure that AT is accessible, affordable, and usable by all who need it.

Challenges associated with Assistive Technology

There are several challenges associated with assistive technology for people with disabilities. Globally, over 75% of low-income countries across the world have no prosthetic and orthotics training programs. Countries with the highest prevalence of disability-related health conditions tend to be those with the lowest supply of skilled health professionals who are involved in the provision of assistive technology (as little as two professionals per 10, 000 population) (Gupta, Castillo-Laborde, & Landry, 2011). The World Health Organization (2017) estimates that more than one billion people around the world (mostly elderly and persons with disabilities) need one or more assistive technology products. With the populations aging and the rise in non-communicable diseases, this number is expected to increase to beyond two billion in the world by 2050 (WHO, 2017).

A major problem faced in the development of Assistive Technology is the absence of a policy that will aid the development of an AT market in India. Presently the demand for assistive technology in India is highly fragmented and a formal market is yet to evolve. The domestic AT industry is nearly non-existent and the industry value chain is broken in most parts. Research and development in AT have been happening in leading IITs, NITs, and other R&D institutions, but there's no serious effort at productization. Technology is only a small part of a good product, other parts being engineering, user-friendliness, quality, reliability, ergonomics, customer service, after-sales support, etc. This is particularly important for an AT product because of the high dependence of the users. The other parts of the industry value chain, like, manufacturing, distribution, sales, service, etc., are also not in place. Educating the users to create awareness is another issue. AT products are rarely advertised.

Cost: AT can be expensive, making it inaccessible for many people with disabilities who may not be able to afford it. This can lead to a significant economic burden for individuals and their families. Lack of affordability in low-income countries is a major reason people in need do not possess assistive products.

Availability: AT may not be readily available in certain regions or communities, making it difficult for people with disabilities to access the technology they need. Today, only 1 in 10 people in need have access to assistive technology due to high costs and a lack of awareness, availability, trained personnel, policy, and financing.

Usability: Some AT devices may be difficult to use or require significant training, which can be a barrier for people with disabilities who may have limited mobility or cognitive abilities.

Stigma: Some people with disabilities may feel stigmatized or embarrassed when using AT devices, which can lead to social isolation and reduced use of the technology.

Maintenance: AT devices require maintenance and repair, which can be costly and time-consuming. This can be a barrier for people with disabilities who may have limited resources or access to maintenance and repair services.

Compatibility: Some AT devices may not be compatible with existing technologies, such as computers or smartphones, which can limit their usefulness for people with disabilities.

Across the globe, many people who need assistive technology do not have access to it. Examples of the unmet global need for assistive technology include:

- 200 million people with low vision who do not have access to assistive products for low-vision.
- 75 million people need a wheelchair and only 5% to 15% of those in need have access to one.
- 466 million people globally experience hearing loss. Hearing aid production currently meets less than 10% of the global need.

Huge workforce shortages in assistive technology: Over 75% of low-income countries have no prosthetic and orthotics training programmes. Countries with the highest prevalence of disability-related health conditions tend to be those with the lowest supply of health workers skilled in the provision of assistive technology (as low as 2 professionals per 10,000 population).

Policy: Very few countries have a national assistive technology policy or programmes. In many countries, access to assistive technology in the public sector is poor or non-existent. Even in high-income countries, assistive products are often rationed or not included in health and welfare schemes, leading to high out-of-pocket payments by users and their families. For example, it is common policy in several European countries for the state to provide older people with only 1 hearing aid, even though most people with age-related hearing loss require 2 hearing aids to function.

Products: The assistive products industry is currently limited and specialized, primarily serving high-income markets. There is a lack of state funding, nationwide service delivery systems, user-centered research and development, procurement systems, quality and safety standards, and context-appropriate product design.

Provision: In high-income countries services are often stand-alone and not integrated. People are forced to attend multiple appointments at different locations, which are costly and add to the burden on users as well as caregivers, and on health and welfare budgets. In many low- and middle-income countries, national service delivery for assistive products does not exist. Those who can afford them buy assistive products directly from a pharmacy, private clinic, or workshop. People from the poorer sectors of society must rely on erratic donations or charity services, which often focus on delivering large quantities of low-quality or used products. These are often not appropriate for the user or the context and lack mechanisms for repair and follow-up. A similar scenario is also common in emergency response programmes.

Personnel: Trained health personnel are essential for the proper prescription, fitting, user training, and follow-up of assistive products. Without these key steps, assistive products are often of no benefit or abandoned, and they may even cause physical harm (as is the case of providing wheelchairs without pressure relief cushions for people with spinal injuries).

Overall, addressing these challenges is crucial to ensure that people with disabilities can access and benefit from the full potential of AT devices. This requires collaboration between policymakers, researchers, industry leaders, and people with disabilities themselves to identify and address the barriers to AT adoption and use.

Role of Assistive Technology (AT)

AT can play an important role in promoting inclusion of the people with disabilities in society. It can have a positive impact on the health and well-being of a person and their family, as well as broader socioeconomic benefits. Access to education: AT can help students with disabilities access educational materials, participate in classroom activities, and communicate with teachers and peers. WHO is coordinating the Global Cooperation on Assistive Technology (GATE), which exists to improve access to high-quality affordable assistive technology for everyone, everywhere.

1. **Employment**: AT can help people with disabilities to perform job tasks, communicate with colleagues, and access information, increasing their opportunities for employment and career advancement.

2. **Independent living**: AT can help people with disabilities to perform daily living tasks, such as cooking, cleaning, and personal hygiene, increasing their independence and autonomy.

3. **Social participation**: AT can help people with disabilities to participate in social activities, such as attending events and communicating with friends and family, reducing social isolation and promoting community integration.

4. **Access to public spaces**: AT can help people with disabilities access public spaces, such as buildings, transportation, and parks, increasing their mobility and participation in society.

5. Proper use of hearing aids by young children leads to improved language skills, without which a person with hearing loss has severely limited opportunities for education and employment.

6. Manual wheelchairs increase access to education and employment while reducing healthcare costs due to a reduction in the risk of pressure sores and contractures.

7. Assistive technology can enable older people to continue to live at home and delay or prevent the need for long-term care.

8. Therapeutic footwear for diabetes reduces the incidence of foot ulcers, preventing lower limb amputations and the associated burden on health systems

Conclusion

It is essential to consider a variety of assistive technology devices to reach persons with disabilities. There are other issues such as cost, care, and maintenance of the devices. Modeling successful environments with assistive technology is a good starting point for creating an awareness of thre appropriate use of assistive technology. We are entering a “brave new world” of assistive technology and professionals need to be prepared and indeed need to be involved in continual lifelong learning to assist persons with special needs and provide appropriate educational and employment opportunities. Lack of accessibility, eligibility, reachability, and affordability are the main barriers to accessing AT services for PWD. Increased community-level awareness, increased Government funding and a community-based, medically informed flexible social model of AT services is a way forward to ensure access to AT services for PWD.

The 2030 Agenda for Sustainable Development places good health and well-being at the center of a new development vision. It emphasizes universal health coverage (UHC) to ensure sustainable development for all, so that everyone everywhere can access the health services needed without facing financial hardship. Universal Health Coverage can be advanced inclusively only if people can access quality assistive products when and where they need them. Addressing the unmet need for assistive products is crucial to achieving the Sustainable Development Goals, providing UHC, and to implementing the UN Convention on the Rights of Persons with Disabilities, ratified by 177 countries. ‘Leaving no one behind’ means ensuring that people with disabilities, the older population, and those affected by chronic diseases are included in society and enabled to live a healthy and dignified life.

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