Azadi Ka Amrit Mahotsav

FICCI

Status & Opportunities for Promoting the Use of

Assistive Technologies and Content for Persons with Disabilities in India

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FOREWORD

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In the last few years especially after the launch of the Digital India campaign, our country has seen a foremost mobile revolution. From online shopping to banking, from consuming content to keeping in touch with loved ones, and even seeking medical help and education - the internet has democratised access to all kinds of services for Indians in urban and rural areas alike. And the next

FOREWORD

tectonic shift, we are witnessing is in the area of Assistive Technologies.

For decades, persons with disabilities in India have been dependent on imported products. The unavailability of affordable assistive devices and technologies, and gaps in service delivery, have been big barriers to full social and economic inclusion of persons with disabilities. Many physical environments and learning opportunities have remained inaccessible to them due to a lack of appropriate and economical tools. However, with the support from various government and scientific establishments, several start-ups, as well as corporates, India in the last few years have made massive leaps in developing Assistive Technologies and products to serve domestic consumers.

We have come a long way, but we believe that this journey is far from over yet, as India has the potential to become a global hub for assistive technology, and keeping that in mind, FICCI has prepared this report "Status and Opportunities for Promoting the Use of Assistive Technologies and Content for Persons with Disabilities in India". We hope that this report will lay the foundation for the next phase of development in Assistive Technologies in India, and we thank our industry partners for the support.

Virat Bhatia

Chairman
Mobile Manufacturing and
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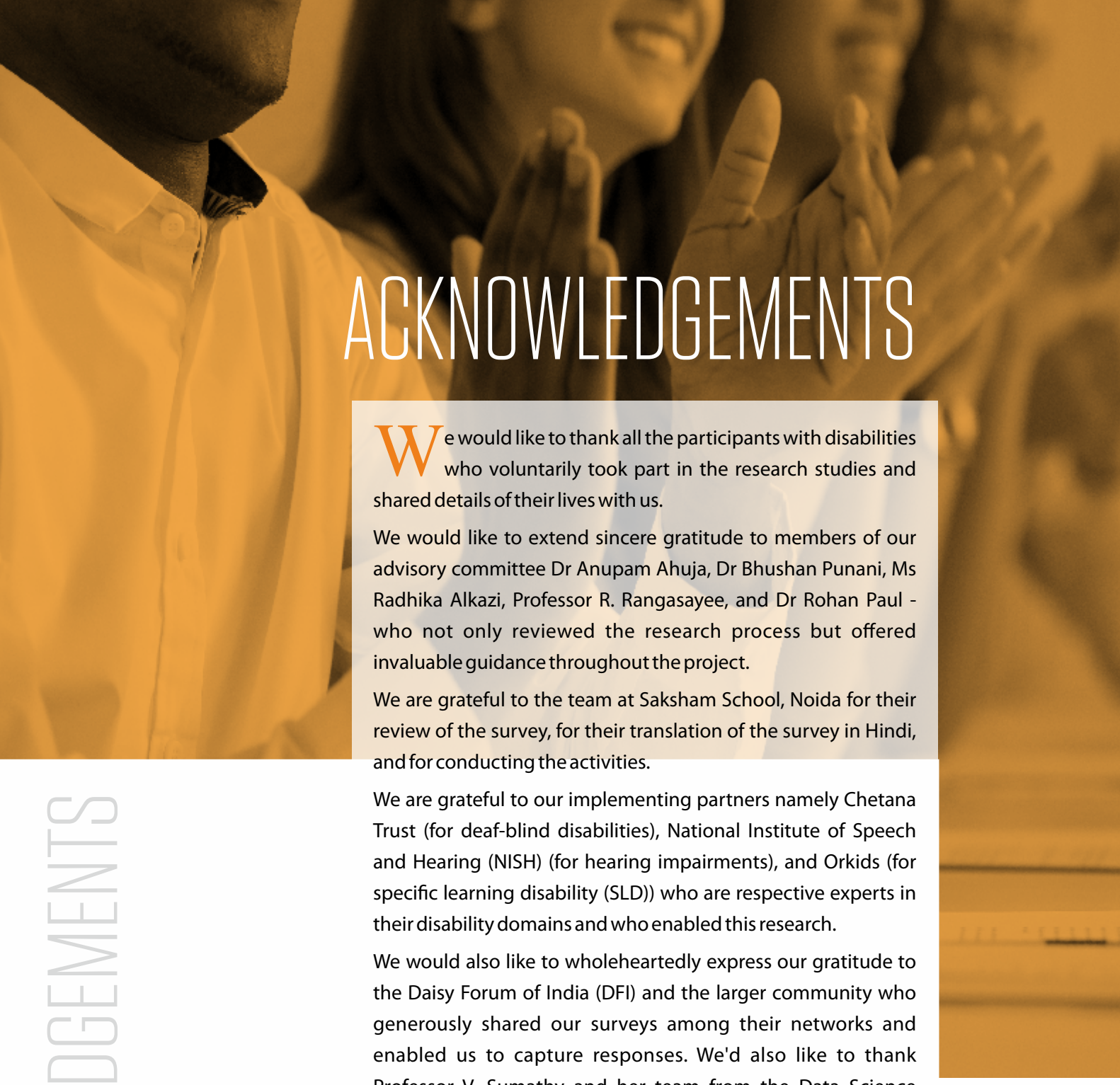

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We are grateful to the team at Saksham School, Noida for their review of the survey, for their translation of the survey in Hindi, and for conducting the activities.

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Technology is a game-changer for persons with and without disabilities and it has an impact across all aspects of our lives. It has the ability to transform and often enables in multiple ways the ability to communicate, have an education, and employment. However, we have not realised the complete potential for its impact in a country like India because there are various gaps in assistive technology (AT) adoption, which we need to address. In many cases, these coexist along with different resources across the country, diverse language and user needs, necessitating the requirement for different solutions for people depending on their diverse socio-economic ability. Solution here is understood as an umbrella term, which may include technological and non-technological and formal and non-formal tools.

This research is a small effort towards understanding what solutions are working for people in different settings, what are some of the gaps and opportunities that exist, and which can give our efforts to scale up AT adoption across the country more focus and direction. The research focuses on three groups of persons with disabilities - persons with vision, hearing, and persons with special learning disabilities. The report lays out briefly the context, the previous studies done, and how it builds upon these studies. It documents and shares the findings that emerged from our interaction with persons with disabilities in our interviews, focus group discussions and surveys. It concludes with some recommendations for different stakeholders, which are by no means exhaustive, but have been indicated through the discussions with participants. We hope that this forms the basis for more focused work and research going forward.

EXECUTIVE SUMMARY

1 Context and Background

1.1 Disability Prevalence in the World

The World Report on Disability estimates that more than one billion persons in the world or about 15% of the world's population live with some form of disability, of which 80% reside in developing countries.[1] Out of this population, an estimated 2 to 4% of those aged 15 years and older have significant difficulties in functioning.[2]

Studies indicate that this number is likely to be considerably higher than reported due to underreporting of disability prevalence in many countries, inconsistency in the definitions of disabilities internationally (e.g. focus on impairment vs. functionality) and the nature of the data collection tool itself. [3, 4] Finally, the number of people who experience disability will continue to increase because of demographic and epidemiological transitions, with global ageing bearing a major influence on disability trends.[5, 6, 7] At the same time, the prevalence of disability is higher for vulnerable groups such as women, those in the poorest wealth quintile, and older people. This is especially true for those in developing countries.[8]

[1] Outcome document of the highlevel meeting of the General Assembly on the realization of the Millennium Development Goals and other internationally agreed development goals for persons with disabilities: the way forward, a disability inclusive development agenda towards 2015 and beyond, General Assembly resolution 68/3, A/RES/68/3 (23 September 2013).

[2] World Health Organization. World report on disability 2011. World Health Organization; 2011.

[3] Karki J, Rushton S, Bhattarai S, De Witte L. Access to AT for persons with disabilities: a critical review from Nepal, India and Bangladesh. Disability and Rehabilitation: AT. 2021 May 14:1-9.

[4] World Health Organization. World report on disability 2011. World Health Organization; 2011.

[5] World Health Organization. WHO global disability action plan 2014-2021: Better health for all people with disability. World Health Organization; 2015.

[6] Tangcharoensathien V, Witthayapipopsakul W, Viriyathorn S, Patcharanarumol W. Improving access to ATs: challenges and solutions in low-and middle-income countries. WHO South-East Asia journal of public health. 2018 Jul 1;7(2):84.

[7] World Health Organization. World report on disability 2011. World Health Organization; 2011.

[8] Ibid

1.2 Disability Rights

The Convention of the Rights of Persons with Disabilities[9] recognises "that disability is an evolving concept and that disability results from the interaction between persons with impairments and attitudinal and environmental barriers that hinders their full and effective participation in society on an equal basis with others".[10] At the same time there is a growing recognition of disability as part of the human condition, as diversity, and as a universal phenomena likely to permanently or temporarily affect almost everyone at some point in life, even as some people may be more disadvantaged than others due to an intersection with other identities such as gender, age, socio-economic status, ethnicity, sexuality etc.[11, 12, 13]. Disability has been recognized as a cross-cutting issue in the 2030 Agenda for Sustainable Development, with explicit references in 11 indicators and five SDGs, namely on education, growth and employment, inequality, accessibility of human settlements, and data, monitoring and accountability. [14, 15, 16] In that sense there is growing realisation that upholding the rights and ensuring the full inclusion of the world's 1 billion persons with disabilities is not only a moral imperative, but also a practical necessity.[17]

1.3 Understanding the Status of Persons with Disabilities

While there has been advancement in the conceptualisation of disability over the recent decades and the articulation of rights of persons with disabilities in the international legal and policy frameworks, there is still much work to be done. Studies suggest that world over persons with disabilities and their families are likely to experience more socio-economic disadvantage than those without disabilities, including a bi-directional link to poverty.[18] Disability also presents significant challenges in their full participation in society ultimately having an effect on the entire lifecycle of the individual from access to information and communication, education, health care, and employment to under-representation in decision-making and political participation.[19]

For example, the UN Disability and Development Report notes that persons with disabilities are more likely to be living below the poverty line, more likely to suffer poor health,[20] more vulnerable in situations of natural and man-made disasters as well as in extreme climate and health events, conflict, and humanitarian emergencies.[20, 21] This is evident from the disproportionate impact of the recent Covid-19 pandemic on this group, which affected their access to education, work, and information and communication itself, leading to a mental health crisis.[23]

Persons with disabilities are also less likely to attend school and complete primary education and more likely to be illiterate than persons without disabilities.[24] Data from UNESCO Institute of Statistics also confirms that persons with disabilities are nearly always worse off than

[9] Ibid.
[10] United Nations Department of Economic and Social Affairs Division for Inclusive Social Development. Convention on the Rights of Persons with Disabilities (CRPD)
[11] World Health Organization. WHO global disability action plan 2014-2021: Better health for all people with disability. World Health Organization; 2015.
[12] Disability UN. Development Report Realizing the Sustainable Development Goals by, for and with Persons with Disabilities. UN: New York, NY, USA. 2018.
[13] World Health Organization. World report on disability 2011. World Health Organization; 2011.
[14] Outcome document of the highlevel meeting of the General Assembly on the realization of the Millennium Development Goals and other internationally agreed development goals for persons with disabilities: the way forward, a disability inclusive development agenda towards 2015 and beyond, General Assembly resolution 68/3, A/RES/68/3 (23 September 2013).
[15] Disability UN. Development Report Realizing the Sustainable Development Goals by, for and with Persons with Disabilities. UN: New York, NY, USA. 2018.
[16] World Health Organization. World report on disability 2011. World Health Organization; 2011.
[17] Disability UN. Development Report Realizing the Sustainable Development Goals by, for and with Persons with Disabilities. UN: New York, NY, USA. 2018.
[18] World Health Organization. World report on disability 2011. World Health Organization; 2011.
[19] Disability UN. Development Report Realizing the Sustainable Development Goals by, for and with Persons with Disabilities. UN: New York, NY, USA. 2018.
[20] Ibid
[21] Ibid.
[22] Tebbutt E, Brodmann R, Borg J, MacLachlan M, Khasnabis C, Horvath R. Assistive products and the sustainable development goals (SDGs). Globalization and health. 2016 Dec;12(1):1-6.
[23] IDA Survey on the Experiences of Persons with Disabilities Adapting to the COVID-19 Global Pandemic Executive Summary and Recommendations September 2021
[24] Disability UN. Development Report Realizing the Sustainable Development Goals by, for and with Persons with Disabilities. UN: New York, NY, USA. 2018.

persons without disabilities. They are less likely to ever attend school, more likely to be out of school, less likely to complete primary or secondary education, and have fewer years of schooling, and they are less likely to possess basic literacy skills.[25]

Lower education enrolment and completion rates not only impact the education outcomes of persons with disabilities but are also more likely to affect their transition into workforce or employment. Persons with disabilities have limited access to the labour market,[26] tend to earn lower wages than their counterparts without disabilities and the lack of accessible workplaces and reasonable accommodation poses further obstacles in their promotion and retention in the workforce. At the same time, data also reveals that they have more limited access to information and communications technology and face a significant gap with their non-disabled counterparts in their access and use of the Internet.[27]

Women with disabilities are often subjected to double discrimination due to their gender and disability status. They are three times more likely to have unmet needs for health care; three times more likely to be illiterate; two times less likely to be employed and two times less likely to use the Internet.[28, 29]

1.4 When Communication Meets Accessibility: A Game Changer

Communication is an intrinsic part of our lives and a fundamental human right,[30] as recognised in Article 19 of the Universal Declaration of Human Rights and Articles 9 and 21 of the CRPD.[31] It is also crucial for the actualisation of other rights such as living independently, personal mobility, education, health, habilitation and rehabilitation, work and employment, participation in political, public and cultural life, among others.[32]

In the recent decades technology has permeated and transformed every sphere of our lives, from the way organizations conduct public relations and marketing to how people communicate officially as well as socially, with a clear shift from traditional to new media. Social media has rapidly gained prominence in recent years, transforming into a crucial communication platform for organizations and individuals, with more than 4 billion monthly users on Facebook, YouTube, Instagram and Twitter. It has also increasingly come to be used by students for engaging with their peers, seeking information and reaching out for learning support.

'Accessibility' is the breaking down of barriers across these sectors that prevent persons with disabilities - and the broader population - from participating in society on an equal basis with others.[33] This applies to information as well as technology so ATs can include any item, piece of equipment or product used to increase, maintain or improve the functional capabilities of people with disabilities.[34] Research notes that accessibility in technology and information can break traditional barriers to communication, interaction, and access to information for persons with disabilities, helping them overcome impairments and enabling them to be active, participating and productive members of the society.[35, 36, 37]

[25] UNESCO Institute for Statistics (UIS). Education and disability: analysis of data from 49 countries. Information Paper No. 49. 2018.
[26] Disability UN. Development Report Realizing the Sustainable Development Goals by, for and with Persons with Disabilities. UN: New York, NY, USA. 2018.
[27] Ibid.
[28] Ibid.
[29] World Health Organization. World report on disability 2011. World Health Organization; 2011.
[30] Assembly UG. Universal declaration of human rights. UN General Assembly. 1948 Dec 10;302(2):14-25.
[31] United Nations Department of Economic and Social Affairs Division for Inclusive Social Development. Convention on the Rights of Persons with Disabilities (CRPD)
[32] United Nations Department of Economic and Social Affairs Division for Inclusive Social Development. Convention on the Rights of Persons with Disabilities (CRPD)
[33] ESCAP U. Investing in accessibility in Asia and the Pacific.
[34] Tangcharoensathien V, Witthayapipopsakul W, Viriyathorn S, Patcharanarumol W. Improving access to ATs: challenges and solutions in low-and middle-income countries. WHO South-East Asia journal of public health. 2018 Jul 1;7(2):84.
[35] Raja DS. Bridging the disability divide through digital technologies: Background Paper for the 2016 World Development Report: Digital Dividends. World Development Report. 2016.
[36] Tebbutt E, Brodmann R, Borg J, MacLachlan M, Khasnabis C, Horvath R. Assistive products and the sustainable development goals (SDGs). Globalization and health. 2016 Dec;12(1):1-6.
[37] Raja DS. Bridging the disability divide through digital technologies: Background Paper for the 2016 World Development Report: Digital Dividends. World Development Report. 2016.

Image courtesy by: Saksham

The rapid technological advancement, expanding reach of the internet, growing number of mainstream everyday Information and Communication Technologies (ICTs) that can be used as accessible devices, and the emergence of social media as a crucial communication platform, is further changing the paradigm of technology-enabled development for persons with disabilities, facilitating the social, economic, and civic participation of persons with disabilities while also becoming attractive features for all users irrespective of disability,[38, 39] making it relevant for a much larger consumer group.[40, 41, 42]

Both ICTs and AT have the potential of significant impacts on the education and employment of persons with disabilities. Features such as text-to-speech, voice recognition, ability to change contrast and colour schemes, touch and gesture input, and screen magnification enable persons with disabilities to receive information and content in the format that they can perceive and prefer allowing for differentiated instructions and learning by adapting content and process to meet a student's unique needs.[43] For example, for persons with disabilities, the ability to read and write in the same language and script as everyone else is an essential requirement for productivity in an inclusive workplace. Technology helps in building this capability among persons with disabilities. In the case of persons with visual impairment, it allows them to read and write in the same script as everyone else and not just in Braille, opening up many new opportunities for them in mainstream education and employment.

Studies also suggest that AT has a positive impact on students with disabilities academic engagement, psychological well-being and social participation as well as academic performance of students, empowering them to be more confident, autonomous and motivated.[44] In that sense studies suggest that AT should not be viewed by educators within a 'rehabilitative' or 'remediative' context, but as a tool for accessing curriculum and exploring measures to achieve positive outcomes.[45]

[38] Ibid.

[39] Tebbutt E, Brodmann R, Borg J, MacLachlan M, Khasnabis C, Horvath R. Assistive products and the sustainable development goals (SDGs). Globalization and health. 2016 Dec;12(1):1-6.

[40] Raja DS. Bridging the disability divide through digital technologies: Background Paper for the 2016 World Development Report: Digital Dividends. World Development Report. 2016.

[41] ESCAP U. Investing in accessibility in Asia and the Pacific.

[42] Tangcharoensathien V, Witthayapipopsakul W, Viriyathorn S, Patcharanarumol W. Improving access to ATs: challenges and solutions in low-and middle-income countries. WHO South-East Asia journal of public health. 2018 Jul 1;7(2):84.

[43] Raja DS. Bridging the disability divide through digital technologies: Background Paper for the 2016 World Development Report: Digital Dividends. World Development Report. 2016.

[44] McNicholl A, Casey H, Desmond D, Gallagher P. The impact of AT use for students with disabilities in higher education: a systematic review. Disability and Rehabilitation: AT. 2021 Feb 17;16(2):130-43.

[45] Cited in: Use of AT in IE- Making room for diverse learners https-//www2.hu-berlin.de/transcience/Vol6_No2_62_77.pdf

The Universal Design for Learning (UDL) framework therefore can be suitable for diversified classrooms. UDL provides a framework for designing curricula and teaching methodology by thinking of all the potential needs of diverse students. The principles that guide UDL are that there are multiple ways of representing knowledge (content, information etc.) for students; multiple ways that students can demonstrate their knowledge and understanding (bringing into focus the purpose and modes of assessment) and that teachers can engage students in learning in many ways. Implementation of the UDL framework is said to improve the learning process for all students. Providing all students with multiple ways of accessing and demonstrating knowledge increases their chance at educational success. Flexibility too, is a key foundation of the UDL. Just like inclusive education, UDL is an evolving paradigm, and evidence for its applicability to educational design continues to be generated.[46]

Smart devices such as the iPad and Android can be configured to offer similar functionality of an AT with the combination of in-built accessibility features and free or paid mobile applications, making it suitable for low-income resource settings as well[47]. This makes investment in accessibility important and a return on investment for governments, country economies, and employers positive and significant[48]. In fact, studies show that return on investment for accessible technology and ICTs almost always outweigh the costs of making the accommodations[49]. ICTs can also help to level the playing field for persons with disabilities at all stages of the employment life cycle.[50] The WHO in its International Classification of Functioning notes that the removal of environment barriers removes functional limitations. However, even if functional limitation is minimal, the presence of environmental barriers results in many disabling conditions.[51]

1.5 Need for an Ecosystem Approach

Despite emerging evidence about the benefits of accessibility in information, communication and technology, several challenges limit the adoption of AT and content among persons with disabilities as well as the wider stakeholder community. Technology does not exist in a vacuum but is influenced by the societal, legislative, personal, and infrastructural factors surrounding it, making an ecosystem approach essential.[52] For example, a study on inclusive education in India found that teachers' attitudes towards students with disabilities and presumptions about their capabilities due to a lack of sensitivity training and resources such as technology had a direct impact on students' retention rates and learning outcomes.[53] While digital literacy can be an enabler for persons with disabilities it also has the potential to further marginalise persons with disabilities and their opportunity to participate in society.[54]

1.6 Challenges in AT and Accessible Content Adoption

The first challenge to adoption is an insufficient level of awareness and understanding of

[46] UNESCO New Delhi Office. (2019). N for nose: state of the education report for India 2019; children with disabilities

[47] Raja DS. Bridging the disability divide through digital technologies: Background Paper for the 2016 World Development Report: Digital Dividends. World Development Report. 2016.

[48] Ibid.

[49] Ibid.

[50] Ibid.

[51] The International Classification of Functioning. Disability and Health. Geneva, World Health Organization, 2001.

[52] Ibid.

[53] Julka A, Vyas S. Including Children with Special Needs: Primary Stage.

[54] ESCAP U. Investing in accessibility in Asia and the Pacific.

accessibility vis-a-vis its value for all of society;[55] inadequate knowledge and capacity among policymakers, development practitioners, advocates and others to effectively mainstream accessibility in their work;[56] and finally the rapid pace of advancement in accessible digital tools making it difficult to keep up to date with new and improving solutions that are constantly emerging.[57]

Secondly, while there is a well-recognised high need for ATs, the demand remains low and supply even lower, especially in developing countries due to a range of factors including lack of awareness, concerns about their effectiveness and suitability; social stigma and privacy; usability and computer literacy; and affordability.[58] There are also further challenges to improving this access to AT that range from low production and limited quality; financial barriers; lack of government funding and provisions; and scarcity of trained human personnel that can provide these technologies.[59] It is no surprise then that the WHO notes that even though 1 billion people in the world currently require AT, only 1 in 10 currently have them.[60] A survey conducted in India in 2019 revealed that approximately 18% of participants with high support needs [referred to as 'severely disabled' in the study] required AT devices. The reason why persons with disability reported not having AT products was because they could not afford them or did not have any knowledge of the product. 23% of persons with high support needs faced challenges while using AT products. Another 9% of persons with 'mild' disability reported facing challenges in using them. They reported the AT to be too complicated to use,

[55] Ibid.

[56] Ibid.

[57] Raja DS. Bridging the disability divide through digital technologies: Background Paper for the 2016 World Development Report: Digital Dividends. World Development Report. 2016.

[58] Tangcharoensathien V, Witthayapipopsakul W, Viriyathorn S, Patcharanarumol W. Improving access to ATs: challenges and solutions in low-and middle-income countries. WHO South-East Asia journal of public health. 2018 Jul 1;7(2):84.

[59] Ibid

[60] Ebuenyi ID, Kafumba J, Smith EM, Jamali-Phiri MZ, Munthali A, MacLachlan M. Empirical research and available data on AT for persons with disabilities in Malawi: A review. AT. 2021 Aug 6:1-3.

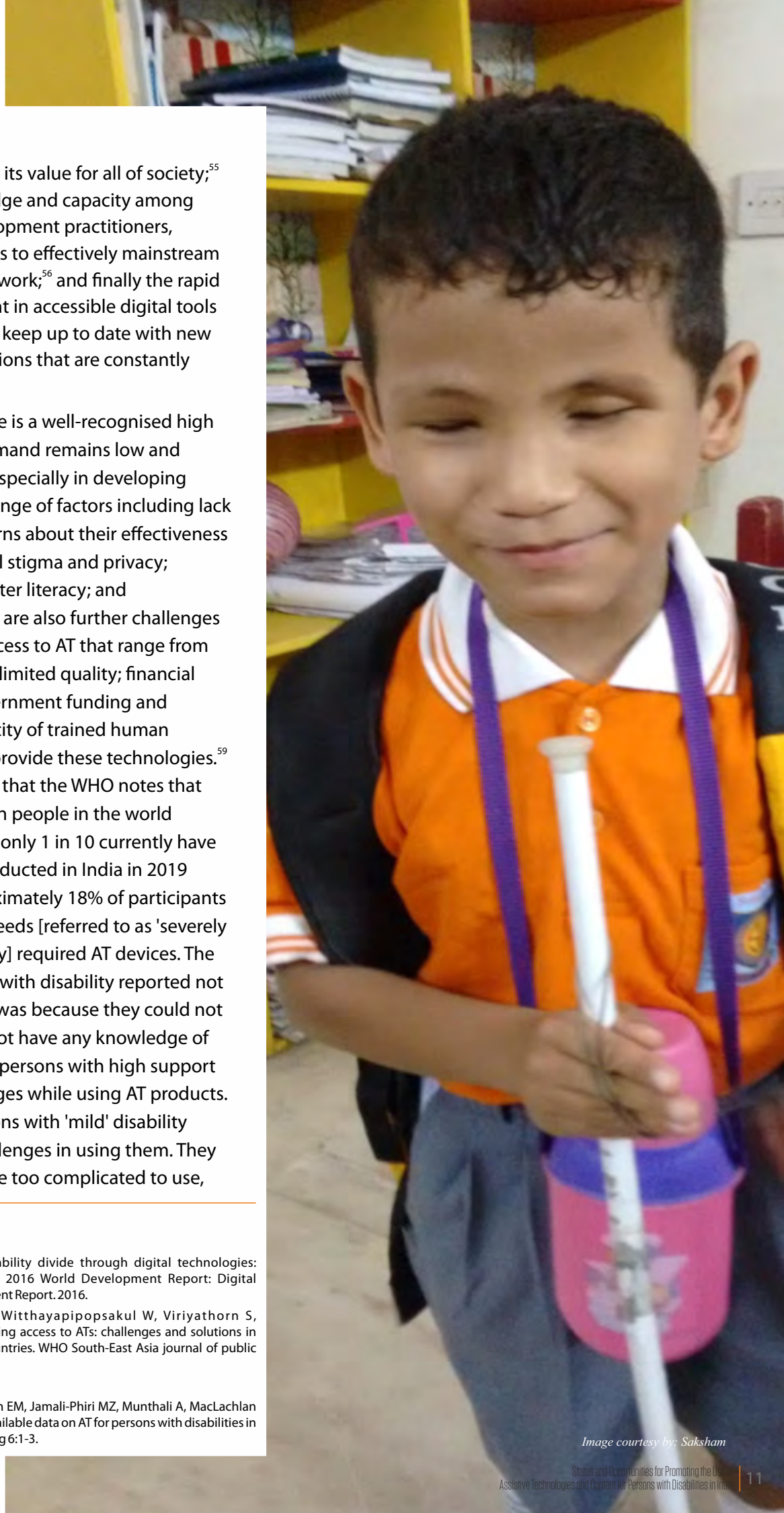


Image courtesy by: Saksham

which meant that they required additional support from another person to use them.[61]

Thirdly, the inaccessibility of digital content is a major barrier since unless a service, website, app, or software is designed correctly, a person with a disability may be unable to use it even if they have the right technology.[62] Although accessibility guidelines, software and standards such as Web Content Accessibility Guidelines, EPUB Accessibility Guidelines, PDF-UA, etc. have been developed, adoption is low. A survey of governmental portals of 193 Member States, website content could be read aloud only in the portals of 7% of countries and videos in sign language were available only in 4% of governmental websites. Further, more than 60% of national online portals were found to be inaccessible.[63] Similarly, although digital literacy has provided independence in reading and writing for persons with print disabilities, the group often encounters barriers with inaccessible education content. The World Blind Union notes that less than 10% of all published materials are accessible. In developing countries, less than 1% of books are ever made into accessible formats. There are also challenges with regard to availability of content in local languages, further compounding the issue, as is the case in India, which has 22 official languages.[64]

Finally, there is a significant lack of valid and reliable data overall, on the size of unmet need in this area.[65] At the same time although there is recognition of the large and growing need for ATs within low and middle-income countries, there is a lack of research in these settings, which impacts evidence-informed policy and practice. Research around AT needs to upscaled, both at the global but especially in case of a national level, where development and use of technology is determined by language, resources economy etc. and solutions have to be embedded into local context. The next section highlights this gap in research and data and brings notice to why it remains crucial for the sector.

1.7 Why We Need Data

Legislation, regulations, and policies play a very important role in advancing availability, acquisition, and use of accessible ICT.[66] Governments need to undertake measures to improve legislation and policy on ICT accessibility and develop mechanisms to promote and enforce implementation however this can only happen with research and data.

Research is integral to generate evidence for the justification and direction of social change, evaluating measures to achieve desired change and for crafting effective and sustainable policy.[67] Reliable data remains central to gaining the confidence of decision makers and the greater community and allows policymakers, programme staff and researchers to monitor the level of disability within a population. It also helps understand trends in disability prevalence and impacts of AT improvements across domains.[68] The importance of data is also backed by policy, as emphasised in Article 31 of the

[61] https://www.statista.com/statistics/1250420/india-completely-unmet-need-of-assistive-products-among-users-by-disability-level/

[62] Raja DS. Bridging the disability divide through digital technologies: Background Paper for the 2016 World Development Report: Digital Dividends. World Development Report. 2016

[63] Disability UN. Development Report Realizing the Sustainable Development Goals by, for and with Persons with Disabilities. UN: New York, NY, USA. 2018.

[64] Ibid

[65] Tangcharoensathien V, Witthayapipopsakul W, Viriyathorn S, Patcharanarumol W. Improving access to ATs: challenges and solutions in low-and middle-income countries. WHO South-East Asia journal of public health. 2018 Jul 1;7(2):84.

[66] Raja DS. Bridging the disability divide through digital technologies: Background Paper for the 2016 World Development Report: Digital Dividends. World Development Report. 2016

[67] Ebuenyi ID, Kafumba J, Smith EM, Jamali-Phiri MZ, Munthali A, MacLachlan M. Empirical research and available data on AT for persons with disabilities in Malawi: A review. AT. 2021 Aug 6:1-3.

[68] Cappa C, Petrowski N, Njelesani J. Navigating the landscape of child disability measurement: A review of available data collection instruments. Alter. 2015 Oct 1;9(4):317-30.

Image courtesy: Saksham

CRPD[69] as well as the World health Assembly Resolution WHA71.8 and the 2019 GReAT Consultation.[70, 71]

Unfortunately, research suggests that traditionally the benefits of AT have been viewed as self-evident by funding bodies and those who provided AT services resulting in a relative gap in evidence for the impact of AT on key outcomes.[72] There is a dearth of disability research, both in low and middle-income settings and high-income settings,[73, 74] with limited evidence to show that ATs improve the functioning of users. This is crucial because there is a growing concern that ATs are developed without taking into consideration the true environmental, social and resource factors that impede the adoption of technology in low-resource settings.[75] At the same time, culturally relevant ATs for specific subpopulation groups also help to minimize unmet needs.[76]

The absence of reliable information on effectiveness is a gap that urgently needs to be addressed and requires collaboration and action amongst the scientific community, research and development agencies, and the manufacturing sector, to fill the evidence gaps through consultation with persons with disabilities beneficiaries and, as appropriate, their caregivers. [77]

[69] Ibid

[70] Tangcharoensathien V, Witthayapipopsakul W, Viriyathorn S, Patcharanarumol W. Improving access to ATs: challenges and solutions in low-and middle-income countries. WHO South-East Asia journal of public health. 2018 Jul 1;7(2):84.

[71] Ebuenyi ID, Kafumba J, Smith EM, Jamali-Phiri MZ, Munthali A, MacLachlan M. Empirical research and available data on AT for persons with disabilities in Malawi: A review. AT. 2021 Aug 6:1-3.

[72] McNicholl A, Casey H, Desmond D, Gallagher P. The impact of AT use for students with disabilities in higher education: a systematic review. Disability and Rehabilitation: AT. 2021 Feb 17;16(2):130-43.

[73] Ibid

[74] Ebuenyi ID, Kafumba J, Smith EM, Jamali-Phiri MZ, Munthali A, MacLachlan M. Empirical research and available data on AT for persons with disabilities in Malawi: A review. AT. 2021 Aug 6:1-3.

[75] Tangcharoensathien V, Witthayapipopsakul W, Viriyathorn S, Patcharanarumol W. Improving access to ATs: challenges and solutions in low-and middle-income countries. WHO South-East Asia journal of public health. 2018 Jul 1;7(2):84.

[76] Ibid.

[77] Ibid.

1.8 Study Context and Objectives

As discussed earlier, there is a significant gap in data available about the use of ATs by persons with disabilities in India. An additional complicating factor is that India has 22 official languages, many of them without any commonalities between themselves, vastly varying cultures, geographies and varying degrees of economic growth and access to resources. Having a large number of people with disabilities within relatively limited resource environments across the country has resulted in wide diversity and disparity amongst this group in terms of the solutions available to them, their standard of living, independence, education, employment and achievements. This has consequently impacted their ability to become embedded into the mainstream society and communicate and function as others do in society.

The aim of this study is to explore the variety of solutions which are available and used by persons with disabilities in India, and various aspects of availability, timing, training, preferences and support which affect their ability to realise optimal efficiency and independence in mainstream education, work and everyday life. The research narrows down its scope to study two specific objectives:

Firstly, what are the gaps and opportunities for promoting the adoption of technology solutions for persons with vision, hearing, and SLD in India (focusing especially on education and employment)?

Secondly, given the increasing role of social media, how can social media platform providers enable persons with disabilities to play an active role on these platforms and improve their usage?

2 Disability in India

In order to review the study findings in perspective, it is important to understand the overall context of disability in India.

2.1 Overview

According to the 2011 census[78], India is home to 26.8 million persons with disabilities i.e. 2.21% of the total population in the country and a majority (69%) of them live in rural India. Among the persons with disabilities, 56% are males and 44% are females. Those with a disability in movement, hearing and seeing constitute the highest percentage of the group - 20%, 19% and 19% respectively. The number of disabled persons is highest in the age group of 0-19 years (29%, 7.8 million) making a focus on primary and higher education essential.[79]

2.2 Disability Rights and Policies in India

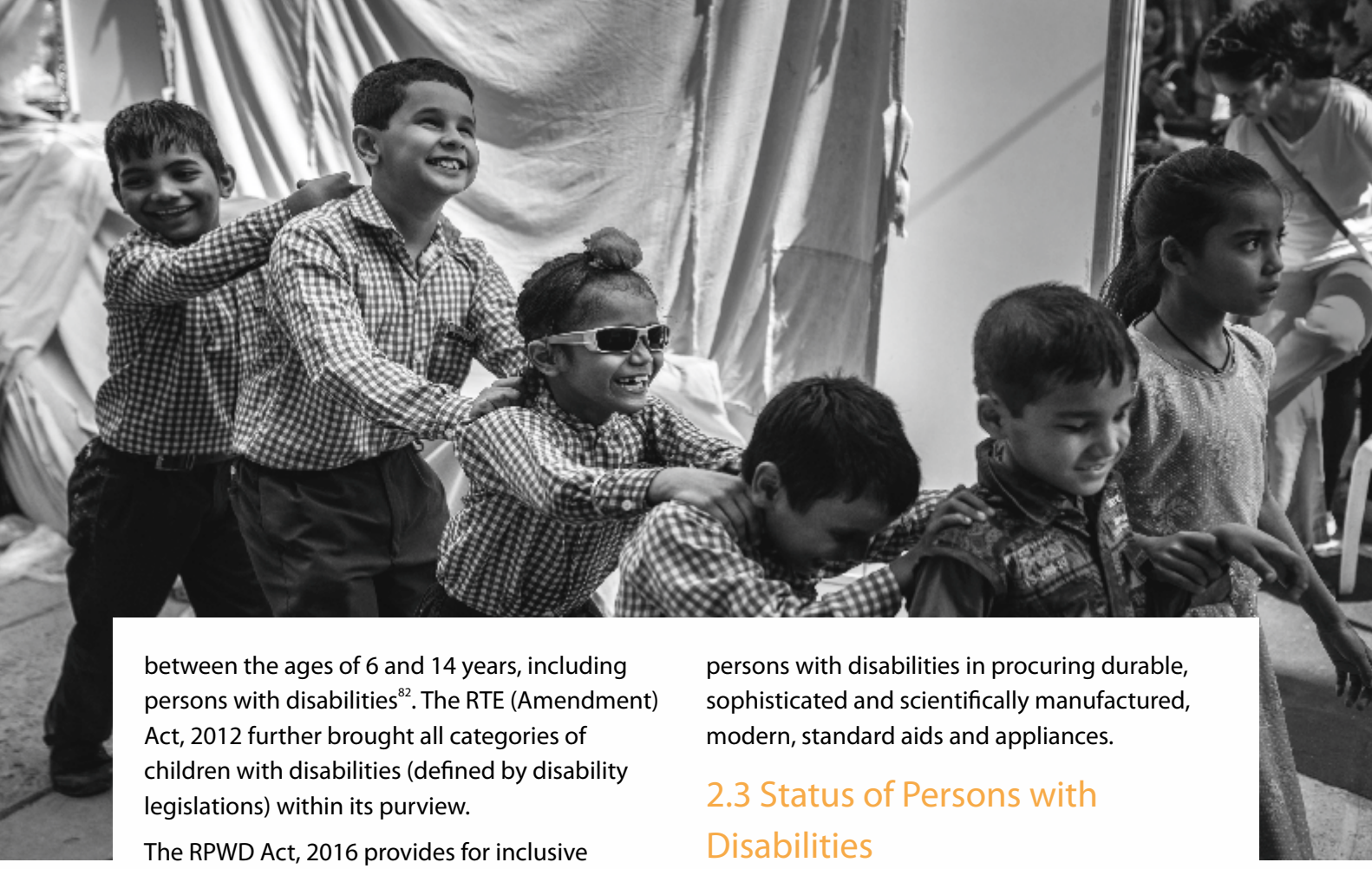
The legal framework for disability in India is provided by Rights of Persons with Disabilities Act, 2016[80], a comprehensive rights-based legislation with detailed provisions for representation, access, and reasonable accommodation.[81] Within the education context, the 86th Amendment Act, 2002 introduced the right to education as a new fundamental right (Article 21A) operationalized through the consequential enactment of the Right of Children to Free and Compulsory Education (RTE) Act, 2009. It provides free and compulsory education to all children

[78] Ministry of Statistics and Information(2021). Persons with Disabilities (Divyangjan)in India - A Statistical Profile : 2021

[79] Verma, D., Dash, P., Bhaskar, S., Pal, R. P., Jain, K., Srivastava, R. P., & Hansraj, N. (2016). Disabled persons in India: a statistical profile 2016. Ministry of Statistics and Programme Implementation, Government of India.

[80] Succeeded the Persons with Disabilities Act, 1995

[81] Ministry of Law and Justice (2016). The Rights of Persons with Disabilities Act, 2016.



between the ages of 6 and 14 years, including persons with disabilities[82]. The RTE (Amendment) Act, 2012 further brought all categories of children with disabilities (defined by disability legislations) within its purview.

The RPWD Act, 2016 provides for inclusive education and notes that it must be imparted with due consideration to most appropriate modes and means of communication including suitable modifications in the curriculum and examination system. Within India, there are 3 modes of education offered to children with disabilities - mainstream schools, home-based education and through special schools. The RPWD Act, 2016 also defined inclusive education for the first time in country and has brought the concept of reasonable accommodations and necessary supports within the legal domain.

The New Education Policy for its part recognizes the importance of creating enabling mechanisms for persons with disabilities in both school and higher education and acknowledges that the use of technology for online and digital education should address concerns of equity.[83] When it comes to AT more specifically, the Scheme of Assistance to Disabled Persons for Purchase/Fitting of Aids and Appliances (ADIP Scheme) operational since 1981 aims to assist persons with disabilities in procuring durable, sophisticated and scientifically manufactured, modern, standard aids and appliances.

2.3 Status of Persons with Disabilities

Unfortunately, persons with disabilities continue to be under-represented in education, with 45% of persons with disabilities unable to read or write, 13% completing secondary education and only 5% being graduates and above; 25% of children with disabilities between 5-19 years do not go to any educational institution.[84] Among those who get further marginalized are children with multiple disabilities and those living with mental illness. Data reflects that 54% of children with multiple disabilities and 50% of the children with mental illness have never attended educational institutions. Government data reflects that children with disabilities are the largest group of children who have dropped out of school.

While the overall literacy level in the country stands at 74.04%[85], statistics reflect that only 55% of the total population of persons with disabilities is literate[86]. The incidence of illiteracy gets further compounded when it intersects with gender. More than half of women and girls with

[82] Ministry of Human Resources Development (2011). The Right to Free and Compulsory Education Act, 2009

[83] National Education Policy, 2020

[84] Verma, D., Dash, P., Bhaskar, S., Pal, R. P., Jain, K., Srivastava, R. P., & Hansraj, N. (2016). Disabled persons in India: a statistical profile 2016. Ministry of Statistics and Programme Implementation, Government of India.

[85] Literacy levels in India 2021 www.indiacensus.net/literacy-rate.php

[86] Persons with disabilities [Divyangjan] in India – A Statistical Profile 2021 www.mospi.gov.in

disabilities (55%) in India cannot read or write.[87] This under-representation in education has a direct bearing on their employment opportunities with 64% (two-third) of persons with disabilities currently not in employment in India.[88]

2.4 Challenges - Barriers to Inclusive Education and Adoption of ICTs

There are a range of factors that affect the actualization of right to education for persons with disabilities and their subsequent life opportunities - attitudes of parents and teachers, physical and digital accessibility of educational eco-system, adaptive curriculum and pedagogy, teaching-learning resources and awareness of the diversity in learning needs, among others[89].

In the context of AT adoption, studies suggest that while there has been wide-scale production and distribution of AT and aids and appliances, various issues persist with the implementation, particularly at the last mile. These range from distribution of aids and appliances without adequate training, lack of inclusion of cost of maintenance of aids and appliances in schemes, lack of availability of repair and maintenance facilities for aids and appliances often leading to abandonment of devices by users, and a striking gender disparity among scheme beneficiaries.[90]

Similarly, although a central role has been accorded to A.T./I.C.Ts and adaptive pedagogy and curriculum, there is lack of clear guidance and research into how the two should interact. Both National Curricular Framework and National Curriculum Framework for Teacher Education advocate student-centric pedagogy and recognize technological innovations and aids as necessary for meeting the learning needs of children with special needs[91, 92]. The National Policy on I.C.T in School Education (2012) also notes that teachers should be sensitized to issues related to students with special needs and the potential of I.C.T to address them. However, there are not many resources that guide the teacher as to what this translates to in the classroom. This is also augmented by a lack of awareness of the diversity in needs and practice-based evidence[93].

What are the skills that I.C.Ts/A.T. can develop in the case of children with disabilities? What are the various modes and means of communications which may be used and how? What is the age for I.C.T intervention and what could be its relationship with current learning pedagogies therefore remain significant questions that need to be explored. This is crucial as studies suggest teachers struggle to make their teaching-learning processes inclusive due to lack of professional and long-term guidance and sparse research documenting what works in an inclusive setup[94]. Teachers also have very little training to make these adaptations, resulting in a lack of motivation and feelings of helplessness[95].

2.5 Opportunities in the Sector

In the Indian scenario, there are many factors that make looking into these questions the need of the hour.

Firstly, under the RPWD Act, the number of disabilities covered has been increased from 7 to 21. It is possible to expect a scenario where children with disabilities in a classroom, will

[87] Verma, D., Dash, P., Bhaskar, S., Pal, R. P., Jain, K., Srivastava, R. P., & Hansraj, N. (2016). Disabled persons in India: a statistical profile 2016. Ministry of Statistics and Programme Implementation, Government of India.

[88] Ibid..

[89] UNESCO New Delhi Office. (2019). N for nose: state of the education report for India 2019; children with disabilities

[90] Ibid.

[91] National Council of Educational Research and Training. (2005). National Curriculum Framework. Government Committee Report, New Delhi: NCERT

[92] National Council for Teacher Education (NCTE) (2009). National Curriculum Framework for Teacher Education: Towards a Humane and Professional Teacher. New Delhi: NCTE.

[93] UNESCO New Delhi Office. (2019). N for nose: state of the education report for India 2019; children with disabilities

[94] Ibid.

[95] Julka, A. & Bharti (2014).Teachers Creating Inclusive Schools: Issues and Challenges. New Delhi: NCERT

range from high functioning to high support needs. I.C.Ts can play a major role in the delivering this curriculum to a diverse student group in an inclusive setup keeping the disability and particular needs and abilities of the student in mind.

Secondly, internet and digitization have permeated all sectors nationally, with India's digital economy estimated to reach one trillion USD by 2025. With over billion mobile phones and half a billion internet users, India's mobile data consumption is already the highest in the world. The Government of India through its Digital India Programme aims to transform India into a digitally empowered society and knowledge economy. Digital Empowerment of Citizens is a key pillar of this that includes universal digital literacy and universally accessible digital resources as key components. At the same time as India looks to expand its share in the digital communications sector through the creation of 4 million additional jobs and aims to secure a rank in the Top 50 nations in the I.C.T Development Index[96], the equity of access and resources gain even more importance.

Thirdly, as India implements its New Policy of Education, it provides an opportunity to chalk out a definitive concrete role of I.C.Ts in the education for persons with disabilities. This is not just relevant nationally but given that India's population of disabled persons is greater than the total population of three-fourths of world populations, it has far-reaching consequences for attainment of SDGs worldwide.

Finally, the last two years have compelled educators and key stakeholders connected with the field of education to re-imagine how education can be imparted amid the global pandemic. With COVID related restrictions and lockdown affecting countries including India, the shift to on-line education has led to changes across the field and brought its own opportunities and challenges, making exploring questions around digital equity necessary. In a 2020 newspaper article, Saksham noted that early introduction of technology and digital literacy in their school meant the students with disabilities were well prepared for the shift to online classes since they were familiar with using technology for their reading and writing activities[97].

While universal design for learning has helped during the pandemic, the transition to online learning is not without challenges which include lack of awareness among stakeholders; lack of accessible content which means even when students have AT they may not be able to use it for education; the lack of proximity between teachers and the students, which makes engagement a challenge for some students; and reaching students in rural areas as well as those who may not have access to data or smartphones.[98]

Image courtesy by: Saksham

[96] National Digital Communications Policy, 2018

[97] https://yourstory.com/socialstory/2020/10/empowering-visually-impaired-independent-saksham-trust/amp

[98] https://www.voyagersopris.com/blog/edview360/2021/10/05 /understanding-dyslexia-today-an-interview-with-dr.-suzanne-carreker-and-lee-ann-tolfree-mertzlufft?utm_source=news&utm_ medium =email&utm_campaign=2021_Edview_Blog

Image courtesy by: Saksham

2.6 Overview of Different Kinds of Disabilities

Within the overarching themes for persons with disabilities as a group, there are also differences in context and challenges for persons with different kinds of disabilities.

2.6.1 SLD

SLD comprises of a heterogeneous group of disorders with the main impairment being cognitive processing and leads to challenges in academic performance and has psychosocial implications. A neuro-developmental disorder of biological origin, it occurs in the absence of intellectual disability, neurological dysfunction or environmental deprivation.[99]

The characteristics noted in Learning Disabilities (LD) include seeming unexplained difficulty a person of at least average intelligence has in acquiring basic academic skills. These skills are essential for success at school and at workplace and for coping with life in general.[100] LD is not a single disorder[101] but an umbrella term that includes within its fold SLD. The three most prevalent SLD are Dyslexia (Difficulty with reading), Dysgraphia (Difficulty with writing), and Dyscalculia (Difficulty with math, number concepts). SLD also has a link with ADHD. The degree of overlap between ADHD and dyslexia has been reported at 35%.[102] Many persons with SLD also face issues with low self-esteem, confidence and difficulty forming and maintaining relationships with peers. The term is defined in 2(a) of the RPWD Act, 2016 which lists the specified disabilities covered by the Act.

While there are numerous studies that have been conducted in different parts of the country and have put forth different estimates of children and persons with SLD, there are no exact numbers available. Estimates pitch the numbers between

[99] Muthusamy-Sahu2020_Article_SpecificLearningDisabilityInIndia https-//link.springer.com/content/pdf/10.1007/s12098-019-03159-0.pdf

[100] https://pearsonclinical.in/learning-disability-indian-scenario/

[101] Ibid.

[102] Carroll JM, Maughan B, Goodman R, Meltzer H. Literacy difficulties and psychiatric disorders: evidence for comorbidity. J Child Psychol Psychiatr. 2005;46:524-32. SLD 5 year study in India https-//www.ijpediatrics.com/index.php/ijcp/article/view/879/663.pdf

5 to 15% of all children[103,104]. According to IDA the worldwide incidence of Learning Disability is 15-17%[105]. The Census of India notes that the total children population in India is 472 million, out of which at least 10% of the children i.e. 47 million children have learning Disabilities as reported by The Times of India.[106] Another study found that among primary school children in India, the prevalence of dyslexia, dysgraphia, and dyscalculia was 11.2%, 12.5%, and 10.5%, respectively.[107] Within SLD, dyslexia has been found to be the most common neuro-behavioral disorder in children and young adults, affecting 20% of the population.[108]

Although the numbers across sources vary, with a recent parliamentary question in the Rajya Sabha[109] putting the total number of children with Specific Learning Disabilities at 1,88,279; the numbers of persons with SLD are expected to be much higher than current estimates. Studies note that this is because of a range of factors. Many children with SLD studying in vernacular medium schools are not identified because of lack of awareness among people. Severe shortage of trained special education teachers and counsellors in schools,[110] and state boards not mandating provision of accommodations for SLD also affects those identified[111]. Further, not all children with SLD are in regular schools and they would get counted under separate heads, with reports noting that it is the largest group of children with disabilities enrolled with the National Institute of Open Schooling. [112]

2.6.1.1Challenges

The challenges faced by children with disabilities in a country like India are manifold. The intersections of identities - gender, of age, of where the person lives, the rural vs. urban divide, where the person falls along the socio-economic hierarchy all impact the opportunities the child has access to. There are five key challenges that affect children with SLD.

Firstly, there is a lack of awareness and training regarding SLD among the key stakeholders, which includes the teachers, principals and school administrators; parents and families of persons with SLD and the persons with SLD themselves. For instance, a study conducted with 50 elementary school teachers, with 5 to 10 years teaching experience to assess the level of awareness regarding SLD found that 14% teachers had low levels of awareness, 86% teachers had medium level of awareness and no teacher had a high level of awareness regarding SLD.[113]

Secondly, even where awareness may exist, there is a lack of adequate referral and assessment procedures. There are not enough centres and professionals conducting assessments to meet the needs of the vast population of children with SLD, which involves the services of a psychologist, special educator and occupational therapist and other trained professionals. Experience shows that even where private centres and professionals may be available, not

[103] https://www.researchgate.net/publication/324277803_Prevalence_of_Learning_Disability_in _India_A_Need_for_Mental_Health_Awareness_Programme /link/5ac8f573a6fdcc8bfc83814d/download

[104] https://www.ijpediatrics.com/index.php/ijcp/article/view/879/663 [Singh S, Sawani V, Deokate M, Panchal S, Subramanyam AA, Shah HR. Specific learning disability: a 5 year study from India. Int J ContempPediatr. 2017;4:863-8]

[105] Dr Nandini Chaterjee Singh presentation at a conference organized by the Ashoka University

[106] S. Karande and N. Gogtay, "Specific Learning Disability and the Right to Education 2009 Act: Call for action," vol. 56, no. 3, p. 171, 2010 Cited in: AT for Preliminary Diagnosis of learning disability of children. https://ieeexplore.ieee.org/document/8862435

[107] Mogasale VV, Patil VD, Patil NM, MogasaleV. Prevalence of specific learning disabilities among primary school children in a South Indian city. Indian J Pediatr 2012;79:342?7. IJPsyM-42-250 https-//www.ncbi.nlm.nih.gov/pmc/articles/PMC7320732/pdf/IJPsyM-42-250.pdf

[108] https://link.springer.com/article/10.1007/s40817-020-00094-3#Abs1

[109] https://data.gov.in/sector/education?page=8

[110] V Sharma and M Alavi , "Delhi students with special needs have to make do with ill-equipped schools, teachers" www.hindustantimes.com 11 Dec 2017Cited in: AT for Preliminary Diagnosis of learning disability of children. https://ieeexplore.ieee.org/document/8862435

[111] "K-12 school quality information and parental resources" Parenting Cited in: AT for Preliminary Diagnosis of learning disability of children. https://ieeexplore.ieee.org/document/8862435

[112] https://www.indiatoday.in/education-today/news/story/unesco-report-says-75-5-year-old-children-with-disabilities-don-t-attend-schools-in-india-1561722-2019-07-04

[113] Learningdisability.JamiaMilia_March14 https-//www.researchgate.net/publication/242685581_Rethinking_Learning_ Disabilities/link/0c96052d442d96630a000000/download.pdf

all are able to afford the fee. Those in rural areas are particularly disadvantaged with there being near zero awareness of LD and no assessment facilities, putting the children at a disadvantage who then have no choice but are expected to follow the 'blackboard method' used in India.[114]

Thirdly, this lack of adequate referral and assessment procedures has a direct bearing on the identification of students with disabilities and the support offered to them, in many cases leading to drop-out of children from the education system. The UDISE data found that the drop-out rate of children with SLD was higher than the overall drop-out of all children. Looked at, from the child's perspective, not knowing why they find it so difficult to cope with reading or writing tasks that their classmates seem to have no difficulty attempting, can be very overwhelming. They try harder and put in more hours of work, yet they struggle to cope. For some, getting identified and finding the necessary supports can put them back on the track to better learning. For some, finding no answers to their inability to cope can lead them to the point where they start finding ways to avoid school.

Fourthly, the lack of accommodations and other social dimensions of the issue impact the education system for students with SLD.[115] Children with SLD often face challenges during the transition from school to college or into professional courses or training centres. A study conducted in India on the transition from school to college and higher education highlighted the entire realm of disclosure leading to labelling and further to teasing and exclusion. It pointed out that many of them had sought accommodations in school, but did not opt for them in college for fear of academic and social exclusion[116]. However, there were some students who did opt for the accommodations for whom taking their exam in a separate place meant having the advantage of fewer distractions and a quieter environment.[117]

AT can play an important role in the lives of children with SLD, especially in the school years. Children with SLD facing challenges in different domains of reading, writing, spelling, math, organization of information can seek recourse through the various technology aids that are easily available. These can support the child in their learning and can be tweaked to suit individual needs and preferences. For example: a difficulty in reading can be substituted by using the text-to-speech application, helping the person attempt the task at hand, independently. However, availability, affordability and other factors determine the access to AT and pose challenges in children being able to access these.

Finally, bilingualism is another characteristic feature of the Indian educational system that aggravates the problems for dyslexics in India.[118] As noted by Mehta and Swarup, many children, especially in cities in India, learn English, which is the medium of instruction, but for most it's not their mother tongue. This combined with lack of literary resources in the home environment, lack of access to preschool instructions, parental illiteracy, overcrowded classrooms and poor instructions, among others add additional layers of complexity to identification and subsequent support for SLD.[119]

Key Issues for persons with SLD in India:

1. Lack of awareness and training regarding SLD among key stakeholders
2. Lack of adequate referral and assessment procedures
3. Delay in identification of SLD students and support offered to them

[114] learning Disability - Indian scenariohttps://pearsonclinical.in/learning-disability-indian-scenario/
[115] Educational planning and drop out rates India.pdf http-//iafor.org/archives/journals/iafor-journal-of-social-sciences/10.22492.ijss.2.2.05.pdf
[116] Policy and Practice in Post secondary education: the transitional experience for students with learning disabilities in India https://mgiep.unesco.org/article/working-paper-i
[117] Ibid.
[118] review on LD In India and abroad http.//www.worldwidejournals.com/paripex/recent_issues_pdf/ 2018/April/April_2018_1523281258__60.pdf
[119] Review on Learning Disability In India and abroad http.//www.worldwidejournals.com/paripex/recent_issues_pdf/2018 /April/April_2018_1523281258__60.pdf

Image courtesy by: Saksham

2.6.2 Visual Impairments

The Census of India notes that among India's 26.8 million persons with disabilities, over 5 million have a disability in seeing. Estimates by The Lancet Global Health however indicate much higher estimates and note that the country is home to 62 million persons with blindness and low vision, the highest of this population in the world.

Although there is recognition within current pedagogical practices on the importance of ATs for students with visual disabilities and how it can assist their education and daily living activities, there is a paucity of studies on the availability of AT in schools for the blind in India[120].

2.6.2.1Challenges

Firstly, there is a lack of accessible content. The World Blind Union estimates that less than 1% of published books are ever made into accessible formats in the developing countries. Although active steps such as the launch of Sugamya Pustakalaya, an online platform created by DEPWD in collaboration with member organizations of DAISY Forum of India, and powered by TCS Access, have made over 6 lakh accessible digital books available to persons with visual impairment in 17 languages and 9 formats[121] , the situation unfortunately continues due to the lack of awareness among students, teachers and the larger education ecosystem. In addition, students' coursework continues to be in inaccessible formats[122].

Secondly, there is a delay in the introduction of technology in the Indian education system as well as a lack of computer training in local languages. While Braille undoubtedly created a strong base for the learning of language skills for persons with visual impairment, its special tactile

[120] Senjam SS, Foster A, Bascaran C. AT for visual impairment and trainers at schools for the blind in Delhi. AT. 2021 Jan 7:1-5.

[121] https://library.daisyindia.org/NALP/welcomeLink.action

[122] UNESCO New Delhi Office. (2019). N for nose: state of the education report for India 2019; children with disabilities

script means that many education opportunities and skills associated with mainstream script are not available to persons with visual impairment, especially in a mainstream school where the peers or teachers are not familiar with Braille.

Although the education and technology landscape has changed considerably making it possible for persons with visual impairments to read and write digitally, this change has not yet been fully integrated in the education system in India, where computer training in mainstream script is not introduced along with Braille in elementary education. This means that persons with visual impairment only receive computer training in or after their higher education in many cases, making learning difficult and creating an avoidable delay in their academics compared to their sighted peers.

In addition, reading and writing skills in local languages are not introduced in computer training, despite the rest of education being imparted in the local language. This means that the computer training skills are not usable outside of the computer lab since the overall curriculum follows the language medium of the school, which may not be in English.

Thirdly, there continues to be a lack of awareness among stakeholders and therefore integration of contextually relevant and updated AT tools in the education institutes of India. For instance, efforts over several decades have adapted AT to suit the needs of diverse users (example INDO NVDA with support for 16 languages) and as well as bringing down the cost of ATs ensuring that everyone irrespective of their socio-economic background can make use of it.

In this regard, a cross-sectional study was conducted in 22 of the 24 schools in Delhi that assessed the availability of AT for visual impairment and trainers in schools for the blind in Delhi. The head teacher of each school was asked about availability of 52 ATs divided into writing, reading, math, sciences, sports, mobility, and daily living, using a questionnaire. Information on availability of trainers was also collected. Of the 52 ATs, the most frequently available were Braille slate with stylus and abacus (>90% of schools), followed by Taylor frame, long cane and talking watch (80% to 90% of schools). Only 11 of 52 AT devices were available in 60% or more of the schools. Tactile-based ATs were more available than vision-based ATs. In the 22 schools, 63 trainers for reading & writing were available (80% of posts), 18 for sciences (59%), 25 for math (70%), and 11 for mobility (50% of posts). The study found that except for Braille slate and stylus, there was a huge shortage of AT in these schools. It also found a lack of special educators trained in the use of ATs, especially mobility trainers[123].

It is important to note here that the use of technology is required throughout all stages of education - whether it is for reading accessible books or writing assignments or building further knowledge through the use of internet. If students do not have access to these devices on a regular basis, they continue to have to be dependent on others for their needs, as seen through the continued usage of scribes. Similarly, proper training is essential to engage with the user, provide room for learning, and for inculcating independence in reading and writing.

Last but not the least, the use of technology is not relegated to reading or writing in school or college alone but affects the entire lifecycle of the individual. It has an impact on his/her possible employment and life opportunities - whether it is accessing jobs online, or growing in the profession, or the economic and social independence that comes with it. This also impacts the current job identification and reservation. The jobs identified assume that the persons with visual impairment are reading and writing independent. However, unless systemic

[123] Senjam SS, Foster A, Bascaran C. AT for visual impairment and trainers at schools for the blind in Delhi. AT. 2021 Jan 7:1-5.

changes are undertaken which address the linkage between education and employment, even a well-intentioned policy cannot be utilized. This is one of the reasons why the 4% job reservation quota remains unfilled as persons with visual impairment continue to face the challenges listed above and remain unprepared for the identified jobs.

Key Issues for persons with visual impairment in India:

1. Lack of accessible content
2. Delay in introduction of technology in the education system and lack of computer training in local languages
3. Lack of awareness among education stakeholders and lack of integration of contextually relevant or updated AT
4. Impact on lifecycle and job identification and reservation

2.6.3 Hearing Impairments

Over 5% of the world's population - or 430 million people - require rehabilitation to address their 'disabling' hearing loss (432 million adults and 34 million children). 'Disabling' hearing loss refers to hearing loss greater than 35 decibels (dB) in the better hearing ear[124]. It is estimated that by 2050 over 700 million people - or one in every ten people - will have disabling hearing loss. Nearly 80% of people with disabling hearing loss live in low- and middle-income countries. The prevalence of hearing loss increases with age, among those older than 60 years, over 25% are affected by disabling hearing loss.

A person who is not able to hear as well as someone with normal hearing - hearing thresholds of 20 dB or better in both ears - is said to have hearing loss. Hearing loss may be mild, moderate, severe, or profound. It can affect one ear or both ears and leads to difficulty in hearing conversational speech at work or school or loud sounds. 'Hard of hearing' refers to people with hearing loss ranging from mild to severe. People who are hard of hearing usually communicate through spoken language and can benefit from hearing aids, cochlear implants, and other assistive devices as well as captioning. 'Deaf' people mostly have profound hearing loss, which implies very little or no hearing. They often use sign language for communication. Persons with unintervened lesser degrees of hearing loss have activity limitation and participation restrictions worse than the intervened deaf persons.

Different types of hearing loss include conductive hearing loss (hearing loss caused by problems in the ear canal), sensorineural hearing loss (hearing loss caused by problems in the hearing nerve) or mixed hearing loss (both conductive and sensorineural hearing loss are found in the same ear). Although the causative factors for hearing loss can be encountered at different periods across the lifespan, individuals are most susceptible to their effects during critical periods in life, such as prenatal (before birth) or in the first years of life. The impact of risk factors for hearing loss is also higher in older age groups when neurodegenerative changes set in. Certain health conditions or environmental influences can also lead to hearing loss at any stage of life.

In developing countries, children with hearing loss and deafness often do not receive schooling. Adults with hearing loss also have a much higher unemployment rate. Among those who are employed, a higher percentage of people with hearing loss are in the lower grades of employment compared with the general workforce

As per WHO estimates in India, there are approximately 63 million people, who are suffering from Significant Auditory Impairment; this places the estimated prevalence at 6.3% in Indian population. According to an NSSO survey,

[124] World Health Organization. (n.d.). World Report on hearing. World Health Organization. https://www.who.int/publications-detail-redirect/world-report-on-hearing

currently there are 291 persons per one lakh population who are suffering from severe to profound hearing loss. Of these, a large percentage is children between the ages of 0 to 14 years. With such a large number of deaf or hearing impaired (DHH) young Indians, it amounts to a severe loss of productivity, both physical and economic. An even larger percentage of our population suffers from milder degrees of hearing loss and unilateral (one sided) hearing loss. Children with unilateral hearing loss as well as those with hearing loss less than 60dB as required under RPWD Act 2016 face problems in attending to classroom lectures and walking safely on roads as they fail to locate the moving vehicle sounds. The problem is more acute in children who are blind and or low vision with unilateral or bilateral hearing loss.

Persons with hearing disabilities may use dedicated AT devices such as hearing aids and cochlear implants or universally designed mainstream ICTs such as smartphones. We reviewed the literature to obtain data on the status of usage of these different kinds of AT by persons with disabilities, especially those with hearing impairment. To emphasize the importance of training and follow-up after the initial technology implementation stages, we refer to the outcome measurement study of cochlear implants under the ADIP scheme by the Government of India[125]. The outcome was measured for 113 children who had received CI, from across five different states in India. The study was conducted in 2014-15 by NISH and it revealed that the receptive (84% of beneficiaries) and expressive (91% of beneficiaries) language skills of the beneficiaries were not age-adequate and the reasons ranged from late identification, late implantation, duration of pre-implant and post-implant intervention, consistency of device use, device-related issues and the large distance to be travelled by the beneficiaries along with their parents to the therapy centres.

The report on a survey conducted by Hear a Million in February, 2021 reveals that for many people who are Deaf and Hard of Hearing (DHH) from rural India, hearing aid provision was not supported by follow-up interventions required such as replacement of batteries or servicing of malfunctioning devices[126]. This prevented the effective use of hearing aids. The survey showed that 64% of the participants were not comfortable with hearing aids, 28% found it comfortable and only 8% were very comfortable with it. These studies give an insight into the complexity of the challenges surrounding the successful last-mile implementation and usage of assistive devices.

2.6.3.1Challenges

Unaddressed hearing loss can impact many aspects of life at an individual level. Some important aspects are described below.

Communication and speech are significantly impacted by hearing loss. Spoken language development in children is directly related to their hearing ability[127]. Language is essential not only for communication, but also for cognitive development, education, and it is the basis for social relationships. Hence, access to language is critical and lack of early language stimulation can affect the overall development of deaf infants.[128]

Cognitive development is another important area impacted by hearing loss. Language deprivation delays cognitive development in children, which can be avoided by suitable early intervention[129].

[125] (2016). Outcome Measure Study of Cochlear Implant Recipients under ADIP Scheme, Govt. of India (OMCI - GOI). NISH, Trivandrum.

[126] Hear a Million. (2021, February). Hear a million - baseline report. Enable India.

[127] Yong, M., Panth, N., McMahon, C. M., Thorne, P. R., & Emmett, S. D. (2020). How the world's Children hear: A narrative review of school hearing screening programs globally. OTO Open, 4(2). https://doi.org/10.1177/2473974x20923580

[128] Hall, W. C. (2017). What you don't know can hurt you: The risk of language deprivation by impairing sign language development in Deaf Children. Maternal and Child Health Journal, 21(5), 961–965. https://doi.org/10.1007/s10995-017-2287-y

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Image courtesy by: Saksham

The adverse impact of hearing loss on communication, speech, cognitive development, hearing the subjects taught in noisy classroom and walking safely on roads as they fail to hear or localise the warning vehicle alerts, has a consequent effect on Education and employment. Around 22% of children with hearing disability between the age of 5 to 19 years never attended any schooling, as per Census 2011 of India[130]. Good quality, deaf-friendly education is available in very few parts of the country.

According to a report by Hear a Million[131], students who are DHH experience limited communication with teachers, lack appropriate learning materials and have to participate in assessments that are not fair and accessible to them. Such factors lead to minimal comprehension and poor learning outcomes. Based on experiential knowledge, the overall trend with respect to accessibility could be similar in special schools as well as mainstream schools in India. However, mainstream schools would offer a more challenging and competitive environment that might or might not be conducive to the growth of a student who is DHH.

Adults with hearing loss have a high unemployment rate. A higher percentage of employed people with hearing loss are in the lower grades of employment compared with the general workforce[132].

Hearing loss also leads to social isolation, loneliness and stigma. People with hearing loss, especially women and older adults experience social isolation and loneliness at all ages, possibly because of their small social network or due to decreased participation in activities[133]. Across the life course, hearing loss is associated with higher depression rates and lower quality of life compared with the general population[134].

Key Issues for persons with hearing impairments in India:

1. Delay in Communication and Speech development
2. Delay in cognitive development – need for early intervention
3. Lack of access to Education and employment
4. Social isolation, loneliness, risk due to not hearing alerting sounds and stigma

[130] 2011 census data. Census of India Website : Office of the Registrar General & Census Commissioner, India. (n.d.). https://censusindia.gov.in/2011-Common/CensusData2011.Html

[131] Hear a Million. (2021, February). Hear a million - baseline report. Enable India.

[132] Hear a Million. (2021, February). Hear a million - baseline report. Enable India.

[133] Shukla, A., Harper, M., Pedersen, E., Goman, A., Suen, J. J., Price, C., Applebaum, J., Hoyer, M., Lin, F. R., & Reed, N. S. (2020). Hearing loss, loneliness, and Social Isolation: A systematic review. Otolaryngology-Head and Neck Surgery, 162(5), 622-633. https://doi.org/10.1177/0194599820910377

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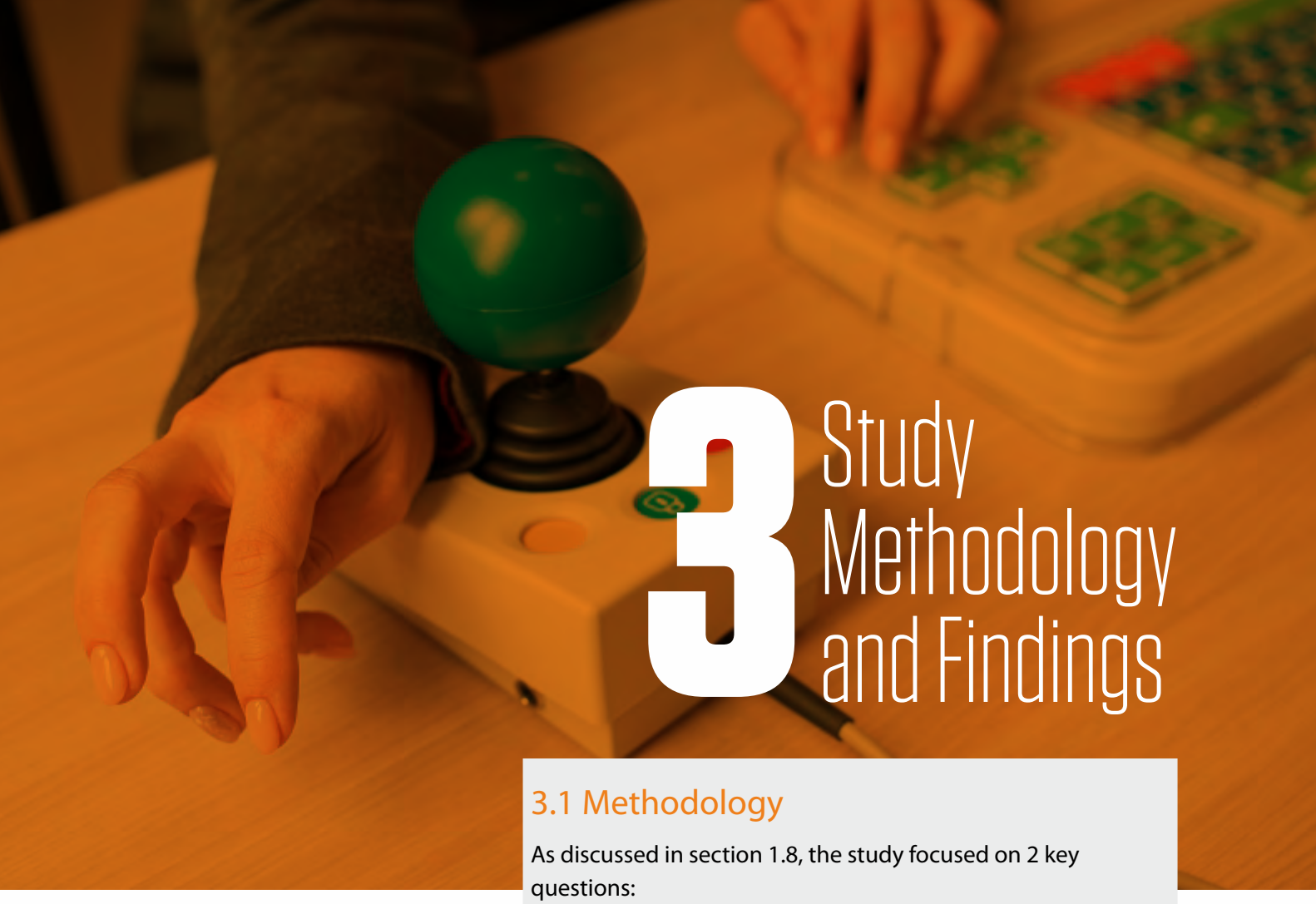


3 Study Methodology and Findings

3.1 Methodology

As discussed in section 1.8, the study focused on 2 key questions:

1. What are the gaps and opportunities for promoting the adoption of technology solutions for persons with vision, hearing, and SLD in India (focusing especially on education and employment)?
2. Given the increasing role of social media, how can social media platform providers enable persons with disabilities to play an active role on these platforms and improve their usage?

Three groups of persons with disabilities were selected for this study, as they require specialised formats and technologies to communicate and access content, persons with visual disabilities, persons with hearing disabilities, and persons with SLD. A sample size of 100 participants per disability was identified in the age group of 3 years to 45 years to coincide with the NEP classification. In the group of persons with visual impairment, 64% participants of the sample were male and 36% participants identified as females. For the group of persons with hearing impairment, around 58% of the participants were male and 41% were female. The group of persons with SLD had 62% male participants, 37% female participants and 1 person who identified as transgender. More gender related information can be found in the findings section.

Survey participants for the interviews were selected from the membership of the implementing organisations, in a way that they represented a mix of differing levels of technology users and covered a range of age groups, languages and occupations. Participants who were not comfortable with English or technology were interviewed via telephonic interviews and their responses recorded and submitted via Google forms by the interviewer. Google form links were circulated widely through disability networks and the survey was open to anyone who chose to participate. The study adopted mixed research methods of Google forms, interviews, Sign Language, Videos, and Focus Group Discussions (FGDs) and where relevant, translations were done to ensure wider participation.

Due to the pandemic, almost all of the responses of persons with visual impairments were recorded virtually, while responses for persons with SLD and HI were recorded both virtually as well as in person. Activities to assess the proficiency of visually impaired students with different technologies were conducted at the Saksham School.

Given that the medium of conducting research was primarily virtual and that the questions of this research relate to understanding the use of different technologies by persons with disabilities, the profile of participants leans more towards technology users and their preferences and difficulties in accessing technologies and apps. Specific outreach towards non-technology users were carried out to the extent that it was necessary to understand the impact that non/ delayed/ limited technology use had on their independence and life opportunities and possible reasons for the same.

Appropriate ethical and privacy measures were taken to safeguard the rights and privacy of study participants. An Advisory Research Committee was set up with representation of experts in the domain of technology, academia, and disability who provided guidance to the project. Feedback on the study for persons with hearing impairment was also taken from the Research and Review Authority (RAR) at NISH.

This study is exploratory in nature and did not propose a hypothesis. The three groups retained the flexibility and discretion to determine their

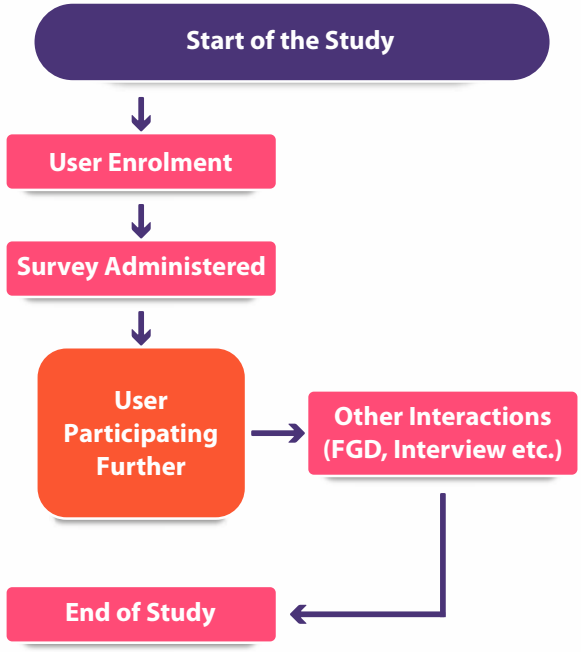
Image courtesy by: Saksham

priorities, questions and age criteria. This ensured they had the flexibility to focus on the key challenges for their disability, which may be different from others. However, the underlying goals and objectives remained the same for all groups, which enabled us to identify common themes that lead to a particular goal as well as specific points of difference.

The lower limit of 3 years and the first four stages were selected to coincide with the NEP and because it was felt that the likelihood of technology learning and use would be mostly within this age group. The upper limit of 45 was chosen to focus on employed persons who had more of likelihood to be exposed to technology training and use. However, a few case studies of participants beyond 45 were also explored to understand the factors that played a role in their technology adoption.

The study focused more on the aspects of literacy and technology since it was felt that literacy is a major barrier for persons with disabilities in India that has a ripple effect on the entire lifecycle of the individual. Within technology, the research studied a broad spectrum of technology users - participants who did not have much access to technologies; those who were basic and moderate level users; advanced users of technology; and those who were working - so that a comprehensive analysis of the situation with holistic recommendations could be made.

Figure1- User Engagement Process

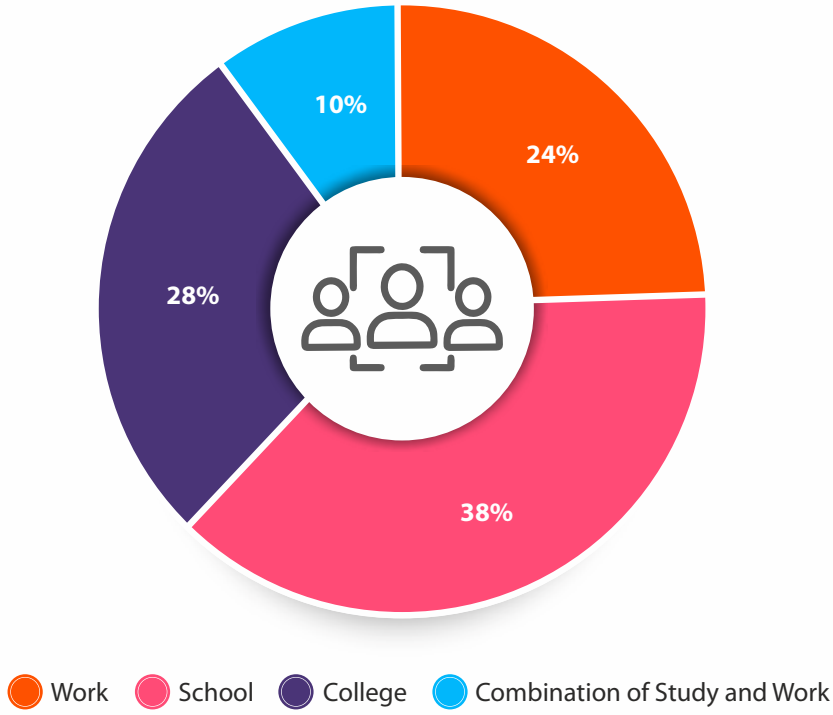


3.2 Findings - Visual Impairments

3.2.1 Demographic Profile

188 participants filled in the survey of which 70% were above the age of 18. More than 60% of the participants were persons with blindness and the rest were those with low vision and multiple disabilities. 66% of the participants were students in school and colleges, 24% were employed and the remaining were studying and working. 36% were female and 64% were males. Figure 2 depicts the activity of participants across a. work (24%) b. school (38%) c. college (28%) d. combination of study and work (10%).

Figure 2- Participants Current Activity



3.2.2 Mode of Communication

English was one of the languages or the only language used to communicate by an overwhelming majority of the participants, with only 10% participants using regional languages only. Hindi emerged as one of the more common regional languages used, as more than 50% of regional language users participating in the survey were found to use Hindi, indicating better support for this language than others.

For writing, more than 50% of the participants cited writing using e-text on a computer or mobile, with Braille being the second most popular method at 20%. When it came to reading, the mix changed slightly. While computers and e-text were still preferred by around half of the survey participants, audio was the second most popular option at 15%. For others, the method varied with many participants also reporting that they use a combination of methods.

Interestingly, when it came to writing exams, the preference of students changed with 48% students preferring to use scribes. One of the reasons for this could be low confidence level of students. For instance, among students who identified as being middle and advanced users of technology nearly 60% still used computers to write exams. However even here the second highest category is of those using scribes, suggesting that there could be other factors at play such as a lack of policies enabling technology usage in examinations.

Overall, participants seemed to prefer a mix of

methods for reading and writing, with the most popular methods being e-text, Braille in combination with Audio or e-text and Braille combined. For more than 70% of the participants, their overall method of reading and writing was equally used at home and school / office, indicating a continuum and showing that once technology skills are learnt, they also seem to impact all domains of the individual's life.

As part of this research a series of activities were also conducted in Saksham School with three groups of students ranging from those in class 1 to 12th to gauge their reading, writing, comprehension, and communication skills across different solutions of Braille, Computer and Orbit. The students were assessed on parameters of speed, punctuation, comprehension, and formatting for computers; and punctuation, speed, and comprehension for Braille and Orbit. The activity demonstrated that when exposed to technology very early on, students were able to use it to enhance their reading, writing, communication, and life skills alongside traditional form of braille. Computers seemed to be the preferred mode of reading and writing among those who knew all three, followed by Orbit, and then Braille. This seemed to align with the findings of our survey as well.

3.2.3 Education and Technology Training

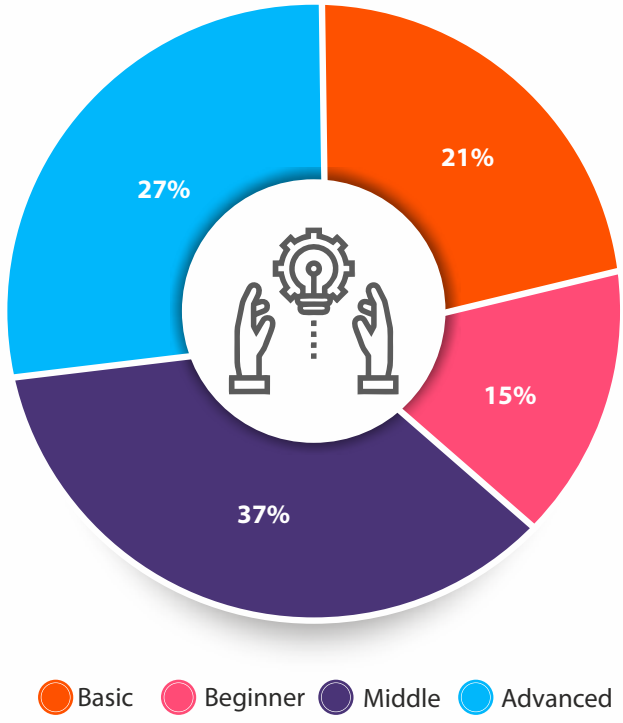
Around three fourths of the participants started using technology or Braille to read and write at a school-going age (36% between the age of 3 and 8; 13% between 8 to 11, 12% between 11 and 14 years and 15% between the ages of 14 and 18). The remaining, who learnt it at the age of 18 and above, started using it during college or university education (13%), employment (6%) or a combination of both (4%). Learning to use solutions after the age of 35 was relatively rare. In case of specific technologies like mobile and laptops, most people learnt to use these between the ages of 18 and 35, followed by 14-18 and then 11-14.

More than 60% people took formal training for learning for learning braille or technology. For their learning of technology or braille, participants were asked to share where they learnt to use the solution from the most and they could include more than one response. School was the choice for more than 50% of the participants, 38% chose resource centres, 39% shared peers or friends and 27% chose family members. About one tenth of the participants learnt as part of their employment training, while others mentioned learning on their own or a combination of the above.

In terms of learning, the time taken for people to get comfortable with the use of technology or AT solution varied, with three months being the most commonly cited timeframe by around half the participants, followed by 6 months (29%) and the rest taking a year or more to learn the solution. Among those who learnt technology within three months, more than 60% identify as needing help for only certain things and 20% identify as being completely independent in their day-to-day tasks. 37% identify as being middle level users of technology and 27% identify as being advanced users of technology.

Figure 3 depicts the technology proficiency level among participants who learnt technology within 3 months a. basic b. beginner c. middle d. advanced. The popularity and efficacy of formal training was borne out by the fact that 60% of the people who learnt technology within 3 months had taken formal training with many learning through resource centres and taking certificate courses.

Figure 3 - Proficiency Level among Users who Learnt Technology within 3 Months



3.2.4 Employment and Skillsets

The skills that people felt were needed the most to function efficiently were internet usage (92%), Productivity software like Microsoft Office or Open Office (71%), email applications like Outlook or other mail clients (56%) and programming languages like python and HTML (21%).

For those in employment, good communication skills were the most commonly cited requirement (72%), followed by knowledge of mainstream software like Microsoft Office (69%), ability to travel independently (67%), ability to network and be connected (57%). About a third of the people cited the need for specialised software required for their work like Tally.

Laptops or desktop devices were the accommodations cited by three quarters of the participants as being required for them to function in their school or college or work. Other important requirements mentioned were accessible communication and documents (61%), training or special software (56%) and customised workplace adjustments (38%).

We also sought the inputs of working professionals with visual disabilities through FGDs on what tools, technologies and skill sets persons with vision impairments require to be

successful and efficient in their employment. Most participants used a combination of laptops and mobile phones - while laptops were preferred for work, mobile phones were preferred for personal use. Even though most people had basic computer skills, almost 90% of technology learning was acquired after employment. Collaborative platforms were emphasized as important technologies that were going to play a much bigger role in the future.

While addressing technological barriers was identified as important in ensuring access to information for persons with visual impairments, it is equally important to ensure that the content created by users is accessible. For this, awareness generation among the online community is necessary. From a training perspective, the participants also opined that the current way in which fundamentals of computers are taught is very basic and not sufficient to meet their needs. Instead, advanced technologies and skillset training that takes cognizance of current market and industry needs is the need of the hour.

From a social media usage perspective, LinkedIn, Twitter, Facebook, WhatsApp and Instagram were the most popular apps, though usage varied amongst participants. Some people mentioned that the emphasis on images and videos in their platforms led to lower interest amongst persons with visual impairments. For personal use, most preferred to use these apps on their mobile devices. Cleaner interfaces and the integration of different platforms or interoperability amongst platforms that would enable them to access multiple platforms through a common interface would be useful. This would ensure that even if a particular platform is not accessible or preferable to the user, it still allows the user access to that platform.

3.2.5 Technology Devices and Usage

More than 90% participants cited using AT solutions, with mobile emerging as the most preferred solution used for social relationships, home-management, personal needs, information and awareness, entertainment and games and mobility. Laptop was the second most preferred solution overall but seemed to be the most preferred for reading and writing, and for school, college, and work. It was also the device that featured in participants' answers as a solution they needed but did not have, mostly due to it being an expensive device.

Participants were asked in relation to their most preferred solution, how they obtained the AT solution that they were using and where they learnt to use the solution the most? 62% of the participants shared they had bought their own device, 13% shared that they received their device through an NGO/Resource Centre scheme, 8% noted they received it through a scholarship, 6% received it through their school, 4% of the participants relied on Government schemes for obtaining their device, and the remaining were divided into smaller subsets. In relation to their most preferred device, participants seemed to have largely learnt to use the solutions from four sources - school (23%), peers (20%), resource centres (20%) and family members (16%) and the remaining people used a combination of these methods and some participants also mentioned teaching themselves using manuals and internet. This suggests that in many cases there is not a fixed distinction between informal and formal learning for the group, which is similar to the general trend in technology learning among persons without disabilities.

For more than 80% of the participants, once learnt, technology also seemed to be used in school, college and office for informal communication or formal writing tasks. Another area that stood out was the use of technology for seeking information with almost 80% of the participants citing the internet as their main source of information, followed by online libraries, which was used by more than 57% people. Over two thirds of the participants also used it for entertainment like watching

programmes or listening to music and other uses cited by participants included online banking (41%), e-commerce (40%) and games (29%). This usage of technology was constant across disability segments. For example, among persons with deaf-blindness, 90% of the people used their technology for reading and writing, 100% used it for communicating with their friends, teachers, and peers; and 80% used it for internet search for information and reading material.

Participants were also asked if there are any other apps or software, which made their life easier. Some of the apps/softwares mentioned include:

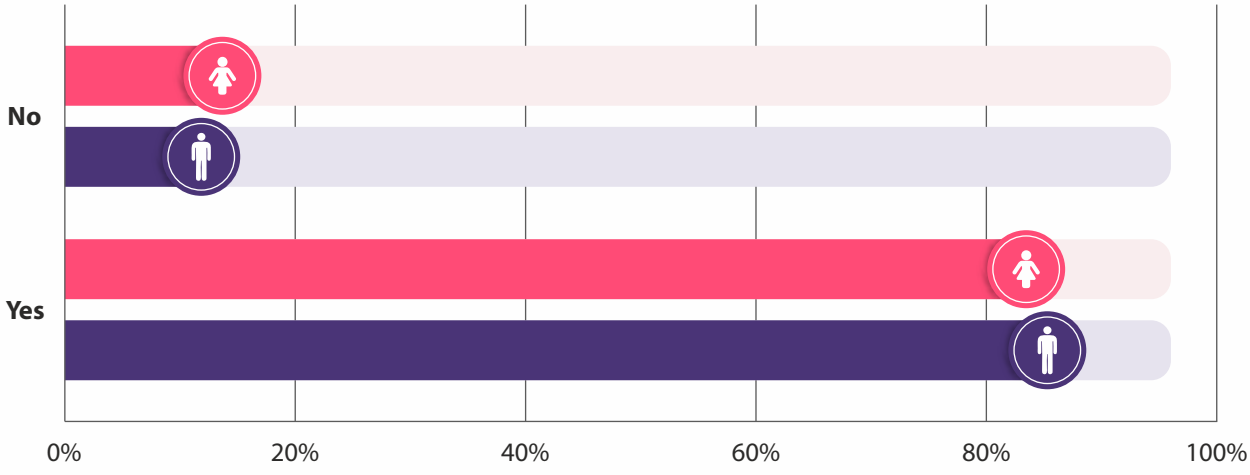
YouTube; Jaws, Google browser, Talkback, Mani app, WhatsApp, Dainik Bhaskar, Twitter, Telegram, Instagram, Zoom, Kibo, E-newspaper apps, Google Pay, ABBY FineReader, Seeing AI, travel apps like Uber, Rapido, Samsung voice assistant, Khabri, lookout, Victor Reader Stream, Supersense, Daisy player, Voice Over, NVDA, Envision, Duo meet, MS office, MS teams, Notepad, Gmail, Sandesh, meri-file, Unacademy, Simply reader, Zoom, NCERT Hindi book, Utkarsh, Tally, e-speaking, Smart Voice

3.2.6 Social Media Usage

An overwhelming majority of the people used social media, with mobile phones being the preferred device to access social media for more than 70% of the participants. A roughly equal proportion of people access social media content in English only (48%) or a mix of English and regional languages (47%), with a very small proportion using only regional languages. An overwhelming majority of people (93%) felt they had access to content in the language of their choice.

More than 80% noted that they also use social media for education and training, with YouTube (more than 40%) and WhatsApp (upto 30%) being the most popular solutions for this. The most popular apps overall were WhatsApp (90%) and YouTube (86%), followed by Facebook (50%), Telegram (46%), Instagram (30%) and Twitter (27%). Most people (80%) were part of peer networks of persons having similar disabilities and shared content like information, books, and course curriculum on these networks. Among males and females, this usage of social media for education and training showed a similar trend. While 85% females used social media for education and training, in case of males the figure was 87%.

Figure 4 - Percentage of Social Media Usage for Education and Training among Males and Females



	Yes	No
Female	85%	15%
Male	87%	13%

The study also conducted an FGD on social media and sought the inputs of persons with visual disabilities on how accessible social media platforms are, what barriers they face (if any), and what could be improved on the platforms to assist their usage. Features that were particularly appreciated were audio and video calls and one-to-one communication on WhatsApp, which participants used for a variety of purposes ranging from communication with parents and friends, to online workplace and celebratory events to accessing online education during the pandemic. Most participants' social media usage had increased during the pandemic.

Amongst things that do not work very well, participants noted that currently 'feeling/activity' and GIF features on Facebook were not accessible and they would like them to be made accessible. They also highlighted concerns in Hindi language automatic alt-text on Facebook, which was not accurate and required switching to a Hindi language TTS. Other areas of concern highlighted were - the need for live captioning in Hindi language on Google Meet; issues in accessing status/stories of people on WhatsApp, Facebook, and Instagram because of limited timeframe and lack of alt-text; the need for audio-description and transcription of videos; and issues in WhatsApp Hindi transliteration keyboard and the way screen reader interprets it.

In addition to this, some of the other challenges identified by participants include - challenges using captcha code; inaccessibility and unavailability of file types; too many advertisements in between the usage of their apps; and need for improving sharing of set up files.

3.2.7 Impact of Technology

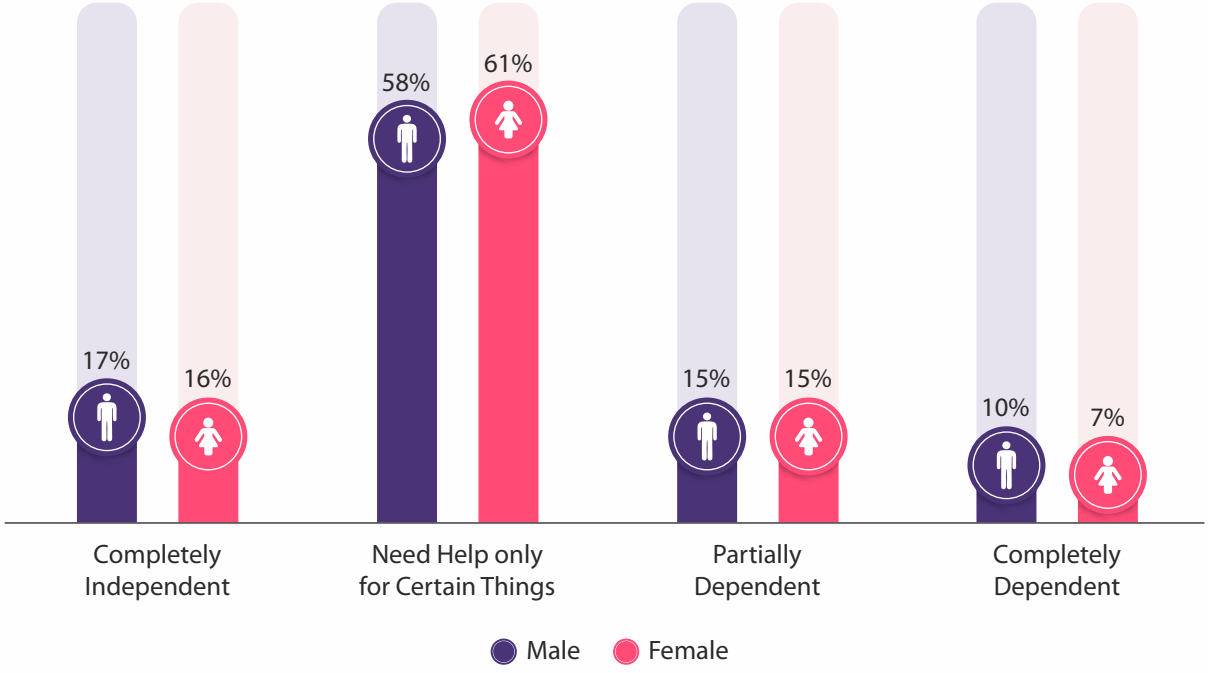
Around two thirds of the people surveyed felt that technology had completely or significantly impacted their lives, with the maximum influence being reported in education and work,

> "I use the phone for gathering news, for my job and to access apps. I can read my smart-phone to cook recipes, and chat with friends. I use my cane a lot. The cane is my life. It allows me to travel independently and get information from my surroundings. For work I use my refreshable Braille display, laptop and smart-phone. Without AT and the devices I would never be able to get a job at a company or communicate the way that I do today."
>
> *- Survey Respondent*

followed by information and awareness, entertainment and social relationships respectively. The least influence was observed in the domain of home management and mobility.

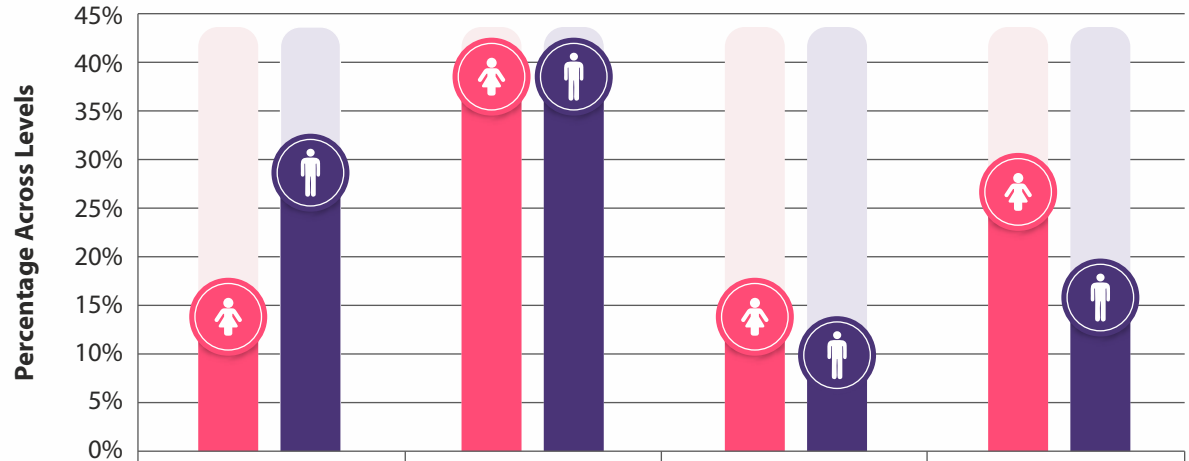
More than three fourth of the participants reported a high degree of independence, with some being completely independent (17%) while others needing help only for certain tasks (60%). While some said they were partially dependent (15%), only a small subset mentioned being completely dependent. When we disaggregate this data as per gender, the trends appear similar across the groups with maximum percentage belonging to the category of those who need help only for certain things, followed by those who are completely dependent, followed by participants who identify as being partially dependent and the smallest subset in both cases as those who are completely dependent.

Figure 5 - Independence Level among Males and Females for carrying out day-to-day Tasks



When it came to technology proficiency, the largest group were the people who felt they were middle level users (40%). A similar number of people rated themselves as advanced users (25%) and basic users (22%), while the rest were beginners. When we disaggregate this data as per gender, although the percentage of middle level users is the same (40% each) and highest for both categories, there is a considerable gap between advanced and basic level users. For males, the second highest category is that of advanced users at 30% but for females, the second highest category is that of basic level users. Among women participants, only 15% constitute advanced level users of technology.

Figure 6 - Technology Proficiency Levels among Male and Female Participants



	Advanced Level	Middle Level	Beginner Level	Basic Level
Female	15%	40%	16%	29%
Male	30%	40%	12%	18%

Interestingly, there appears to be a link between technology usage and mainstream schooling. Among those who identify themselves as being completely independent and studying (college, school, work and college), nearly 60% study in mainstream schools, followed by those from special schools and a combination of mainstream and special schools at 17% each. We see a similar trend in advanced users of technology with among those currently studying, with nearly 60% of participants belonging to mainstream schools, and the remaining being in mainstream and specialised school.[135] However, there were no advanced users of technology from specialised schools amongst the survey participants. Among other reasons this could be because the need for adopting mainstream script for reading and writing was less in these schools. Advanced users of technology are mostly English language users (more than 54%) and also those that use combination of both English and regional (46%) but none of the regional language users who responded to the survey were advanced users of technology, indicating that perhaps the support offered for Indian languages is less.

A huge majority of people (95%) spend over 2 hours a day using technology, with 71% spending more than 4 hours. Of the people spending more than four hours using technology, 88% felt that constant exposure to the technology outside school or work improved their life skills, which was in this case, understood to be the ability to read, write and live independently. People benefited from technology usage in a variety of ways such as

[135] Note –this is mentioned specific to those studying because it wasn't a mandatory question so someone who is working and maybe advanced user of tech may not have filled this which won't make it comparable

> "Technology has increased my self-confidence and made me more productive at work"
>
> *- Survey Respondent*

being part of social network groups (77%), members of digital libraries(60%),being part of groups or networks with parents 59%) or peer networks (56%).

3.2.8 Persons with Deaf-Blindness

Amongst the study participants with deaf blindness, 70% were working; 10% were studying and working and 20% were currently in school. 90% use English as their main language for reading and writing and 10% use a combination of English and regional language. In terms of their overall method of reading and writing, 40% use e-text only, 20% use Braille only, 10% use Braille and e-text, and 30% use e-text and large print. Within this group, 60% said that they use their mobile phones primarily at home, 30% said that they use it equally at home and school or office and 10% said that they use it primarily at school.

All the participants mentioned they use AT and mobile was the most preferred solution for all. 80% said that they bought the AT with their own money while 20% said that they received it through an NGO or as a resource centre scheme.

80% said that their solution was readily available in the market.

When it comes to learning their most preferred solution which is mobile in this case, 40% mentioned that they learnt it from family members and peers, 30% said that they were completely self-taught, 20% said that they learnt it from their peers and they were also self-taught, and 10% said that they learnt it formally through a teacher. 60% noted that they learnt technology within three months, 30% said that they learnt their AT within six months, and the remaining 10% said they took one year or more. Unlike the case of persons with visual impairments only, here a majority (60%) identified as being basic level users of technology with a small proportion identifying as being advanced (20%) or mid-level users (20%).

All the people in the group use technology for communicating with their friends, teachers and peers; 90% use technology for reading and writing; and 80% use it to search the internet for information and reading material. Other activities identified include using it to magnify text, watching programmes and listening to music, e-commerce, reading books, and online banking. Utility apps, e-commerce, dictionary, Microsoft teams reading apps, Voice Over or talk back software, news and information apps, games and entertainment apps and social media apps were among the category of apps used.

While all of them use social media, only 20% said they use social media for education and training, and YouTube and WhatsApp were the platforms they use the most. For all of them mobile was their preferred medium for accessing social media. Among social media apps, (100%) all of them used WhatsApp, 60% used Facebook, and 70% used YouTube. Other apps used by the group include Google meet, zoom, Instagram, dictionary, Microsoft teams, Telegram, Quora, Medium, Twitter, and LinkedIn. 90% shared they are part of peer networks having similar disability as them.

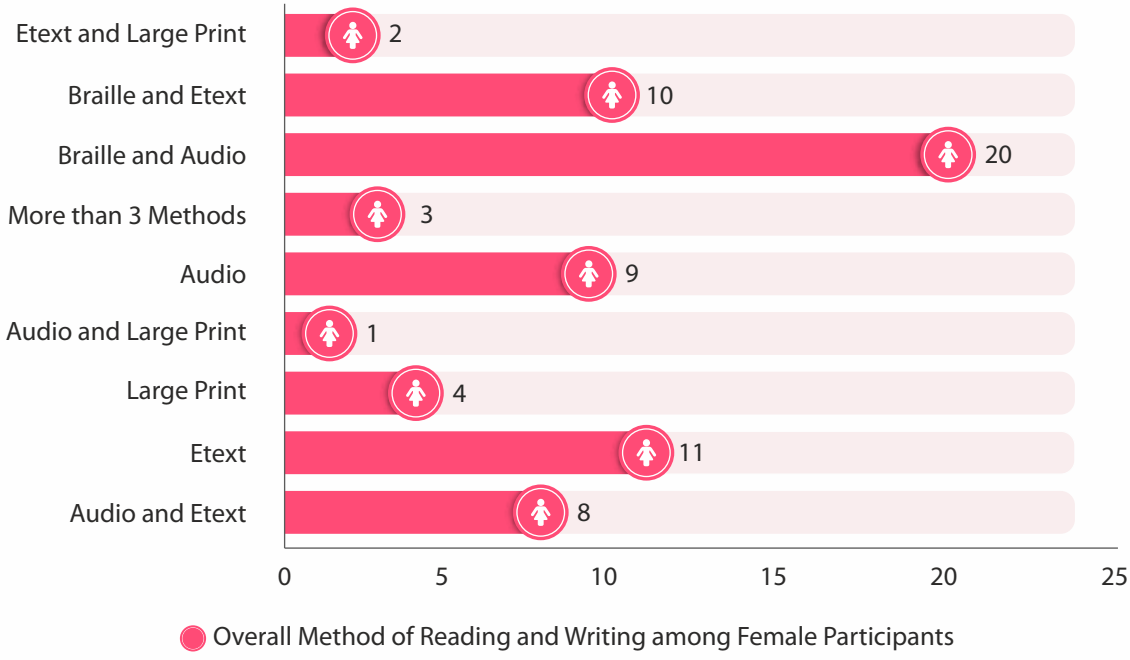
10% said they are completely independent. 30% said they are partially dependent, 60% said they

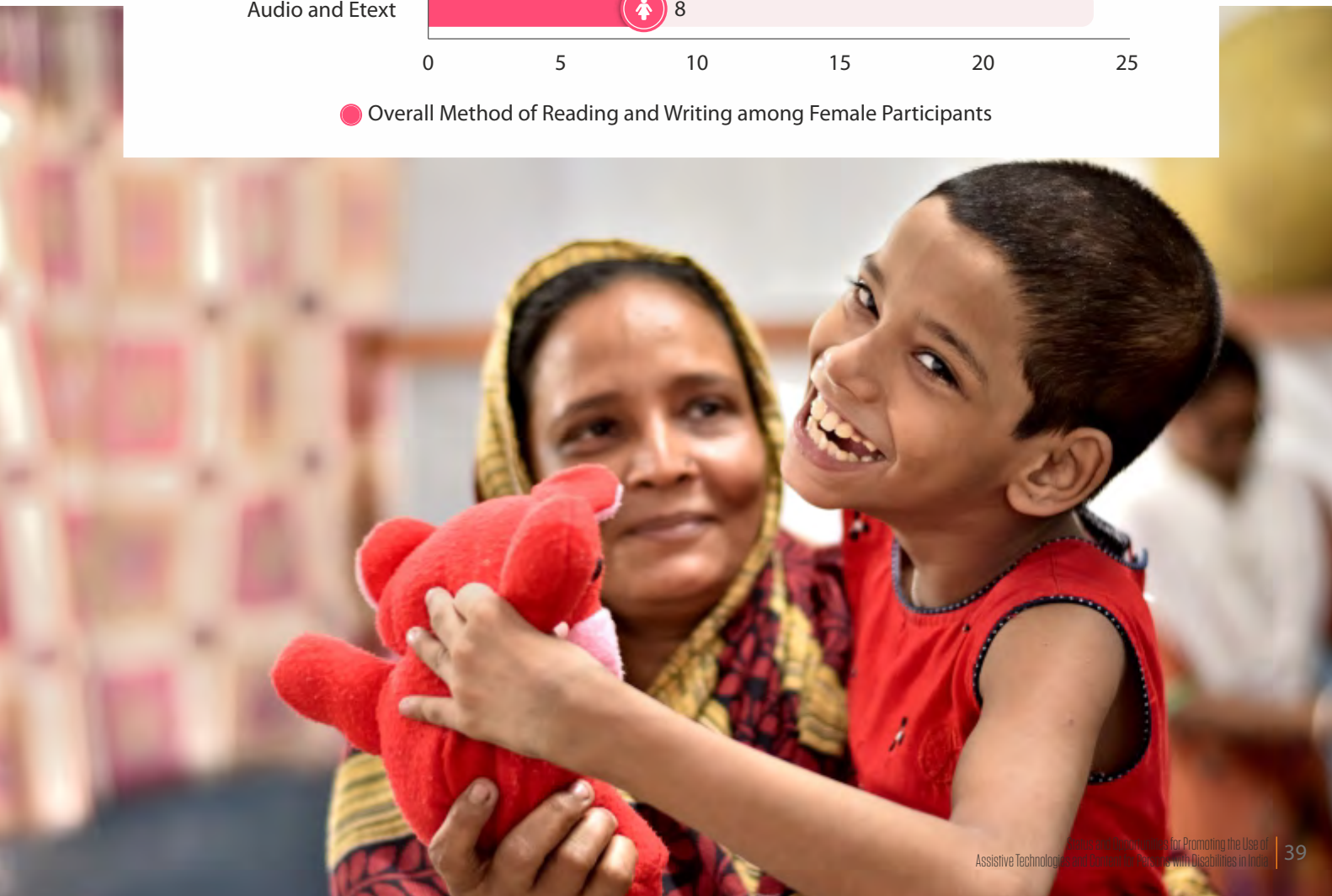
need help only for certain things. 70% shared they use technology for more than 4 hours a day, and the remaining 30% said they use it for 2-4 hours.

3.2.8 Women with Visual Disabilities

Among the 68 participating women with disabilities, 44% were in school; 32% were in college; 18% were working; and 6% were working and studying. Among those in school, the largest group were in mainstream schools 57%, followed by those in special schools at 30%. 62% use a combination of English and another regional language, 25% use only English and 13% use only regional language.

Figure7- Method of Reading and Writing among 68 Female Participants





Braille is more popular within this subset than the overall VI group, with 29% using Braille and audio, 16% using e-text, 15% using Braille and e-text,13% using audio,12% using audio and e-text, and the remaining using multiple combinations of large print, e-text and audio or more than three mediums. Figure 7 shows the overall method of reading and writing among female participants.

Most women (78%) said that they use technology equally at home and school or work, 15% said they use it primarily at home, and 7% said they use it primarily in school.

Among this group 62% said they learnt to use technology within three months, 22% said they learnt to use it within six months, and 16% said that they learn to use it within a year or more.

62% said they need help only for certain things, 16% identify as being completely independent, 15% identify as being partially dependent and 7% identify as being completely dependent.

Among proficiency levels the mid-level users of technology were the largest group (40%) followed by basic level (29%), beginner level (16%) users of technology and advanced (15%).

We also asked women participants if they face any specific barriers on account of their gender. A woman participant shared that she does face extra restrictions from her family, which impacts her mobility. Another woman participant was of the view that women tend to face more challenges and obstacles at every step, whether it is a woman who is working or married or a mother.

I work in a Public Sector Company. When I joined my organisation, for the initial 3 or 4 months I was idle and no work or department was assigned to me. There was lack of understanding on what kind of work to give to me as well as attitudinal barriers with regard to what work I was capable of doing.

Finally, a manager reached out to me and asked me what kind of resources I would need to make my work easier. I told him I needed a computer with a screen reading software and a scanner. He provided that but he also shared that there are about 400 files that we need to handle and he asked me how I will manage that.

It was definitely a challenge for me but I devised a system where I put braille stickers on the files and later scanned and read them. I was provided two assistants to help with the task. I arranged the filing and storing system in such a way that both braille and the file numbers were visible to everyone, creating in the process an inclusive filing system for my team. I also prepared a detailed list of the file numbers corresponding with their subject matter in the form of an excel, which helped me access these files through my computer. This was also printed out in mainstream script and shared with my sighted colleagues so that they could easily access files.

I have now been working in this organisation for more than 14 years. In retrospect, I feel there are attitudinal barriers initially and one has to take initiatives and come up with solutions. We definitely need to have basic computer skills. For me, braille along with basic digital literacy is an added advantage that allowed me to create the inclusive filing system. However in the absence of digital literacy, only knowing braille wouldn't work.

- Mansi (name changed to protect identity)

3.3 Findings - Hearing Impairments

3.3.1Demographic Profile

For hearing impairments, inclusion criteria for the study was that a participant should be a person who is DHH (mild to severe hearing loss) in the age range of 15 to 45 years or should be a parent of a child who is DHH (Mild to severe hearing loss) in the age range of 3 to 14 years.

The study excluded persons with any additional disability other than hearing impairments.

Out of the 97 participants who took part in the online survey, 25 participants (27%) were parents of children who are DHH in the age range of 3 to 14 years, largely between the age of 3 and 9 years. 67 participants (72.8%) were persons who are DHH in the age range of 15 to 45 years, predominantly (66%) between the ages of 18 and 24 years.

Around 58% of the participants were male and 41% were female. Due to the pandemic and communication constraints that are typical of the DHH, NISH was not able to fully succeed in getting enough responses from participants outside the state of Kerala: 70% of the survey participants were from Kerala and 30% were from other Indian states.

87% of the participants had severe hearing loss (70 dB hearing loss in speech frequencies in both ears – Deaf as per RPWD Act 2016) and were able to provide deep insights into the serious challenges that they face because of their hearing impairment. The source of hearing loss was mixed among the survey participants: 59% of the participants had hearing loss from birth, while the remaining lost their hearing later in life.

83% of the participants had no family members with hearing loss and hence had need of external support to avoid isolation i.e. support from beyond the family to become aware of, understand and tackle the challenges of hearing loss.

The preferred disability terminology gives an insight into how the individual perceives his or her disability. In Deaf Culture, persons who are DHH attach pride and identity to being referred to as 'Deaf' (with capital D). 73% of the participants above 18 years of age prefer to be referred to as 'Deaf' whereas 68% of the participants below 18 years of age prefer the term 'Hearing impaired'. It is to be noted that parents or caregivers filled the survey on behalf of the participants below 18 years of age.

Table 1. Comparison of responses of participants above 18 years of age and below 18 years of age, pertaining to the different domains from the survey

Sl. No.		Rank	Persons who are DHH and above 18 years of age (n=67)	Persons who are DHH and below 18 years of age (n=25)
1	Primary mode of communication	1	Both sign and speech (49%)	Speech only (92%)
		2	Sign only (33%)	Both sign and speech (4%)
2	School type	1	Special school (58%)	Mainstream school (76%)
		2	Mainstream school (42%)	Special school (19%)
3	Primary information source	1	Internet and social media (77%)	Parents (88%)
		2	Peers (54%)	Schools (68%)
4	Usage of mainstream technology devices	1	Smartphone (98%)	Smartphone (48%)
		2	PC (88%)	PC (24%)
5	Usage of special AT devices	1	Hearing aid (25%)	Cochlear implants (60%)
		2	Smart watches (12%)	Hearing aids (44%)
		3	Cochlear implants (10%)	-
		4	Visual alerts (6%)	-
6	Usage of social media	1	WhatsApp (96%)	WhatsApp (8%)
		2	Instagram (90%)	Instagram (8%)
		3	Facebook (71%)	Other (4%)

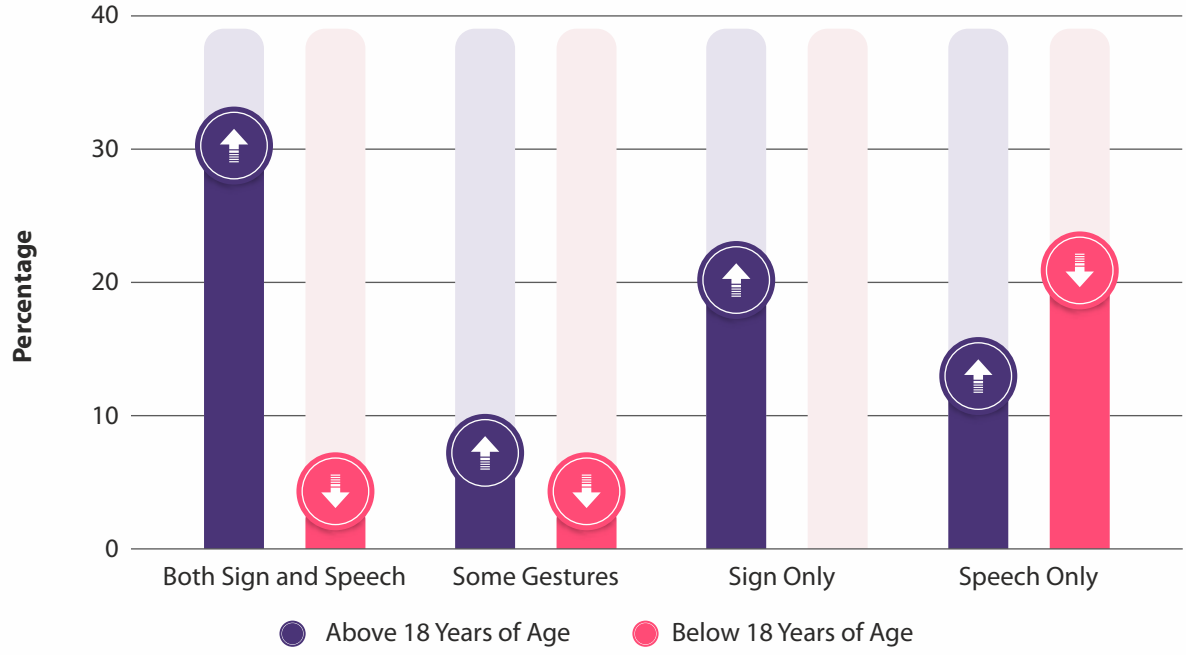
Image courtesy by: Saksham

3.3.2 Mode of Communication

Figure 8. Comparison of the different modes of communication between persons who are DHH and above 18 years of age or below 18 years of age (a) Both sign and speech (b) Some gestures (c) Sign language only (d) Speech only

The primary modes of communication for persons who are DHH are speech and sign language and various combinations of these two modes, in different situations. As shown in Figure 1, 49% of the participants above 18 years of age use both sign language and speech, followed by 33% of the participants using only sign language to communicate. As opposed to this, a predominant 92% of the participants below 18 years of age use only speech to communicate. Such a drastic difference could be attributed to the fact that the participants below 18 years of age are from the early intervention programme at NISH, where the impetus is on communication through speech. A similar trend can also be observed in the usage of hearing devices, which is discussed later in this report.

Figure 8- Comparison of the Different Modes of Communication Between Persons who are DHH and above 18 Years of Age or Below 18 Years of Age (A) Both Sign and Speech (B) Some Gestures (C) Sign Language only (D) Speech only



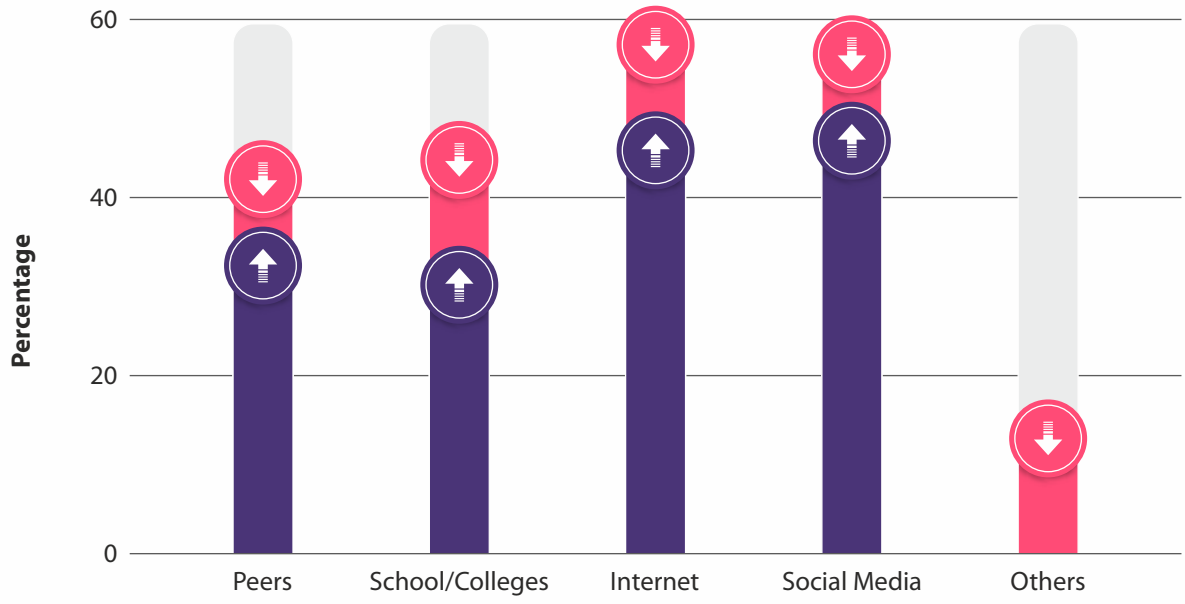
3.3.3 Source of Information

Figure 9. Comparison of the primary sources of information for persons who are DHH and above 18 years of age or below 18 years of age (a) Peers (b) Schools/colleges (c) Internet (d) Social media (e) Others

Persons above 18 years of age largely rely on the internet and social media (77%) and peers (54%) for their primary source of information whereas persons below 18 years of age depend upon parents (88%) and schools (68%) for the same. In the in-depth interviews, it emerged that several of the persons above 18 years of age, who are sign language users, do not share a good relationship with their parents and feel a higher sense of belonging to the deaf community.

Cochlear implant (CI) users do not belong to any community, unlike their sign language counterparts. One of the CI users, however, has founded an NGO called 'Our World of Sound' to create awareness about CI among parents of children who are DHH. Parents of kids with CI from Kerala are part of a peer support group called CIACS (Cochlear Implantees' Association and Charitable Society)

Figure 9- Primary Information Source



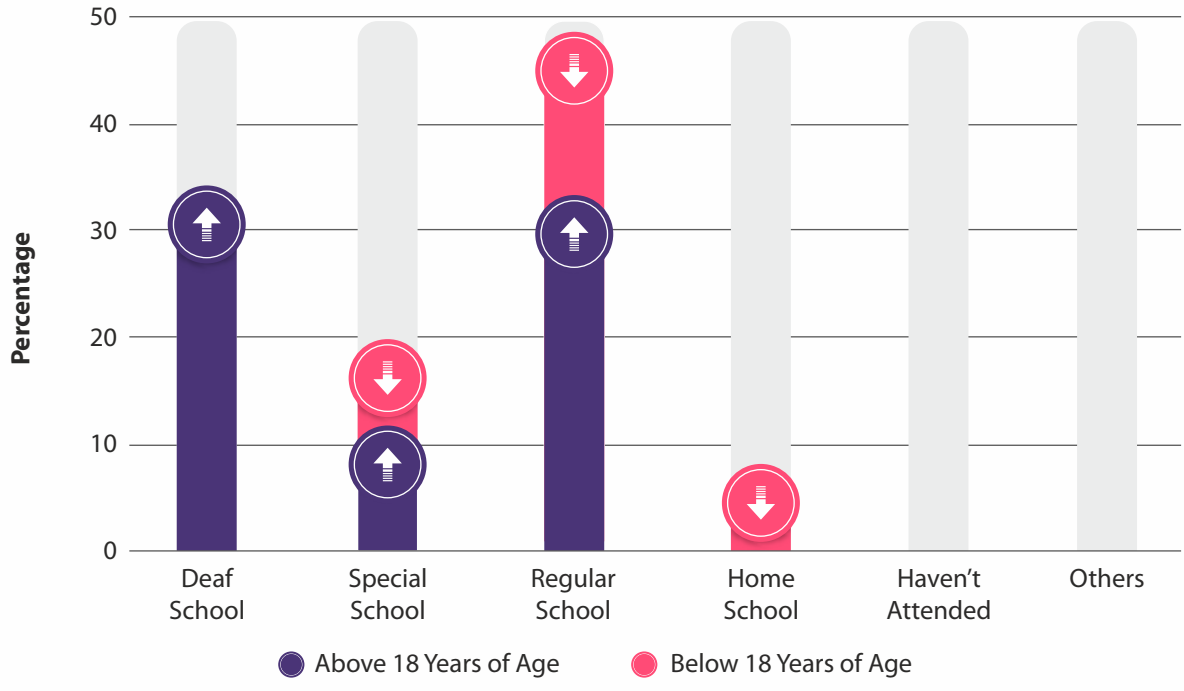
3.3.4 Education and Training

Figure 10. Comparison of the type of school attended by persons who are DHH and above 18 years of age or below 18 years of age (a) Deaf school (b) Special school (c) Regular school (d) Home school (e) Haven't attended school (f) Others

In our survey data, the proportion of participants above 18 years of age who completed their school education in special schools was 58%, while 42% went to mainstream schools. In contrast, 76% of participants below 18 years of age go to mainstream schools and 19% go to special schools. The reason for this difference could be that participants below 18 years of age have been mainstreamed more effectively because of better quality of early intervention for their hearing impairment, through technology as well as rehabilitation.

The participants were asked a few questions addressing accessibility of the environment at schools such as good lighting (important for persons who are DHH because they are primarily visual learners), good acoustics in the room (include good sound level, less echo and less background noise, as persons using CI or hearing aid or both need a quieter classroom environment and better signal to noise ratio for optimal and effective use of technology) , availability of spoken information in alternative formats like written text or sign language and presence of sensitized and deaf-friendly persons (educators). 43% said they experienced good acoustics, 62% had access to good lighting, only 39% had access to information in alternative formats and 61% interacted with sensitized and deaf-friendly persons at their schools.

Figure10- Comparison of the Type of School Attended by Persons who are DHH and Above 18 Years of Age or Below 18 Years of Age (A) Deaf School (B) Special School (C) Regular School (D) Home School (E) Haven't Attended School (F) Others



3.3.5 Employment

A majority of the working DHH persons surveyed were in private jobs (56%), 28% in government jobs and 11% were self-employed. Based on the survey findings, they faced significant gaps when it came to accessibility of the workplace environment. Only 10% had access to good acoustics, 18% had good lighting, 13% had access to spoken information in alternative forms and 9% worked with sensitized and deaf-friendly colleagues. During in-depth interviews of some participants, one person who uses CI and works in a government institution shared that online Zoom meetings at his workplace lack captions and thus he misses out on a lot of important information. Usage of masks during the COVID-19 pandemic also presented a big barrier for those who depend on lip-reading for communication at the workplace.

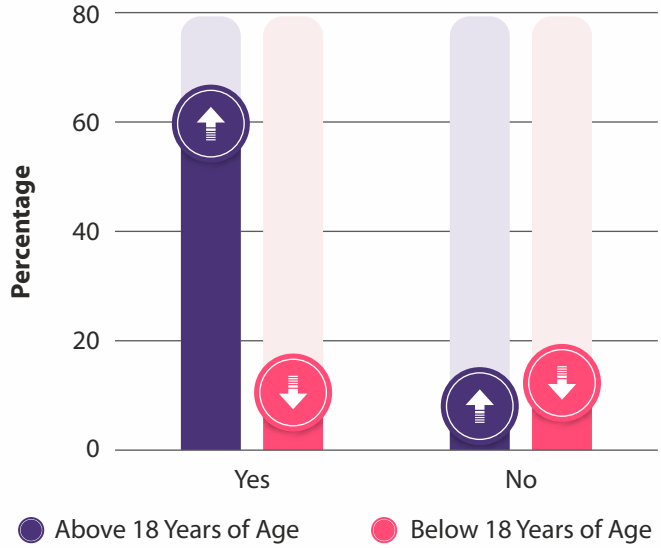
3.3.6 Technology Devices and Usage

Figure 11. Percentage of users who possess smartphones for those who are DHH and above 18 years of age and those below 18 years of age

An overwhelming 98% of the participants above the age of 18 years use smartphones and 88% use a personal computer or laptop. On the other hand, only 48% of the participants below 18 years of age use a smartphone and 24% use a personal computer. The main use of the personal computer (66% of participants) is for browsing the internet. From the in-depth interviews conducted with parents of persons who are DHH and below 18 years of age, we gathered that there is little awareness of ATs available on mainstream devices such as smartphones and computers. To address this issue and to aid them in better understanding the questions related to the technologies in the survey, we prepared a flyer containing information about the different technologies available for persons who are DHH. The flyer was translated into Hindi and Malayalam and passed to the participants, before they took the survey.

45 to 60% of the participants use smartphones for video call, internet browsing and watching videos with subtitles. Apps used for video calls include WhatsApp, Google Meet, Duo, Facebook Messenger, Zoom, Jio video call, FaceTime, Hangout and Signal - most of these apps are used for the dual purpose of texting as well. YouTube is the preferred site for watching videos. Only one well-informed and tech-savvy respondent reported using the 'Live transcribe-cum-translate' feature in Google Translate app, which can be very handy to communicate with persons speaking different languages.

Figure 11– Percentage of Users Who Possess Smartphones for Those Who Are DHH and Above 18 Years of Age and Those below 18 Years of Age



Around 30 to 40% of the participants use apps for communication, entertainment, educational purposes, for reading/writing and for sign language translation. Voice-to-text conversion apps, apps for safety and apps that vibrate upon detecting sounds are used by 15% of the survey participants. Surprisingly, only 10% use the Bluetooth pairing feature in hearing aids for better access to smartphone calls and media. Few persons who are DHH are aware about the Google pixel phone that has recently added the in-built 'Live captions' feature which transcribes audio in phone calls to text. This feature is available in many smartphones with the recent Android OS versions and is helpful to caption any media file, although phone call captioning is restricted to the Pixel phones.

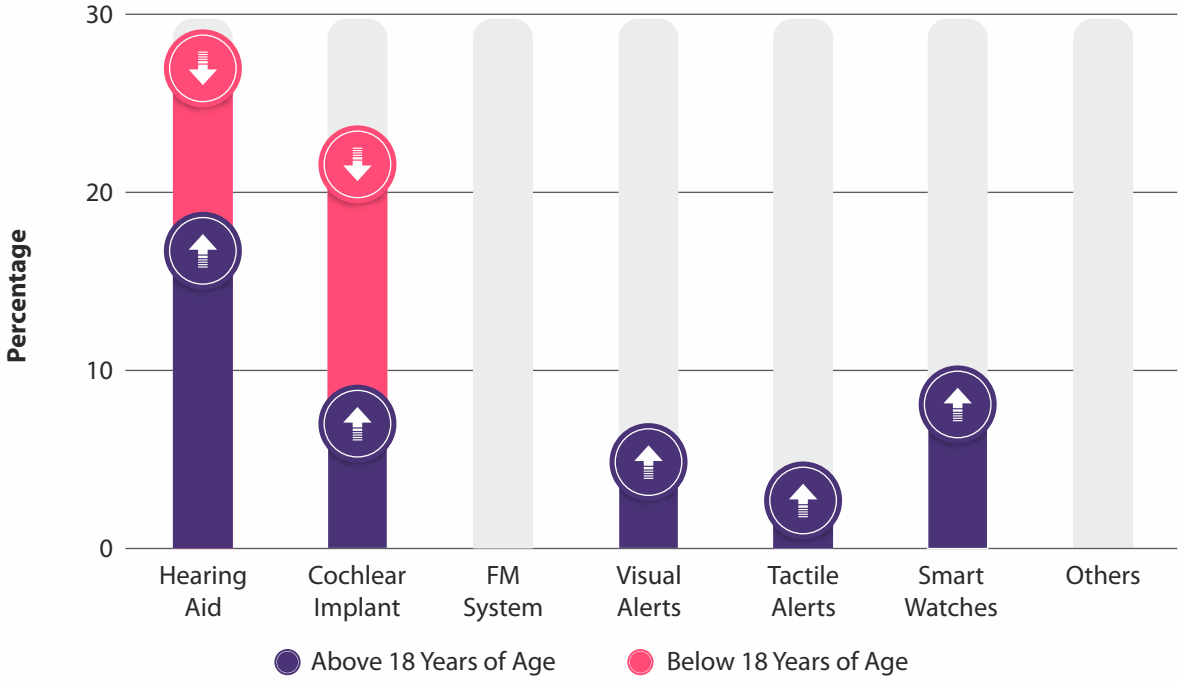
3.3.6.1Dedicated AT Devices

Figure 12. Comparison of dedicated AT devices by persons who are DHH and above 18 years of age or below 18 years of age (a) Hearing aid (b) Cochlear implant (c) FM system (d) Visual alerts (e) Tactile alerts (f) Smart watches (g) Others

Table 1 and Figure 5 indicate that the usage of dedicated AT devices for hearing is higher in persons who are below 18years of age: 60% of them use Cochlear Implants, 44% use hearing aids and there is no awareness or usage of other devices such as FM devices, tactile or visual alerts. This trend of high usage of cochlear implants and hearing aids is not surprising as these participants are from the early intervention programme at NISH. The cochlear implantees are beneficiaries of the Srutitharangam scheme of the Government of Kerala.

Among persons who are above 18 years of age, 54% don't use any dedicated AT devices, 25% use hearing aids, 12% use smart watches, 10% use cochlear implants and 6% use visual alert devices. This is a striking difference in trend, as persons who are DHH and above 18 years of age are predominantly using more mainstream devices such as smartphones and less of the dedicated AT devices such as hearing aids and cochlear implants. Through the in-depth interviews, we learnt that many persons who are above 18 years of age had abandoned their hearing devices or they use them very sparingly. Reasons for hearing aid abandonment include: finding it inconvenient to wear, the noise being frustrating, the device being visible to others reveals the hearing disability which is otherwise invisible. One cochlear implant user explained the lack of device trial, maintenance or insurance support and also expressed the need for financial support such as GST rebates on AT devices.

Figure 12- Use of Dedicated AT Devices



3.3.7 Social Media Usage

Figure 13. Comparison of usage of social media platforms by persons who are DHH and above 18 years of age or below 18 years of age (a) Facebook (b) WhatsApp (c) Instagram (d) Twitter (e) Others

The ubiquitous nature of social media in everyone's lives was demonstrated by the fact that 94% of the survey participants above 18 years of age use social media. WhatsApp ranked the highest among the social media platforms used (96%), followed by Instagram (90%), Facebook (71%) and Twitter (31%). The simple and easy-to-use interface in WhatsApp makes it widely popular. Youngsters, especially persons who are DHH, consume more visual information and hence are more into Instagram, which offers a convenient platform for media. Instagram reels, belonging to online communities such as those of DHH and watching vlogs are reported to be popular social media features. Many people shared that captions are not available for every video posted in social media, which makes it inaccessible to persons who are DHH.

3.3.8 Conclusion

While technologies are becoming more affordable and available to the general public, persons with disabilities continue to be excluded from availing the complete benefits of ATs that can improve their quality of life and safety in the world of sound. We used methods such as survey and personal interview to gather end user perspectives, focusing on persons who are DHH, regarding their preferences, usage, availability and barriers in accessing ATs in their daily lives. Our analysis supports previous findings regarding less comfort, usage and hence abandonment of hearing aids, poor financial support for procurement, service and maintenance of good quality hearing devices such as hearing aids and cochlear implants, difficulty to travel to reach distant therapy centres and consequently, poor language outcomes.

Current day smartphones have in-built as well as freely downloadable apps, which could be used for language development as well as ease of communication by persons who are DHH. However, we discovered that parents of persons who are DHH and below 18 years of age are not aware of these technologies as these are not being promoted enough by professionals working in this area. Smartphone and PC usage is very low for persons who are DHH and below 18 years of age. It is possible to provide multiple alternative formats of spoken information, such as in text and sign language formats in both educational institutions and workplaces for improved accessibility for persons who are DHH. Current status of technology allows free voice-to-text transcription but sign language translation would involve significant cost overheads as it would depend on scarcely available human interpreters. However, recent apps such as Signable make available human interpreters virtually at a lower cost. Steps need to be taken to act upon these results and improve digital literacy for the users as well as professionals in this regard to make information and communication more accessible for persons who are DHH.

One important insight that we gained from this study is the sheer difficulty in reaching out to, communicating with and gathering information from the community of persons who are DHH. Despite translations into multiple languages, including Indian Sign Language, there were still difficulties for the participants to complete the survey. Dedicated support, real-time hand-holding and guidance through every question in the form, was necessary to collect responses. Improved accessibility to high quality professional services along with appropriate ATs, starting at a very early age, is an urgent and long-overdue need for persons who are DHH to attain their fullest potential in all aspects of life.

List of ATs for persons who are DHH

1. **Technologies to improve access to good quality of sound:**
    a. Sound amplifier app - Turns your phone into a hearing aid!
    b. FM device - Book an appointment at NISH to try the FM device which can pair with the person's hearing aid and improves listening in a crowded and noisy environment like a classroom or at a meeting in the workplace.
2. **Voice-to-text conversion technologies:**

    Persons who are DHH

    a. Live Transcribe app
    b. Google Translate app
    c. TranscribeGlass - an affordable, heads-up captioning solution
3. **Remote sign language interpretation - Avail the professional services of an Indian sign language interpreter from anywhere, at any time.**
    a. Signable app
4. **For creating accessible, deaf-friendly educational resources**
    a. Video subtitles - Captions are easy to generate using automatic subtitling tools. There are several tools available. This is a demo video in Malayalam with one example.
    b. QR codes - QR codes can be easily generated and printed with any educational materials. The codes could lead to sign language videos or other visual elements to better explain concepts to students who are DHH.

Rekha was born and brought up in Chennai, Tamil Nadu. Although she had hearing difficulties from a young age, she started using hearing aids only at the age of 7 years, due to late identification and intervention. Her mother tongue is Hindi, but her parents were recommended by early intervention experts to focus on developing English as her first language. The reason could be the lack of early language intervention services in Hindi in a Tamil-speaking region. Rekha developed good speech because of her mother's consistent efforts in rehabilitation. After schooling, she moved on to a well-reputed government college for higher education in technology. She recalls, "I would borrow notes from my classmates since I was not able to hear the teacher very well in the classroom. I was the go-to person for anyone in the class who wanted a photocopy of the notes."

Rekha remembers a particularly distasteful experience with one of her teachers who taught Mathematics. Rekha was late to his class, because she had trouble crossing the busy road to the college on her own, the noisy vehicles confused her and she couldn't make quick decisions required for this activity. She had to wait for someone to accompany her across the road. She shares, "The teacher censured me in front of the entire class. Although I explained to him about my hearing difficulty, he was not understanding and did not permit me to appear for the exam."

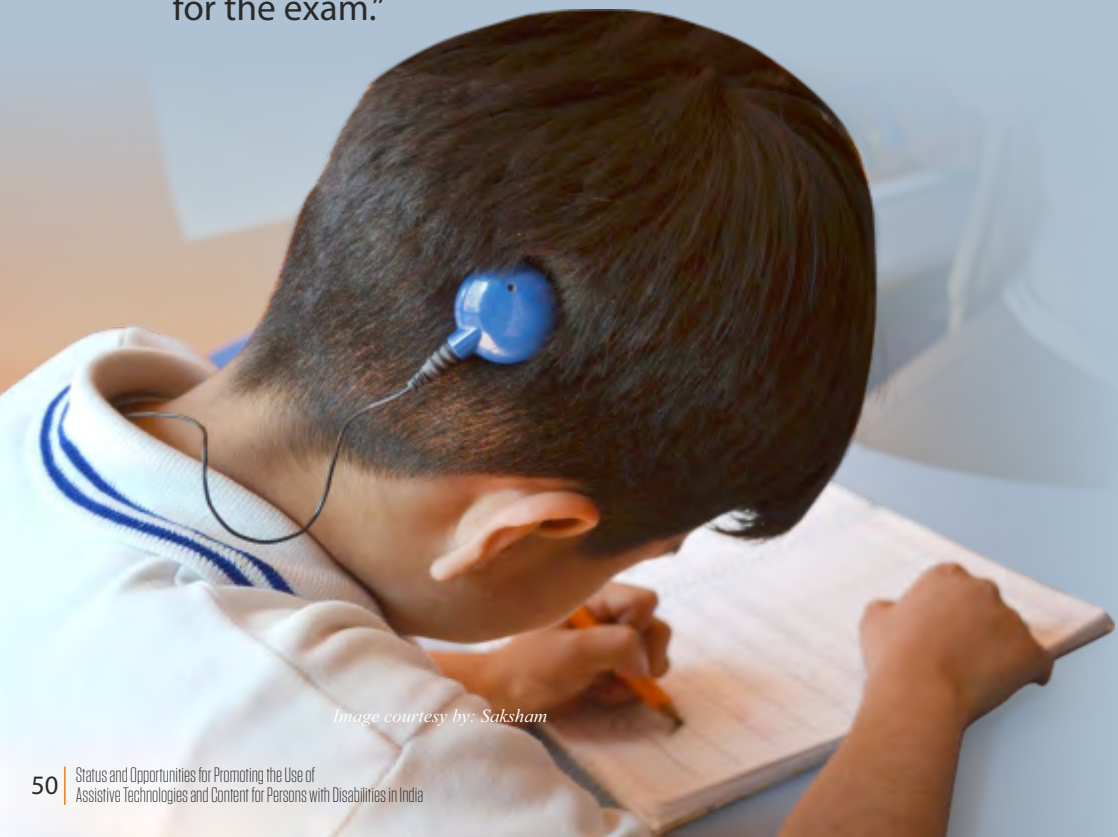


Image courtesy by: Saksham

Rekha started using Cochlear Implant (CI) at the age of 29 years and has been very happy with its performance. She uses accessories like Bluetooth streaming for better audio quality in listening to phone calls and other media in the phone. She also uses an FM system, which has a microphone that can be placed closer to the speaker and directly streaming the sound to her CI. She is also very good at communicating her exact needs for CI mapping to her audiologist - she has a special profile in her CI that she can switch to, for better hearing in a noisy environment. She notes, "iPhone is more compatible with my cochlear implant, as it can directly pair and I don't need an extra hardware accessory, which is needed to pair with an Android device. I also use an Apple Watch, which is paired to my phone and vibrates when there is a call. I don't depend on captions now because I have very good access to audio with my CI."

Rekha has joined salsa classes, which help her to socialize with many people and also to de-stress. When asked about her perceptions regarding the society's attitude towards hearing impairment, Rekha said, "Everyone knows how our hands work, our eyes work and how our nose and mouth work. But nobody actually makes it a point to understand that we are surviving on our ears like food and water".

"I was earlier not aware of sign language culture. I am learning more about it now. I wish to learn sign language and understand the perspective of the signing community as well".

Rekha wishes that Government of Tamil Nadu would grant funds for CI surgery even after 6 years of age. She is now running an NGO that increases awareness of CI and helps parents to raise funds for the surgery for their child. She expresses the immediate need for affordable AT, trial options, availability of insurance schemes and access to repair and maintenance of AT.

- Rekha (name changed to protect identity)

3.4 Findings - SLD

The survey for persons with SLD was formulated with input from young adults with a lived experience of SLD obtained via a focus group discussion. The focus group discussion provided some insight into the tools, technologies and other factors that are enablers in school, college or workspaces. Participants discussed the type of tools, technology and content that work for them in tasks involving reading, writing, math and other aspects integral to optimum functioning. Once the questions were finalized, a survey was created on Google forms and children and young adults with SLD were requested to answer the questionnaire.

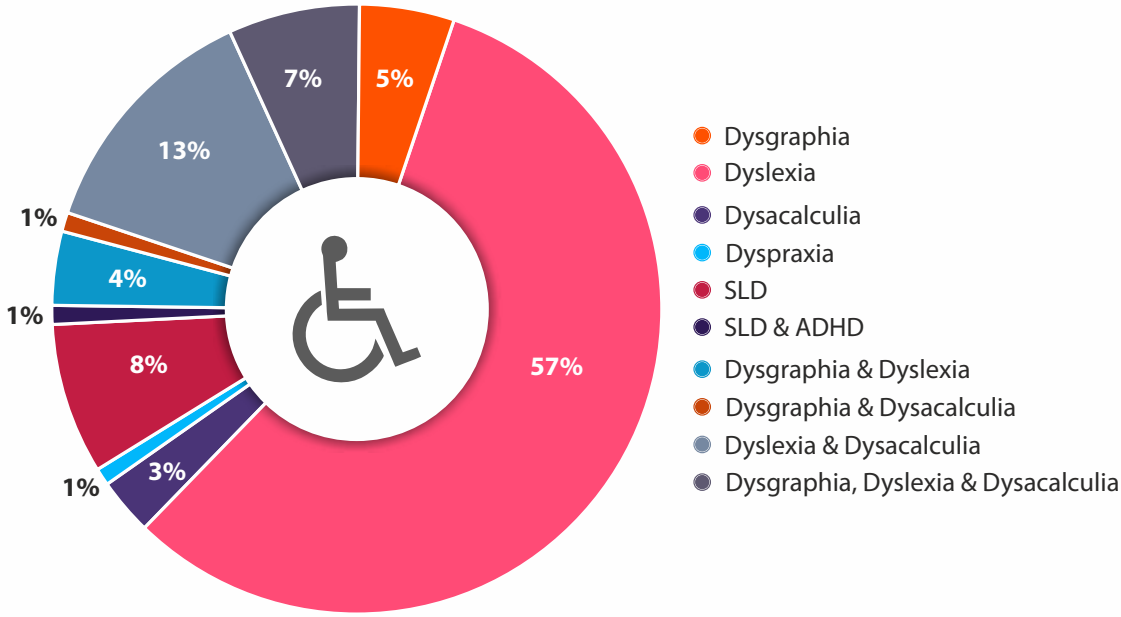
3.4.1Demographic Profile

A total of 101 individuals responded to the questionnaire of which 62% were male, 37% female and 1 person identified themselves as transgender.

From the perspective of nature of disability, a little over half i.e. 57%, identified themselves as persons with Dyslexia, reiterating the fact that dyslexia is the most prevalent of all SLDs. Dyscalculia was the next most prevalent at 13%, followed by Dyspraxia at 7% and Dysgraphia at 5%. 4% said they were persons with both Dyslexia and Dysgraphia. Figure 14 depicts a pie-chart showing the different types of disabilities of the participants.

71% of the total participants were school going children below the age of 18, with 56% participants being children studying in Secondary school and between the age of 14 -18 years. The individuals above the age of 18 years who are either studying or working or both, with 14% pursuing education in College or at the University level or pursuing a professional course.9% of the total participants said that they were studying as well as working. Those who are employed constitute 13% of the total participants.

Figure 14- Types of Disabilities of Participants



3.4.2Mode of Communication

A majority of the participants, i.e.77.2% said they read and write only in English while 22.8%reported using English and a regional language/ Hindi, indicating that all of them know English and use it for reading, writing and in their daily lives. These individuals are thus able to access a wider pool of information on the internet, through apps and other sources, which is readily available in English.

3.4.3 Education

61% of the children in school were studying in mainstream schools and 17%were studying in special schools. 6%were accessing specialized training programmes in addition to attending mainstream school. Home based along with open schooling was the preferred mode of education for 16% of the children.

Thus, there was a significant variation in the type of school in which children with SLD are enrolled and the spectrum of choices that exist. This adds another important dimension in the context of this study as it also looks at the links between children in these different types of schools and their access to and use of technology in their education.

3.4.3.1Children Studying in Special Schools and the Use of Technology:

A mobile phone was the preferred device for accessing technology for the 17% children studying in special schools, followed by a laptop. Only around 14% of the students in special schools reported taking the support of a scribe for writing their exam, while the remaining 86% write independently.

In contrast to the 61% children studying in mainstream schools, a slightly higher proportion i.e.23% use a scribe for exams while 77% write on their own. Writing independently here involves both writing using pen on paper and using a computer.

3.4.4 Employment and Skillsets

Among those who are in the workspace, only 2%were self-employed while the others worked in different professions including working in corporates, event management, teaching, special education, fashion design, hotel and hospitality, marketing, human resources etc.

Among the IT skills that the participants have listed as 'must-haves' to function efficiently are MS Office and Power Point [86%], Google and Firefox [69%] , Adobe [36%]. Outlook and other mail clients are used by 28% of the participants and Python, HTML are used by 13% of them.

As with other disabilities, persons with SLD also highlighted 'Good Communication skills' as one of the most important skillsets required for work, with 57% of the participants voting for it. For 38% of the participants, 'Good working knowledge of mainstream software like MS Office' was important; while for 11%, the ability to use special software like Tally was necessary. 34% felt that being 'Highly Networked and Connected' was seen as an asset.

Besides the technical and social skills, the ability to travel independently was seen as important by 29% of the participants.

3.4.5 Technology Devices and Usage

All participants in the study cited using technology, with mobile phones being the most preferred devices overall, followed by laptops or desktops. Around 70% of participants obtained the devices by purchasing them with their own money, or their parents had bought it for them, while 22% said they got it from the school they were studying in.78% persons said that the devices and AT solutions were readily available, while 11% said that they needed to order it and get it customized to suit their specific needs. Respondents in the present study repeatedly cited the affordability and availability of AT as a challenge and stressed the importance of making these accessible to all those who need it.

Survey participants shared their experience with respect to the use of technology and the range of tools and apps that they find helpful. Their use of technology varied across different dimensions:

- Age and stage of education or work i.e. whether they are in school or college or workspaces.
- Task/ domain i.e. reading, writing, math, executive functioning, social or at work

They shared:

- Whether they learnt the use of technology at home or in school or at work
- The level of comfort while using technology
- The role technology plays in supporting them in accessing and dealing with tasks of everyday life.

Overall, technology was found to be the main route through which reasonable accommodations are being extended to persons with SLD. The use of technology weaves in the concept of Universal Design of Learning by incorporating multisensory techniques in the teaching and learning processes, thereby supporting the specific needs of individuals with SLD. There are a number of apps that are designed around specific skill areas for facilitating a range of needs for individuals with SLD.

3.4.5.1 Patterns of Technology Use

The survey findings emphasized the role played by both formal and informal systems - family at home, schools and peer groups in introducing persons with SLD to technology. Over 60%of participants learnt the use of technology from members of their family and friends. Only 3% said they learnt the use of technology on their own. 31% learnt the use of technology in school or at the resource centre they attend, while among the older persons- 3% said that it was part of their training in their workspace.

Technology was found to be an integral part of participants' lives with about 75%saying that they used technology for more than 4 hours everyday and another 22% using it between 2 to 4 hours everyday.

Technology did not seem to pose a major challenge to the participants with 64%of participants said that they were able to use technology and were comfortable using it within three months of being introduced to it.

3.4.5.2 Purpose of Use

The use of technology has permeated all domains- whether it is academic (reading, writing) staying in touch with what is happening around the world (news and information), entertainment, organizing and planning their schedules, or the use of social media. Different devices are preferred depending upon the task at hand.

Laptops/desktops are the most preferred device for tasks involving reading and writing followed by mobile phones. This holds true for both children who are in schools as well as persons who are in workspaces.

When it comes to social relationships and connecting on social media, mobile phones are the go-to devices followed by laptops/desktops. For personal needs and home management, again, a mobile phone is the preferred device for most of the participants.

3.4.5.3 Age of Introduction to Technology

The overall data reflects that a third of the individuals began using technology on their mobiles or desktops/laptops or tablets between the ages of 11 to 14 years i.e. during their school years. The second most common age group was between 8 to 11 years. However, there were some variations in the age at which the individuals started using different devices.

It was interesting to note that older persons who are now in the workspace, reported starting the use of mobile phones much later, when they were between 14 to 18 and 18 to 35 years old. In contrast, children who are in middle school at present, report having started their use of mobile phones when they were 3-8 and 8-11 years old. The younger the children, the earlier they started using mobile phones, compared to children currently in secondary school many of whom started using mobile phones when they were 11-14 years old. This is an indication of how technology is being introduced to children much earlier on. The pandemic and the shift to remote learning systems perhaps added to the number of children using mobile phones much earlier in life.

A similar trajectory was observed with respect to the use of laptops or desktops i.e. younger children are beginning to use laptops/ desktops much earlier than the individuals who are at present in college or in workspaces. 25% of the children in middle school at present, reporting use of laptops/desktops between the ages of 3

to 8 years and 50% between the ages of 8 to 11 years. What stands out is the fact that none of the 18 years plus individuals reported using laptops/ desktops when they were in the 3 to 8 years age group.

3.4.5.4 Challenges in the Use of Technology

While the use of technology has percolated down to each domain- reading, writing, math, social skills and executive functioning there are also children who are not linked with technology in school or college. Experience on the ground reflects the fact that not all schools are equipped with technology and tools to support the specific requirements of persons with SLD. Also, there are schools that do not permit the use of laptops and other devices in classroom settings. This is a fact pointed out by one respondent who says, "Schools do not allow reading or writing assistance using technology. This makes it very difficult for us." Here is a situation where the student is able to use technology at home and be independent in reading, writing and other activities but does not have access to tools and technology in school/college. They would require some other support to be able to cope, else, left to deal with the challenges to the best of their abilities. Another student who has just transitioned from school to college says, "I used text-to-speech for reading tasks at home and to prepare for tests and assignments, but in school there was no access to technology. I was not allowed the use of a phone or a laptop for reading. The only support offered was that the teacher would read out some words or parts of the text when I sought help." This underlines the limitations that the person faces trying to read and keep pace with the others in class.

The awareness among stakeholders about the availability and use of tools and technology and about the range of accommodations extended to persons with SLD, adds another dimension. Add to this the fact that a large number of children with SLD get identified much later in school, some may even go through school without getting identified, the reasons for which vary. Some lose out on identification because lack of facilities for identification and support or a lack of awareness.

3.4.6 Social Media

All the participants said that they are active on and connected with others through social media. Social media is used not only for connecting with others but also to get updates on news and information. 77 individuals with SLD said that they read and write in English while 23 individuals use a combination i.e. English along with the regional language reflecting the fact that all the participants are comfortable accessing information in English and also implying that they have access to the same tools and technology that exist for all others. The accommodations they require are now in-built with text to speech and voice commands for searching information on the internet.

73% of the participants indicated that they use social media apps and 71% said they use entertainment apps and 45% use apps for keeping in touch with the news and updating knowledge and information.

95% are active on WhatsApp, 90% on YouTube, 75% on Instagram and 40% on Facebook. 13% are active on Snapchat and 17% are active on Messenger and Twitter respectively. Another 16% said they use Telegram. Thus, persons with SLD are active across a variety of social media forums, often using more than one social media platform.

The survey findings also show that social media platforms like WhatsApp, LinkedIn are also increasingly being used as learning platforms, with 86% of the participants using them for this purpose. Among these 86% using social media for learning and education, 62% of the participants said that they use WhatsApp for learning; 78% used YouTube; 15% are connected with Byjus. Similarly, 7% young adults with SLD shared their experiences in learning through LinkedIn learning platforms that extends flexibility and supports the learning process.

87% of the participants said they do not face any barriers in accessing social media or messaging apps, while 13% reported facing challenges. While one person said 'I was trolled'; others said, "I faced difficulties with spelling, grammar or with reading and writing' - challenges that are integral to SLD. There was one person who said, "No one talks to me…" reflecting the isolation the person seems to be facing.

Network of Persons with similar difficulties:

While all the participants are connected with others on a range of social media platforms, 32% are connected with persons with similar difficulties as them. Of these 86% share content such as information, books and curriculum related texts through social media.

3.4.7 Popular Tools, Technologies and Methods Used by Persons with SLD

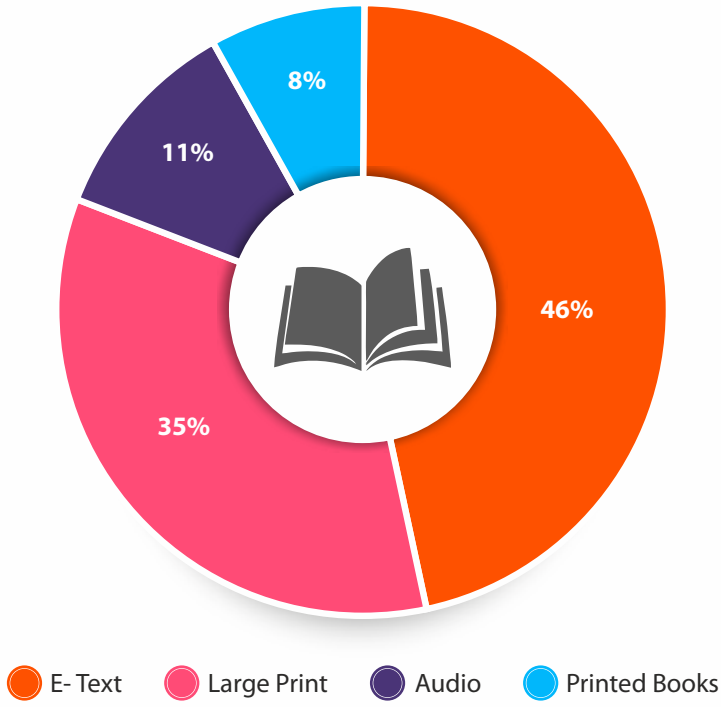
3.4.7.1Technology for Reading:

Persons who read from regular printed books are only 8%, while 35% use large print, 11% use audio books and 46% favour e-texts. This is indicative of the fact that a majority of the participants opt for alternate formats to enable reading. Persons with Dyslexia have voted overwhelmingly in favour of e-text, large print and audio for reading. In comparison fewer persons with Dysgraphia and dyscalculia have opted for these modes for reading. Figure 15 depicts a pie-chart depicting the preference to read among persons across 4 categories.

Among the specific technology used for reading- text to speech [18%] , e-books [19%] and audio books [10%] top the list of choices. Again, the largest group was that of persons with Dyslexia who voted in favour of text-to-speech, audio books and e-books among other options. Since persons with dyslexia face challenges while reading, use of text-to-speech, e-books, audio-books provide the necessary accommodation and enable independence. The majority of the participants have indicated their preference for e-books, indicating the shift to digital formats.

The pace and fluency of reading are seen to impact comprehension and these differences are evened out with the use of text-to-speech. Text-

Figure 15 - Preference to Read



to-speech enables the child to complete the task, and also supports them and helps build reading skills.

A college student with SLD says, "It takes much longer for me to read that is the reason I request someone (usually my parents or siblings) to read to me." He goes on to say, "I wish there was a robot that could explain things that I don't understand and read it out many times over. A robot will be better because humans get tired and annoyed explaining the same thing over and over again."

Having multisensory techniques in accessing texts and information is beneficial not only for persons with SLD, but for all persons with and without disability. In the words of a college student with SLD, "Using text-to-speech and speech-to-text and other technology helps me feel totally independent. It instils a sense of confidence in me."

3.4.7.2 Technology for Writing

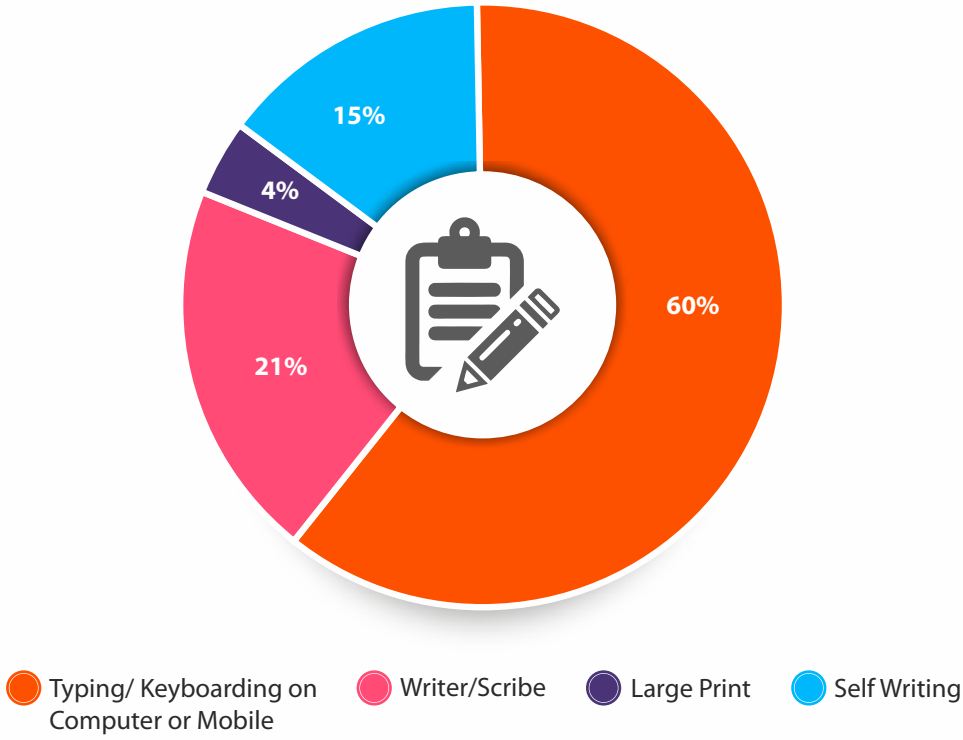
When it comes to tasks involving writing, a large majority, 60% say they prefer typing / keyboarding on a computer or a mobile. 21% say they opt for a scribe or a writer. Among those who write in the traditional way, using pen on paper but in large print are 4% and 15% write on their own in the regular way. Figure 16 depicts a pie chart showing the preference to write across the 4 categories.

Among the choices of specific technology used for writing 21% of the participants opt for Speech to Text mode. Supportive features like Grammarly [19%] and Auto-correct [28%] are increasingly being used. While these are tools and apps that are specifically mentioned by the participants with SLD, it is important to note that these are tools and apps that are used by many people in their day-to-day tasks and are not designed specifically for persons with SLD. While some technology and devices may need to be individualized, to suit specific needs, most of the supports are embedded within the contours of technology that is available to all.

Comparing persons using technology for writing assignments and persons writing exams:

Within the given sample size, it is interesting to note the difference among persons with SLD

Figure 16- Preference to Write



who are writing their assignments on their own versus those who write their exams on their own; the specific focus being on persons opting for the support of a scribe.

Writing assignments

When it comes to writing assignments, 48% of the participants type out their assignments while 25% write on their own, using pen on paper.20% prefer the support of a scribe.

Writing Exams

For writing their exams, 34% of the students use typing/ keyboarding, 26% said they write their exams themselves using pen on paper. A few participants have specified that they get the accommodations extended to children with SLD primarily extra time and exemption from deduction of marks for spelling errors. Over 27% of the participants seek a scribe for writing exams.

Comparing the two categories a difference can be seen with more people seeking the support of a scribe for writing their exam compared to those seeking scribes for writing assignments.

Again, a marked difference in the number of persons who use keyboarding/ typing for doing their assignments and those who use it for writing their exams, reflects that fewer children are using technology for writing exams. Leading back to the point made earlier about some schools still not allowing technology, tools and devices in classrooms.

A few students shared their thoughts and experiences with respect to the facility of having a scribe, while some felt that it was necessary, others felt it took away their independence.

"I type out my assignments on my own at home, but that facility is not available in school, so I have to write them."

"I had to write my exams on my own till class 9. It was difficult at times to do so, even if I had extra time, I found it challenging."

"At the time of my class 10 boards, my school insisted that I had to write my exams with the support of a scribe. I had always written on my own and preferred doing the same, with the accommodations for extra time. I spoke with my teachers but the school was adamant. They believed a scribe would enable me to score better. Left with no choice, I had to take the facility of a scribe."

"I was really happy when I got the facility of a scribe for my exams. It helped me focus on answering the questions and the scribe was able to organize the information on paper. The final presentation and overall result made such a huge difference. It helped me score well and I think that is what matters in the end."

"I had a scribe when I sat for my class 12 board exams, but when I reflect back today, it did not prepare me for the present as there is no scope of a scribe in a workspace."

3.4.7.3 Technology for Math

For math work, 55% of the participants reported using a calculator while 26% said they solve sums mentally. Some students said they have dropped math as a subject. There are others, in college or in workspaces, for whom Math is no longer necessary.

Among the different modes, technology and apps for math, 30% solve the sum on paper and then upload the picture of the work done. Another 10% rely on mental math for finding answers. 21% access You Tube, 5% use Excel.

3.4.7.4 Technology for Accessing Information, Knowledge, Reading Material

Technology is used extensively to access information, knowledge and reading material. All the participants utilise technology to gain access to information and knowledge via the Internet and online libraries. What is interesting to note is that there are persons who while on one hand list out the technology they use and on the other hand do not really label or see themselves as users of technology! A reflection of how technology has become so integral to our lives that it is no longer seen as a specific solution or support.

3.4.7.5 Technology Executive Functioning

75% of the participants said that they use technology for executive functioning. 25% use calendars for organizing their schedules, 15% use planners, 17% use Reminders, 25% use Google tasks to support them in their everyday lives. Being able to use MS Office and Power Point are the skill sets necessary for over 80% of the participants. 70% use Google, Firefox and 36% said that they use Adobe. Only 13% use more specialized tools like Python and HTML.

3.4.8 Impact of Technology

Technology, as discussed in earlier sections is an integral part of the lives of persons with SLD. It has had an impact in several different ways.

1. *Technology Building Bridges and Creating Inclusive Environments:*

   For persons with SLD the features that enable them in their daily tasks involving reading or writing are those offering the text-to-speech options. Participants highlighted the fact that voice-messaging options in social media apps, like WhatsApp, have further enabled them to communicate with others by eliminating the sole dependence on typing.

   Since text-to-speech option is in-built in most of the apps and programmes, there is no special add-on technology or tool that is necessary. Audio and text-to-speech features have enabled persons to navigate their way through tasks involving reading; speech-to-text is being used for writing.

2. *Impact of Technology on Life Skills:*

   71% of the participants who said they use technology for over 4 hours a day felt that the exposure to technology had impacted their life skills specifically their ability to read, write and live independently.70% among them said that there was a positive impact ranging from 'significant' to 'completely impacted it'.

3. *Impact of Technology on Efficiency and Independence in Everyday Life:*

   The response to the impact of technology on efficiency and independence in everyday life varies across domains. It is interesting to note that while the participants have said that technology does not influence them much, when it comes to home management or personal needs; the impact is clearly seen when it comes to Information/Awareness; on their Education/ work and on Entertainment. There is also an impact on mobility as well as social relationships.

Journey of a person with SLD and his reflections on how he has evolved as a person and the impact technology has had on him:

Aarav is a 29 year old with SLD. Aarav reflected back to the time when he was a child and traces his journey from mainstream school to a school that catered to the specific needs of children with SLD and then onto studying commerce in college. After that Aarav enrolled for a MBA and a course in Human Resource Development. Today, he works with a multi national company in the IT sector and his career graph is showing an upward trajectory.

Sharing about his experience in School, he notes that there was hardly any awareness about SLD in his mainstream school and only one or two teachers extended accommodations in junior school. This was at an informal level and wasn't part of the school policy. At home, his mother read out the chapters to him and made notes. Aarav shares that if technology and the supports available to him today were available back in school, he would have gone through school without the tag of being 'different' attached to him.

The lack of support class 6 onwards led to his move to an inclusive school that had trained special educators to support children with SLD. Although his previous experiences of an unsupportive school environment had demoralized him, the new school gradually gave way to a more positive approach. Looking back, Aarav feels that technology would have helped here too since his class comprised of students with diverse abilities which meant the teachers had to repeat information in multiple ways. For Aarav, who was a bright child who generally understood what was taught in the first instance, this repetition meant he was unable to maintain his levels of concentration after that.

In college, Aarav was one among 80 students in the class with limited opportunity for individualized attention. He shares that reading the texts and making notes was a constant struggle. He shares that he understands best when he hears the text read out to him and if the use of technology was permitted in class, he would have recorded the lectures and listened to them. However, since teachers were not comfortable with that, he would request his mother or his classmates to read out to him and if they were comfortable, record it using a tape-recorder.

It's only when he started working that he got the opportunity to use technology. He uses mainstream technology in his everyday work like Microsoft's Outlook and its feature that allows emails to be read out to him. This ensures he does not miss out on any point. He shares, "my mind works faster than my hand, so when I dictate an email into my computer using speech-to-text, all the points I want covered are added and I don't miss out on anything. It ensures that my flow is not broken because of the difficulty faced while writing. Later, I listen to the reply that I have framed and edit it if necessary." During meetings, Aarav uses his laptop and mobile to record the discussion points and later converts this into typed, print versions. There are some technical glitches where homophones like 'wait' and 'weight' may get interchanged or some parts do not get fully covered and that requires a careful look at it to ensure that everything is in place.

Finally, when asked whether life would have been different for him, had the technology available to him today was available back in school, Aarav says, "I think it would have changed my life and my personality. I would not have had to deal with the constant stress that I had to through my school and college years. I would not have missed out on what was being taught. I would not have had to put in much more effort into coping with my academics. I would not have been left behind. More importantly, I would not have chosen subjects that were 'easier' and or chosen because of keeping my limitations in mind. I would have chosen subjects I wanted to study, that interested me. I think I would not have grown up feeling 'different' and having my life choices dictated by the SLD. I would have been a different 'me'…"

4 Recommendations and Conclusion

The evidence in this report indicates that technology positively impacts persons with disabilities and furthers their inclusion especially in education and employment as well as enabling them to lead a more independent life.

Early intervention of technology seems to work for all groups. It is not limited to one sphere but improves overall life skills of individuals as well as their ability to learn and use other devices. Early introduction of technology enables more effective and early mainstreaming, increased competence, confidence and increased opportunities. A minimum of technologies- mobile and laptop/ any other appears to be a requirement for successful navigation of life- education, work and communication. In many cases, once people have become exposed to technologies, they often go for more than one and look for options in other domains of life, which can make functioning easier and more independent. In fact, many people have even learnt programming languages and become advanced users of technology, enabling them to trouble shoot for themselves.

Those who communicate in English or a combination of English with another language appear to have a better advantage in use of technology, reading, writing and communication over those who only use a non-English language - this merits further study to identify the underlying reasons for this pattern. Almost all the participants of the study across the three groups use some form of AT, at the very least a mobile phone with some apps. This study has helped to highlight several gaps and opportunities to promote the use of AT use in India. Social media clearly plays a huge role in bridging the communication and literacy divide for persons with disabilities and users have drawn attention to aspects and features that can radically improve its appeal and use.

Given below are recommendations arising from findings of the research targeted towards different stakeholders. These are divided into 2 sections based on the key research questions.

4.1 Recommendations to Address Gaps and Opportunities for Promoting the Adoption of Technology Solutions for Persons with Vision, Hearing, and SLD in India

4.1.1 Government

Specific Recommendations

1. Provision of AT Devices and Subsidy Schemes
    a. Assess and identify required AT devices and make such devices available on subsidy as an on-going service
    b. Include digital devices such as tablets, smart phones, computers and refreshable braille displays, etc. in the government and non-government subsidy schemes such as in ADIP
    c. Ensure training is an integral part of subsidy schemes for devices and provide training materials with devices and pre-loaded applications so that they can be accessed easily
    d. Provide subsidy schemes on priority to trainees of established ICT training institutions
    e. Assessment and provision of appropriate AT solutions may be done through designated centres/institutions around the country which function throughout the year and also camp mode for people who can't be reached easily or are in far flung areas
    f. Lower the age at which such devices are introduced along with checks and balances to avoid misuse or spending too much time on diversions such as video games, etc.
    g. Develop appropriate devices and their maintenance systems suitable for addressing specific needs such as for young children, suitability in rural or low resource regions, etc.
    h. Include provision of connected devices and AT bundled with trainings specifically within the charter of Universal Service Obligation Fund
2. Implementation/Maintenance systems
    a. Strengthen maintenance systems in low resource regions for digital devices
    b. Create 3 to 5 year strategy and implementation plan to introduce ICT devices to eradicate use of scribes and writers for writing assignments and examinations
3. Technology Availability
    a. Enhance regional language support for ATs along with training and content to help increase the number of Indian language users
    b. Include accessibility as key criteria for procurement of ICT products and services
    c. Increase the offerings of AT solutions by fostering local development of ATs for Indian users and by easing import requirements

Generic Recommendations

1. Introduce technology along traditional modes of communication as per the earliest category identified in NEP - 3-8 years
2. Increase focused outreach for awareness raising on accessibility among different stakeholders
3. Set up an inter-ministerial high-level advisory committee to bring inclusion into government policies, standards, and programmes
4. Ensure accessibility of all government digital resources such as digital libraries, Government communication, programmes, and documents across Ministries and agencies. Institute monitoring and reporting mechanisms such as accessibility audits across Ministries to ensure compliance
5. Target women with disabilities for providing AT and training

6. Include disaggregated data on persons with disabilities and their usage of AT and ICT in the upcoming Census and National Sample Surveys

4.1.2 Educational and Training Institutions and Content Developers and Concerned Ministries and Agencies

1. Promote usage of AT in classrooms and make educational resources available in accessible formats such as audio books, accessible digital text, videos with sign language and captioning etc.
2. Allow early introduction of computers for writing exams so that there is less dependency on scribes
3. Introduce along with traditional methods, technology and social media at an early age to enhance communication and content sharing options for students
4. Train teachers to make use of new capabilities offered by technology; develop their skills for creating accessible learning materials and inclusive thinking through regular training programmes
5. Allow for flexibility in examination procedures for students with disabilities if required due to situations like unavailability of scribes during pandemic etc.
6. Sensitise teachers and peers on students with disabilities and ensure their curriculum includes a balance of academic and extra-curricular activities
7. Expand the curriculum of computer training programmes to include advanced computing and employment relevant skills
8. Include soft skills, professional etiquettes, life skills, and personality skills as part of training programmes of persons with disabilities
9. Connect with NGOs for advice on supporting the education needs of students with disabilities

4.1.3 Employers and Private Sector

1. Ensure that all human resource personnel are sensitised to the needs of persons with disabilities
2. Improve accessibility of communication and documents, internal and work related software, and training resources and meetings
3. Provide customised workplace adjustments for example, a DHH person needs better lighting, acoustics, provision of information in alternative accessible formats
4. Proactively hire persons with disabilities and have an equal opportunities policy in place as mandated by RPWD Act 2016
5. Sensitise clients to the need for accessibility and create de facto accessible products and/or services
6. Include accessibility within CSR activities and programmes

4.1.4 Persons with Disabilities and their Organisations, Families, and Friends etc.

1. Participate in and inform research and policies through active involvement and articulate needs and wants
2. Promote provision, training, and use of ATs along with other solutions amongst persons with disabilities
3. Work with different stakeholders to educate, train, and help implement use of AT

4.2 Recommendations for Social Media and Technology Companies

1. Explore partnerships with education institutions, employment agencies, skill training institutions and NGOs working with and for persons with disabilities on how social media can further improve persons with disabilities access to education, skill building, job identification, and networking with

employers and other persons with disabilities.

2. Provide cleaner interfaces across social media platforms that are simpler, user friendly, and allow for easy AT navigation
3. Improve automatic alt-text generation across all platforms to the same level as that provided in Facebook
4. Make 'feeling/activity' and GIF features on Facebook accessible; standardise accessibility of GIFs
5. Improve Hindi/regional language automatic alt-text generation on Facebook to obviate the need to switch to a Hindi language TTS. Many of the study participants were Hindi-speaking and representative of a group that is likely to benefit.
6. Provide live captioning in Hindi/regional language on Google Meet
7. Improve accessibility and usability of status/stories on WhatsApp, Facebook, and Instagram (currently difficult due to limited timeframe and lack of alt-text)
8. Improve the ability of creators to add audio-description and transcription for videos on social media platforms. Where relevant supplement it with user guidelines to ensure user generated content is made accessible before it can be posted
9. Improve WhatsApp Hindi/regional language transliteration keyboard
10. Upgrade software to make auto-captions in YouTube and other video applications more accurate. Provide options for accessing these in multiple languages, including a mix of languages
11. Design communications campaigns to raise awareness among stakeholders on understanding of disability and that challenge negative attitudes and attitudinal barriers towards them
12. Actively involve persons with disabilities in creating more accessible tools and partner with them for conducting accessibility audits
13. Create systems that allow persons with disabilities to communicate accessibility challenges they face in apps, websites etc.
14. Improve accessibility of Zoom and other presentation platforms that allows the screen reader to capture the content on the slides and present it to the user
15. Improve spelling recognition in Screen-readers
16. Collaborative platforms were underlined as very important technologies that are going to play a much bigger role beyond their current functionalities in the future
17. Ensure colour contrast ratio and readability of fonts is not compromised in the name of branding
18. Improve spell check mechanisms
19. Create alternatives to capture image or captcha code in online banking systems
20. Work more on building AT ecosystem for India

4.3 Conclusion

The use of technology and devices should be seen within the definition of reasonable accommodation, thus providing a level playing field. The principle of equality is actualised through the use of technology.

Availability, Affordability and Accessibility: These factors are necessary to ensure that persons with disabilities are able to deal with their curriculum independently. Currently, studies show that there are many children across the country, especially in the rural areas who do not have access to devices and/or the internet. When devices are not available in the hands of persons, they lose out and are not able to optimise their abilities. Financial limitations and lack of information are primary reasons why persons

with disabilities do not have devices or equitable access to technology. The challenges they face pose barriers and they are unable to function to their optimum ability. Strategies will need to be evolved to bridge the digital divide and ensure equal access to persons with disabilities. Finally, while ICTs play a transformative role in empowering persons with disabilities, they do not mitigate the need to work towards transforming mind sets, eradicating stigma and looking towards simple solutions, outside of technology use, which make things work on a day to day basis for people with disabilities in India. Time and again, lived experiences shared during the course of this research have shown that traditional, innovative and modern technological solutions can come together to positively impact the quality of life of persons with disabilities in India.

Key Takeaways:

1. Introduction of technology as early as possible, enhances competencies and independence and assures more comprehensive mainstreaming of persons with disabilities. It offers the flexibility to choose or devise one's own solution; often hybrid solutions work for people in different settings.
2. There is a need to focus on enabling persons with disabilities to take their exams independently using technology.
3. The range of apps and resources available, especially social media have offered a world of opportunities and possibilities for persons with disabilities.
4. Learning occurs most comprehensively when it is not restricted to one setting; peers, friends and family, resource centres, NGOs, school and workplace all have a role to play to enhance life skills.
5. People with disabilities work best with multiple devices - laptop for work and mobile for communication is often preferred.
6. More features and training resources, outreach efforts and encouragement need to be done to upscale adoption and use of social media and ATs in regional languages.
7. Women with disabilities need to be especially targeted in outreach and governments efforts for AT and content adoption and for skill training to improve the share of advanced technology users among the group
8. Need to provide holistic solutions with bundled ATs, apps and content for persons with disabilities in urban and rural areas.
9. There is a need for a multi pronged approach towards raising awareness for different stakeholders.

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NOTES

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