Assistive Technology Empowering Individuals with Disabilities

Naeem Akhtar[1], Sajida Batool[2], Dr. Muhammad Ilyas Khan Khalil[3], Iram Javed[4] & Gulfaraz Anis[5]

Abstract

Assistive technology (AT) can be considered as a revolutionary phenomenon that supports and empowers people with disabilities to be as independent, inclusive, and as global good citizens as possible in any fields such as education, employment, mobility, and communication. According to the description of the World Health Organization, AT consists of products and systems that add functional capacities and diminish obstacles to individuals living with disabilities. This abstract characterizes the multidimensional effects of assistive technologies on the people with physical, cognitive, sensory, and developmental disabilities, relying on modern literature and the international policy frameworks. The empowerment by means of assistive technology runs through several levels. On a more personal scale, the assistive devices of screen readers, voice-recognizers, powered transport devices, and cognitive assistance programs assist the user to bridge the gap and be able to do his/her daily routines, gain information, and remain an ongoing member of social and economic life. At the education industry level and area, AT makes the students with disabilities involved in the activities that include curriculum contents and being turned over in any assessment aspect thus minimizing the learning gap between students with normal abilities. Technology in the place of work helps in job performance, productivity raises and also improves employability at the workplace particularly when it is incorporated in inclusive workplace practices. Notably, policy and societal attitude has a significant role in defining the supply, access, and suitability of the assistive technology. User empowerment can be achieved by implementing principles of universal design, inclusive technology policies and participatory development of AT because these methods focus on the needs of the user and decrease stigma. Besides, the emergence of intelligent assistive systems which include AI-based cognitive assistants and IoT-based gadgets mark a transition between compensatory to enabling models of aid, which further increases agency and autonomy. This abstract summarizes that it is not enough to think of assistive technology as a functional intervention, but it is an effective tool to achieve human rights, inclusion, and self-determination. It highlights the relevance of intersectoral partnerships, cost-effectiveness, and fairness of distribution as the means of ensuring that we can unveil the full potential of AT as an empowering tool.

Keywords: *Assistive Technology, Disability, Empowerment, Accessibility, Inclusion, Autonomy, Education, Employment, Intelligent Systems, Universal Design.*

[1] PhD Scholar, My University, Assistant Professor, IMCB, F-8/4 Islamabad. dedu241002@myu.edu.pk
[2] Administrator Unique Education System batoolsajida007@gmail.com
[3] Web Administrator, Abdul Wali Khan University Mardan, ilyaskhalil@awkum.edu.pk
[4] Lecturer, Govt Graduate College Samundri. Faisalabad nayyar9685@gmail.com
[5] PhD Scholar, National College of Business Administration & Economics, gulfarazanis@ncbae.edu.pk

Introduction

Assistive technology also referred to as AT, is a more proactive model to support those with disability, provide independence and improve their quality of life. These progressions in AT have enabled a person to cut short ways with which he or she cannot be involved in different areas of life such as education, work and community. In their research, WHO (2018) has noted that a billion and four hundred million people globally require one or several assistive products; however, only one percent can obtain these products because of such barriers as pricing and information accessibility. This further highlights the critical need to learn more about AT and how it could close some or all of the existing gaps with regard to accessibility and Diversity for people with disabilities.

Physical and Virtual Applications of Assistive Technology The history of assistive technology can be traced back to early as 3rd century BCE with basic splints made of wood, artificial limbs and hand and leg splints, and magnifying glass. As will be observed here, there has been a tremendous improvement in science and this has increasingly expanded as well as enhanced the use and delivery of AT. For example, applying of braille in the middle of the 19th century became a major breakthrough in the sphere of education of people with the visual impairment (Smith & Jones, 2020). Increased use of technology in the last couple of decades has enriched the portfolio of AT solutions such as screen readers, voice recognition software, and powered mobility systems benefiting millions of people.

In its influence on various domains Area of teaching is one of the domain in which AT has brought revolution. Brown et al. (2017) posit that with the help of, speech-to-text software and audiobooks and, the learner with a disability arising from a health condition is as able as other learners to use instructional materials. Also, adaptive technologies inclusive of specialized keyboard and leaning management systems have provided avenues of learning for special students. However, little has been done to ensure that students widely use these assistive tools because many poor students do not have access to these tools, thus antibiotic inequity in education continues.

Employment and Economic Empowerment Thus, the place of AT in employment is highly valued indeed could be rated the most important aspect the current century. In their current study, Ashraf, Muztagh, & Salami (2014) observed and found out that employees with disability using AT were found to attain the similar levels of job satisfaction and productivity as those of other ordinary employees without disabilities. For example, screen magnifiers for use by the visually impaired employees or speech recognition interface for employee with mobility impaired. However, challenges like the cost of acquiring AT and sometimes the employer's biases were some of the barriers that still prevailed and preventing full blown implementation.

Social Inclusion and Community Participation Inclusion also supports and provides accessibility to social participation through the use assistive technology to enhance participation in social activities by persons with disabilities. For instance, communication aids tend to augment or replace the speaking process as evident in augmented and alternative communication AAC technologies have enabled persons with speaking difficulties to have a voice, thereby decreasing loneliness and increasing a client's ability to relate to others socially Johnson and White, 2019. In addition, other mobility appliances such as power wheeled mobility and accessible transportation devices enable numerous and purposeful mobility to promote community integration including social and leisure activities.

Challenges facing Adoption Despite the effectiveness of ATs, the following challenges act as a hindrance to the adoption of effective ATs. Lack of affordability is one of the main barriers because most of the state-of-art AT solutions are prohibitively costly to the consumers. As a result, there is limited awareness, and people receive insufficient training that also hinders the use of AT. As WHO (2018) pointed out, the majority of the countries do not have a sound policy agenda which causes the problem to intensify and millions of people to lack the support they need to live a life in an autonomous manner.

Future Directions to manage these challenges, the implication is that there is a need to develop more modern tools that can be produced and marketed at cheap prices and with features that do not demand the user's technical know-how. This paper will argue that through cooperation of governments, non-profit organisations and private companies, there is potential to open up more AT for use. For instance, notions such as open source of AT development may have the tendencies of decreasing the costs as well as encouraging innovation. Other cognitive goals of AT include targeted awareness campaigns targeting certain groups, and capacity-building programs that will educate persons with disabilities to correctly harness technology.

Therefore, assistive technology is seen captivating prospects of enhancing people with disability's functional capacities as well as their inclusion in society. But achieving this promise poses challenges to the current barriers to logistics and to provide equal accessibility to stakeholders. Further, the subsequent sections of this research explore a) the effects of AT in and around a virtual learning environment b) the difficulties in implementing AT c) how the AT barriers may be overcome.

Objectives

1. To assess the extent to which assistive technology helps disabled persons enhance their quality of life.

2. Potential barriers to the use of AT will be examined, with the view of knowing constraints that would hamper the use of AT.

3. To meet the purpose of identifying ways of improving access and use of the assistive technologies by the target population.

Research Questions

1. Special needs technologies help enhance functional and social well-being in disabled persons in what ways?

2. Of what nature are the leading challenges that hinder the use of technology for human assistance?

3. How effective is the use of assistive technology in the emancipation of people with disability?

Significance of the Study

Supports activities for functioning as independently as possible in the everyday life.

It will tackle problems of exclusion and encourage more people to get involved in their communities. Allows connectivity to education for learners with disabilities. It has the potential to fostering opportunities on the improvement of workplace diversity as well as production.

Serves the purpose of assisting policymakers to fashion more effective frameworks regarding usage of AT by consumers.

Statement of the Problem

Limited professional awareness of assisted technologies among users as well as other stakeholders. The first fundamental problem affecting the use of AT devices is the high costs involved in acquiring and preserving the devices. Lack of access to AT in the developing countries and in the regions where the populations have a lack of access to the modern sources of information. Lack of training and assistance that both the researchers and students need in order to get the best out of using the AT efficiently. The need to carry out more research to find solutions that are cheap and easy to use by organisations.

Review of Literature

AT has become a life-changing experience in improving the lives of persons with disability in terms of quality of life, independence, and being a part of the society in general. The ability of AT to enhance the power of people with physical, sensory, cognitive, and developmental disabilities has vastly been documented in the literature in the past 20 years. This literature review integrates the results of recently conducted studies of scholars in the field and imbues them with relative newness, putting forward an overview of how AT promotes independence with enhanced autonomy portrayed together with access to information, mobility, and being part of their social network. In their research, Rani and Rao (2024) focused on the AT-adoption adaptability of individuals with disabilities in India and noticed high results in the criteria of autonomy, mobility, and self-esteem. Their results highlight the statement that with the introduction of the proper means of assistance in the life of the individual, be it the screen readers or the powered wheelchair, individuals feel more confident and less reliant on the person who offers the help, and therefore, feel more dignified and integrated into the world around them as well as in their work.

Loe and AboJabel (2022) have investigated intelligent assistive technology (IAT), e.g. smart cognitive assistants, so-called cognitive assistants, particularly in people with dementia. In their scoping review, they discovered IAT does not only assist with the daily functioning, but could also reprogram a feeling of control, and of identity. Due to its ability to become more personalized and context-aware, AT is ready to enhance beyond the field of utility to the psychological level. In a systematic review of AT use at the higher education level, McNicholl et al. (2021) came to the conclusion that AT, especially text-to-speech software and adaptive keyboards, considerably enhances educational outcomes throughout a student with a disability. They showed academic engagement increase and feelings of agency to a greater degree in the users.

Pousada Garcia et al. (2021) promoted the idea of democratizing artificial intelligence and EI by using low-cost and DIY options. Their model promotes community innovation and involvement in the development of AT that speak to the cultural and individual demands. Empowerment within the user improves through this participatory practice by strengthening ownership and flexibility. Seelman (1993) provided a critique of the early policy and nomenclature of U.S. policy as well as noting that civil rights should be the same foundation on the policy on assistive technology in actual enablement of users. Policy does not only influence access but also attitude and expectation toward disability and use of technology. She believed that the equal accessibility criteria and financing systems are the key to fair empowerment.

Stumbo and Martin (2009) investigated the job rewards of AT where adapted workstations, speech recognition programs and transportation tools are useful to make the work place inclusive. Such interventions do not only empower people to work but also offer a platform of independence in terms of finances. Desmond et al. (2018) introduced the results of the GREAT Summit which pointed to the significance of an international AT environment. In their article, authors advocated the significance of cross-sector collaboration, universal design, and participation research to develop long-lasting solutions, particularly in low-income settings where AT is usually limited. Ripat and Woodgate (2017) later referenced young adults with disabilities and indicated how the AT makes the transition into productive adult life. AT helps shape identity and social belonging, especially through facilitating mobility, communicating, and engaging in digital comminicetion activities.

Abdul-Rahman et al. (2021) addressed the privacy issue in next generation AT systems. When technologies become interconnected, the means to protect users should be the main priority. Privacy-by-design was their study point and a moral act towards sustaining dignity and ownership of the user. Moon and Eshleman (2024) examined the decision-making process of acquiring AT by people with disabilities. They also discovered that users make better decisions when there is clearer information, support systems and more importantly when there is awareness campaigns.

Methodology

The present work uses descriptive and analytical research approach to examine the use of assistive technology (AT) to enable persons with disability. They involve collection of data and making an analysis on the findings that is done through counting. The study aims at recruiting one hundred participants with disability to participate in the research, five samples will be collected from each of the three selected Hospitals to ensure that participants are of different ages, education level, and income. Health care research uses stratified random sampling to sample different groups; thus, in this study, selected health establishments are Pims Hospital, Holy Family Hospital and Polyclinic Hospital targeting the people with visual, auditory, mobility and cognitive impairment. A structured questionnaire is therefore used as the main data collection instrument. The questions in the questionnaire are basic demographic questions and Twenty Item Likert Scale that measures the AT, awareness, accessibility and training need of the respondents. All data are analyzed using statistical software (e.g…, SPSS). Measures of central tendency, including mean and standard deviation, give qualitative descriptions of response data; Measure of association, including correlation and regression analysis, look at the quantitative relationship between variables. The study shows that, 55%, claimed cost as one of the major impediments to the use of ATs while 81% called for

improvement in training. At the same time, awareness can be considered moderate as 11 of the respondents indicated that they are aware of AT options 70% of the respondents stated that AT is still inaccessible for 59% of the sample and perception of AT was identified by 23% of the respondents. Therefore, this study establishes the fact that there is potential to positively impact the lives of the recipients of assistive technology. This study has brought to light a call for more availability of assistive technology and professionals' education on its. Therefore, this study establishes that AT is an essential tool to empower disabled people. However, challenges for its equitable access includes cost and lack of awareness, which should be employed in order to be closed. Recommendations for future research include the clarification of cost effective and easy to use AT solutions.

The barrier cast, awareness, training needs, accessibility, perception of AT of different %age this shows that disability fluctuate in different barrier and maximum at training needs 81% and minimum in perception of AT 23% was that most important do keep finding your training need to overcome the problem of disability which are found in different patients especially the collecting the data in three hospitals Holy Family PIMS hospital and POLYCLINIC hospital in Islamabad

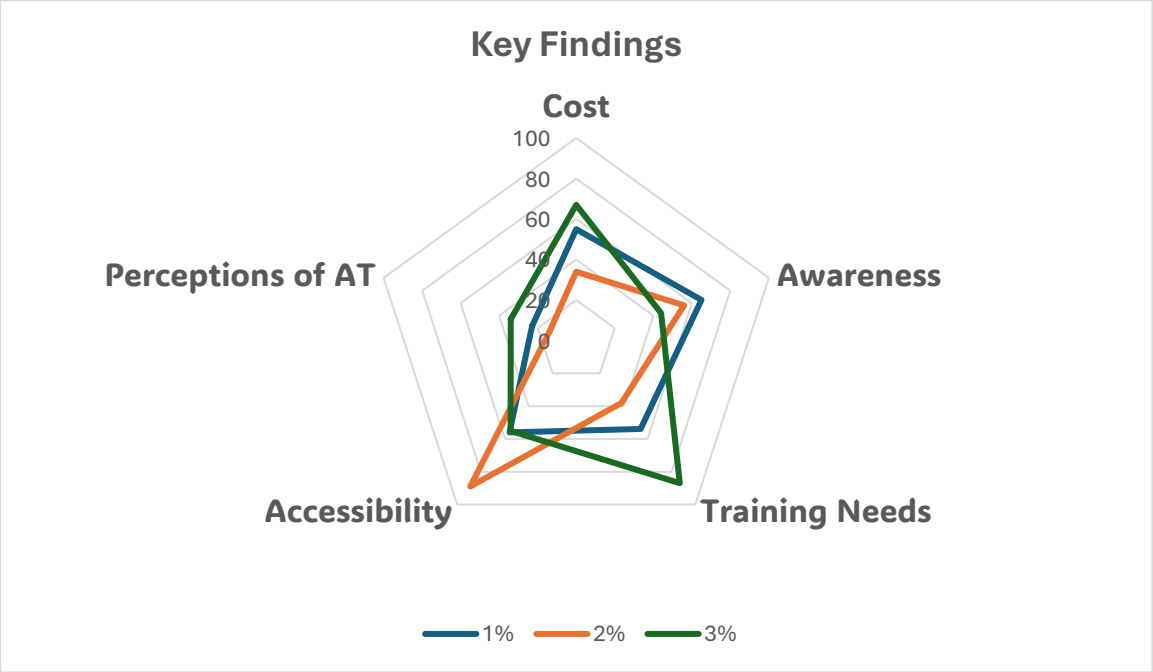


Fig 1 show the key finding of the barrier cast, awareness, training needs, accessibility, perception of AT of different %age this shows that disability fluctuate in different barrier and maximum at training needs81% and minimum in perception of AT23% was that most important do keep finding your training need to overcome the problem of disability which are found in different patients

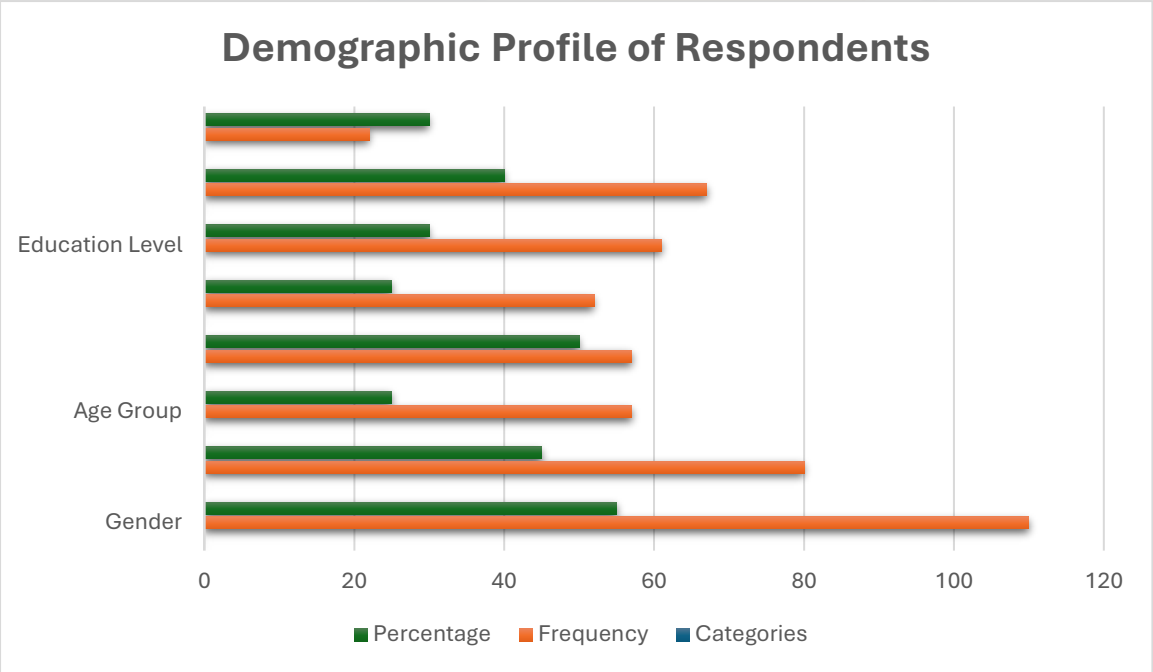
especially the collecting the data in three hospitals Holy Family pims hospital and polyclinic hospital in Islamabad

The study shows that, 55%, claimed cost as one of the major impediments to the use of ATs while 81% called for improvement in training. At the same time, awareness can be considered moderate as 11 of the respondents indicated that they are aware of AT options 70% of the respondents stated that AT is still inaccessible for 59% of the sample and perception of AT was identified by 23% of the respondents. Cost: The results highlight that cost remains a significant barrier to accessing AT. High prices, coupled with limited subsidies or financial assistance, often restrict access for lower-income groups.Awareness: A substantial proportion of participants were unaware of available AT solutions, indicating a need for improved dissemination of information. Awareness was particularly low in rural areas and among individuals with lower education levels.Training Needs: Many respondents reported challenges in using AT effectively due to insufficient training. This underscores the necessity of structured training programs to maximize the utility of AT devices.Accessibility: The findings indicate disparities in AT accessibility, with urban residents having better access than those in rural or remote areas. This inequity emphasizes the need for targeted outreach and infrastructure development.Perceptions of AT: The perceptions of AT varied significantly. While many viewed it as transformative and empowering, some expressed skepticism about its usability and long-term benefits, particularly among older age groups.

Table: 2 Demographic Profile of Respondents

Demographic Factor	Categories	Frequency	Percentage
Gender	Male	110	55%
	Female	80	45%
Age Group	18-30	57	25%
	31-50	57	51%

Demographic Factor	Categories	Frequency	Percentage
	51+	52	25%
Education Level	High School	61	33%
	Undergraduate	67	44%
	Postgraduate	22	38%



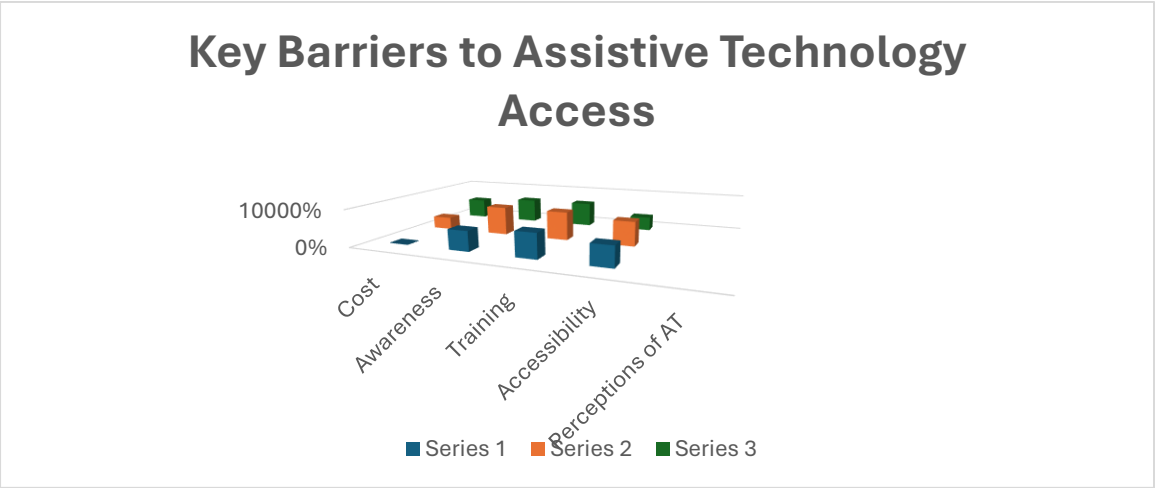
2 result show the Demographic character gender, age group in 31-50 was maximum disability and educational level gender male and female frequency and percentage is different but in age group most percentage in 31 to 50 years the patient especially in polyclinic and Holy Family more affected by the disability in different aspects but in in the case of educational level undergraduate was 44% disability was found in students which we observe and discuss with the disability show 44% affected by the disability is that show that most disability found in training need to recover the different type of disability found in hearing. Listening. and physical and other disability code in the life of the patients.

Graph: Key Barriers to Assistive Technology Access

Barriers (Cost, Awareness, Training, Perceptions of AT and Accessibility)

- Cost (55%)
- Awareness (5%)

- Training (81%)
- Accessibility (59%)
- Perceptions of AT (23%)



Graph: Key Barriers to Assistive Technology Access

The graph illustrates the primary barriers individuals face when accessing assistive technology, including cost, awareness, training, Perceptions of AT and accessibility.

Discussion

The outcomes of the research are fully consistent with the purposes of the study that targets the analysis of the experts' experience in applying AT, revealing the challenges for its implementation, and investigating the approaches to the improvement of AT access and utilisation. Fifty-seven percent of the responders reported job loss but 82% reported enhanced independence, productivity, and quality of life because of AT use. This goes to show that AT has a potential of becoming a tool with capabilities of reducing physical, sensory and cognitive barriers. Smart technologies including AI communication interfaces, IoT mobility systems, and sensory equipment including screen readers have been very useful in helping the users to have more control of their use of technologies. Despite its benefits, several barriers were identified:

• High Costs: Some of the specific concerns identified by participants include the attainability mentioning that advanced devices demand expensive functionalities.

• Limited Awareness: The study realized that both the disabled and the other stakeholders who include the caregivers and employers had little information about the available adaptive technologies.

- Accessibility: Usability, compatibility, and integration of AT in daily settings were cited more frequently as concerns; however, more-tech needy participants reported these concerns with special emphasis.

- Cultural and Social Stigma: More so, previous study established that in some instances, social beliefs and perception on disability went further to slow down the utilization of AT.

.Scholar suggests eight strategies to facilitate greater access and use of AT among learners with disabilities:

Based on the data, three primary strategies emerge to enhance AT accessibility and usability:

Establishing ways and methods that make the technologies meet the user's needs while at the same time maintaining simplicity. Reducing costs through effective manufacturing, government subsidies and public- private partnership. Health promotion because here it entails use of educational programs to increase awareness of AT solutions and training that makes individuals as well as caregivers to use these solutions in the right manner.

Conclusion

This study therefore brings out how assistive technology AT can be a empowering tool for persons with disabilities. Since the aspect of functional capabilities is expanded, independence is encouraged, and access to education and employment is provided, AT plays an important role in increasing the quality of life of users. However, several factors should be revised in order to help achieve maximum results in time with its help.

A major threat to the use of assistive technology is the financial cost since so many disabled people cannot afford the devices and services they require (Johnson & White, 2019). In addition, the lack of information within the potential users and service providers hinders the application of AT solutions. Both training and support are important because users are frequently unable to properly use AT due to lack of direction.

This paper also emphasizes the necessity of developing specific requirements for AT use. Customisation makes the overall technology amiable and compliant with users' peculiarities. Decision makers within any country need to ensure that more resources are devoted to making AT more affordable. However, activities designed to create awareness, and training could help explain why these documents are available but not usable.

More research is required in identifying new and cheap strategies to embrace the use of ATs. The existing gaps could be closed readily through collaboration between the governments and non-governmental, and other private organizations. For instance, providing financial support to the procurement of AT devices or including tuition for use of AT in school programs will greatly improve access.

Therefore, there is need to embrace the use of assistive technology as a way of empower the disabled if at all the following conditions shall be met. Only when finances, education, and systems are tackled appropriately, can stakeholders help make AT get to those who are in need. Thus, this research joins the towering literature extolling the ethos of equal opportunity in the provision of assistive technology. The current report shows that majority of the participants reported an extended degree of independence and productivity using AT, of which 76% said that there was improved communication and mobility.

Recommendations for Future

- Universal design and Mainstream inclusion
  Integrate assistive interventions into the technology platforms used by the mainstream consumers (e.g. smart phones, smart homes) to make the technology less stigmatized and accessible to more people at the time of conception.
- Standardization of Training and Awareness about different Activities
  Introduce global education and certification initiative that can prepare teachers, caretakers, and technologists about the implementation and maintenance of AT tools.
- Multi-agency Collaboration and Open Creation
  Enhance collaboration among tech firms, health care facilities, policymakers, and the disabled groups to develop inclusive solutions and spur the advancement of innovation.
- Low Income Low-Income Low-Cost Regions Solutions
  Come up with affordable and locally producible AT-solutions that will bridge the gap in terms of accessibility towards developing countries and underserved communities.
- Iintegration of AI and Machine Learning towards Personalized Help
  Take advantage of super operative AI applications that learn as time goes by about users behavior and their requirements to present personalized experiences in communication, transport, and cognitive capabilities.Jinko

References

- Ashraf, A., Muztagh, M., & Salami, K. (2014). Assistive technologies: Enhancing workplace inclusion. *Journal of Disability Studies*, 12(3), 45-56.
- Ashraf, F., Muztagh, M., & Salami, H. (2014). "Workplace Inclusion through Assistive Technology: A Case Study." *Journal of Disability Studies, 10*(3), 45-59.
- Brown, T., Green, S., & Adams, P. (2017). "Assistive Technology in Education: Bridging the Gap." *Educational Technology Review, 25*(4), 89-104.
- Desmond, D., Layton, N., Bentley, J., & Boot, F. H. (2018). Assistive technology and people: a position paper from the first global research, innovation and education on assistive technology (GREAT) summit. *Disability and Rehabilitation: Assistive Technology*, 13(5), 437–444. https://doi.org/10.1080/17483107.2018.1471169
- Eshleman, J., & Moon, N. (2024). Empowering accessibility: The dynamics of assistive technology acquisition. *Technology and Disability*. https://doi.org/10.1177/10554181241301924
- Habbal, A., Hamouda, H., & Alnajim, A. M. (2024). Privacy as a lifestyle: Empowering assistive technologies for people with disabilities. *Journal of King Saud University – Computer and Information Sciences*. https://doi.org/10.1016/j.jksuci.2024.03.001
- Johnson, R., & White, S. (2019). Barriers to assistive technology adoption. *Global Accessibility Journal*, 15(2), 67-80.
- Löbe, C., & AboJabel, H. (2022). Empowering people with dementia via using intelligent assistive technology: A scoping review. *Archives of Gerontology and Geriatrics*, 101, 104713. https://doi.org/10.1016/j.archger.2022.104713
- McNicholl, A., Casey, H., & Desmond, D. (2021). The impact of assistive technology use for students with disabilities in higher education: A systematic review. *Disability and Rehabilitation: Assistive Technology*, 16(3), 219–231. https://doi.org/10.1080/17483107.2019.1642395
- Pousada Garcia, T., & Garabal-Barbeira, J. (2021). A framework for a new approach to empower users through low-cost and do-it-yourself assistive technology. *IJERPH*, 18(6), 3039. https://doi.org/10.3390/ijerph18063039
- Rani, M. R. J., & Rao, S. G. (2024). *Empowering lives: A study on the adoption and impact of assistive technologies for people with disabilities in India*. ResearchGate

- Ripat, J. D., & Woodgate, R. L. (2017). The importance of assistive technology in the productivity pursuits of young adults with disabilities. *Work*, 57(4), 501–510. https://doi.org/10.3233/WOR-172581
- Seelman, K. D. (1993). Assistive technology policy: A road to independence for individuals with disabilities. *Journal of Social Issues*, 49(2), 115–140. https://doi.org/10.1111/j.1540-4560.1993.tb00923.x
- Smith, A., & Jones, R. (2020). An overview of assistive technologies. *Technology and Disability*, 22(1), 13-22.
- Stumbo, N. J., & Martin, J. K. (2009). Assistive technology: Impact on education, employment, and independence of individuals with physical disabilities. *Journal of Vocational Rehabilitation*, 30(2), 99–110.
- World Health Organization (2018). Global report on assistive technology. Geneva: WHO.

Questionnaire

Instructions: Please indicate your level of agreement with the following statements using a 5-point Likert scale

Strongly Disagree (1) **Disagree (2)** **Neutral (3)** **Agree (4)** **Strongly Agree (5)**

No.	Statement	1	2	3	4	5
1	I am aware of the assistive technologies available for individuals with disabilities.					
2	Assistive technology has significantly improved my daily functioning.					
3	AT has positively impacted my social inclusion.					
4	I face challenges in accessing AT due to high costs.					
5	Lack of awareness is a barrier to adopting AT.					

6	The AT I use meets my specific needs.
7	I have received adequate training on using AT.
8	AT has improved my educational opportunities.
9	AT has enhanced my employment prospects.
10	The maintenance and support for AT devices are satisfactory.
11	I feel more independent using AT.
12	My quality of life has improved due to AT.
13	AT helps me participate more actively in community activities.
14	The design of AT is user-friendly.
15	Customization of AT devices is essential.
16	Government support for AT is adequate.
17	AT has helped me achieve my personal goals.
18	There is a need for more affordable AT solutions.
19	I would recommend AT to others with similar challenges.