Global report on assistive technology[1]

Section 6
Creating enabling environments

Key messages

- Accessible, inclusive, barrier-free or age- friendly environments can enable the use of assistive products and make life easier for everyone, including users and their caregivers.
- Enabling environments are essential for users to access buildings, transport systems, digital spaces, etc.
- Services including access to health, education and livelihoods are only possible for users when they are accessible and located within inclusive enabling environments.
- Three types of barriers exist to enabling environments: infrastructural, informational and attitudinal.
- Universal design helps increase the range of people who can access and make use of mainstream products, spaces and services.
- Cross-department approaches and coordination are essential when planning and delivering services that are inclusively designed and usable by people with functional difficulties.

The environment is made up of: products and equipment; built and digital environments; the natural environment; services, systems and policies; and support, relationships and attitudes *(6)*. It comprises spaces, places, services and interactions that are important for living. When the environment is accessible, inclusive, barrier-free and age-friendly, then all people benefit – irrespective of functional abilities – and users have an experience that is equal to that of people without functional difficulties. But when barriers exist, having assistive products is not of much use. Access to assistive technology and accessible environments is complementary – without one, the other is of little use. A user of a manual wheelchair cannot wheel up steps; and a screen reader user cannot hear a website that has not been made accessible. Similarly, accessible environments without

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access to assistive products can defeat the purpose. Assistive technology needs increase when people with functional difficulties cannot use mainstream products, buildings and services. Creating an enabling environment means ensuring that it has a positive impact on the functioning of users and their caregivers.

The right to equitable access to the environment is a fundamental aspect of the UN *Convention on the Rights of Persons with Disabilities*. Achieving universal accessibility requires a cohesive approach to access and inclusion. For a service to be *accessible*, the buildings or online platforms that house these services must be accessible, services must be designed inclusively, and staff need to have adequate disability equality and awareness training. If any one aspect of a user journey is inaccessible, then the whole service is considered inaccessible. And for a service to be truly *inclusive*, everyone – irrespective of differences or diversity – should be able to experience that service in an equal way without the need for overlay or 'special' treatment or provision. An example of this could be a government building with level access and automatic, sliding double entrance doors. There is no need to add a ramp or an 'accessible' entrance as the building has been designed inclusively from the beginning.

Box 6.1 Enabling transport systems

Transportation includes services, systems and policies that enable goods or people to get from one location to another. Without transportation, people do not have access to employment, education, health care, and everyday activities of living such as shopping, banking, social and recreational activities *(28)*. Article 9 of the UN *Convention on the Rights of Persons with Disabilities* states that to create an environment where all can participate in all aspects of life, transportation needs to be accessible *(2)*.

Country specific regulations such as Canada's *Accessible Transportation for Persons with Disabilities Regulations* describe the legal mandates that are required to make all federally-regulated transportation such as air, and interprovincial and international passenger rail, bus and ferry, security and border crossing accessible *(226)*. Despite international, national and local policies to make transportation accessible to all, barriers remain. For example, in a study of a bus terminal in Kenya, a disconnect between policies and their implementation resulted in lack of accessible signage and physical barriers resulting from wear and tear in the terminal *(227)*. Many steps need to be taken to successfully complete the travel process, including accessing travel schedules if relevant, getting to and into the transportation option, navigating to and arriving at the destination. If any link along the way is not accessible the chain is broken.

Many examples of how to design enabling transportation environments are available. Travel schedules can be made accessible by using large print or audio output, or ensuring that websites follow accessibility guidelines *(228)*. Some

suggestions for incorporating universal design principles into large transportation terminals include decreasing the number of decisions points for getting to a final departure location/gate, breaking up large terminals into smaller sections, ensuring that seating is available for those who need it, and making sure that signage is visible, uses accessible fonts and internationally recognized symbols *(229)*. Recommendations for accessible buses include having lowering floor or lift access with wide doors for those who use wheelchairs, have baby carriages or heavy luggage when boarding. Seating for people with strength or endurance difficulties should be available and signage should be visible and use colour-coding, which has been shown to help all people with direction finding *(230)*. The WHO *Age-friendly cities framework* identifies access to transportation as one of the eight domains that are critical for ensuring that elders remain active and connected. To decrease financial barriers to transportation, numerous countries have provided free access to public transportation or taxis for elders in the community *(231)*. Other recommendations include ensuring a safe driving experience for all by having adequate signage, roads with adequate lighting and in good repair. Safe parking that is located close to a destination is also recommended *(232)*. Finally staff training regarding how to welcome all people to the transportation they choose is recommended to decrease stigma and bias *(233)*.

Attitudinal barriers can be found through discriminatory practices or processes from both service staff and other service users. Informational barriers include not providing information in accessible and/or alternative means, including vital information relating to routes, timetables and service accessibility. Physical barriers include the accessibility of transport infrastructure and the vehicles themselves such as trains, buses, train stations and bus stops; for example, ensuring there are no hazards such as wide gaps between a train and platform *(234)*.

A goal of universal or inclusive design is settings with no need for any additional modifications or accommodations. Inaccessibility of infrastructure and services create not just physical barriers for people with disabilities, but limit access to transportation, health care, education, employment, etc. Barriers also often relate to attitudes, behaviours, information or infrastructure.

To participate fully and experience the world around them in a fair and equal way, people need access to a range of infrastructure and services that must be accessible and inclusive. A cohesive approach across domains and sectors, complemented by compliance with legislation and standards and universal or inclusive design approaches, supports this, as demonstrated in the transportation (see Box 6.1), health (see Box 6.4), education (see Box 6.9) and humanitarian (see Box 6.10) sectors.

Universal design for enabling environments

One of the key approaches to achieving enabling environments is to apply the principles of universal design. Text-to-speech functions built into cell phones or motion-controlled doors are examples of universally designed products. Other examples include digital assistants that enable people to control a variety of communication and home-based functions with their voice.

Universal design involves designing products, buildings and services so that they can be used by all people, to the greatest extent possible, without the need for adaptation or specialized designs *(2)***.**

Universal design aims to ensure that people with functional difficulties "have access, on an equal basis with others, to the physical environment, to transportation, to information and communications, including information and communications technologies and systems, and to other facilities and services open or provided to the public, both in urban and in rural areas *(2)*." It also involves promotion of research and development leading to universally designed goods, services, equipment and facilities. To promote their availability and use, they should require the minimum possible adaptation and the least cost to meet the specific needs of people with functional difficulties (see Constance's story). Universal design should also be included in the development of standards and guidelines.

My prosthetic leg has been my one-way ticket to freedom and independence. I am so thankful for it.

Jacqueline (28), Zambia

The seven principles of universal design *(235)*

1. **Equitable use:** The design is useful and marketable to people with diverse abilities.
2. **Flexibility in use:** The design accommodates a wide range of individual preferences and abilities.
3. **Simple and intuitive use:** Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills or current concentration level.
4. **Perceptible information:** The design communicates necessary information effectively to users, regardless of ambient conditions or the users' sensory abilities.
5. **Tolerance for error:** The design minimizes hazards and the adverse consequences of accidental or unintended action.
6. **Low physical effort:** The design can be used efficiently and comfortably and with a minimum of fatigue.
7. **Size and space for approach and use:** Appropriate size and space is provided for approach, reach, manipulation and use, regardless of user's body size, posture or mobility.

Universal design was originally intended to go beyond minimum accessibility requirements mandated by law in many countries and push designers, architects and others involved in constructing built and virtual environments to incorporate its principles from the beginning of the design process, and to avoid creating barriers that later need to be mitigated by the use of assistive technology. Despite the cost-benefits and increased inclusivity that result from implementing universal design *(236,237)*, barriers to its implementation remain, including lack of awareness, lack of education regarding the concepts of universal design, mistaken notions that universal design is only for people with disabilities and is a regulatory and cost concern.

Physical and digital environments

Products and equipment

For products and equipment to be useable by all, their physical, sensory and cognitive features, as well as their psychosocial and emotional characteristics, must be considered. However, some may resist these changes because they do not see the immediate value in new design options, or they may think it is too frustrating to make this kind of a change when they have been doing things a certain way for a long time. These psychosocial and emotional attributes must be considered in product (and service) design because they are equally important as the physical or sensory features in people's decision to use them *(238,239)*. Moreover, instructions and manuals, regulatory legislation and standards, cultural context, and aesthetics must also be considered.

Solutions

Numerous studies have shown that including users in the design of products and equipment that they will be using increases the likelihood that the products will not be abandoned *(240–242)*. For example, older adults are more likely to adopt equipment for aging if they have been involved in developing them *(243)*.

Product designers in a variety of areas are using principles of universal design to ensure their designs meet the needs of an inclusive society. Everyday tools can cause wrist and hand injuries or pain because of their physical design, but by changing the width of the handles and the angle of the tools, these difficulties can be lessened *(244,245)*. For a person with visual difficulties, raised bumps on key letters and high contrasting letters on a keyboard can make products accessible. For someone with attention or concentration difficulties, the same high contrast letters and tactile cues on a keyboard may also be useful.

By partnering with the fashion industry, spectacle designers have changed certain products from being perceived as a medical device to being seen as a fashion item *(246)*. An inclusive line of boots features oversized double zippers, toggle-adjusted stretch laces, and rear pull tabs to make it easy to put them on. And a wristwatch, designed with universal design principles in mind (tactile cues for telling the time) has been produced by a designer in collaboration with people who have visual difficulties, creating a watch that everyone, regardless of their visual ability, can use and enjoy *(247)*.

Meet Constance

South Africa

Constance is an office assistant and advocate for people with disabilities at a prominent university. When not at work, she enjoys being the mother of two young daughters.

When she was a young girl, Constance mysteriously lost her voice. Her family sought medical help, but Constance was not able to regain her ability to speak. This marked the beginning of a difficult time in her life. She was taken out of school because she was being made fun of by other students and the staff felt they could not protect her from discrimination.

Constance eventually enrolled in a school that offered disability-related support, where she received speech therapy services and a customized communication board. With this help she finally felt understood. Constance was then invited to participate in a youth empowerment programme for people who require augmentative and alternative communication (AAC) devices. The programme included a full week of training where Constance learned how to use different AAC devices, improve her communication skills, and realize her potential. She said, "I was introduced to a whole new world of AAC and it changed my life. I started to have dreams and goals for my life again,"

Constance received her first digital AAC device at the age of 23 years. Today, she uses a speech assistant app on her smartphone every day to communicate. This app converts text to speech and is available in different languages.

Access to AAC has helped Constance gain confidence and create a full life. She hopes better performing digital communication technologies such as higher quality sound and Bluetooth speakers will become more affordable in the future.

Technology has been increasingly developed to be usable for as many people as possible. This can delay the need for assistive technology or give an alternative to an assistive technology. For example, most computer and smartphone operating systems now come with accessibility features that narrate the interface for blind and visually impaired users. Similarly, text editors have text to speech as standard, and video conferencing platforms offer automatic subtitle captioning. While both the latter features have been created to enhance the accessibility of the products, it should be noted that this was not only for the benefit of persons with functional difficulties. Sometimes this might be situational, such as when automatic doors are helpful for a non-disabled person with their hands full.

A recent strategy to develop products that harnesses new technologies, users and interdisciplinary design teams in developing products, is the 'maker' movement *(248,249)*. In addition to using emerging additive technologies (i.e 3-D printing), these

interdisciplinary designers often put their designs on open-source platforms for others to access and add to.

Built environment

The built environment comprises buildings, roads, transport networks, and indoor and outdoor settings, including schools, housing, medical facilities and workplaces[2]. It can easily be taken for granted, but their designs influence accessibility. For example, doorknobs become difficult to use for those with arthritis, decreased strength or motion, or fine-motor difficulties. And the slope of a sidewalk – necessary to drain surface water – can cause wheelchairs to turn slightly, and to stay on course, wheelchair users experience shoulder forces that may contribute to injury. And obstacles are not just physical. Places can become inaccessible due to poor information availability or changing factors, such as crowds. In many countries, laws have been passed that mandate minimum accessibility guidelines for the built environment, but where these guidelines are not fully implemented *(250)*, physical and cognitive challenges remain.

To participate fully in the built environment, people must be able to perceive relevant information and make sense of it (cognitive function) and then act on it. For example, meeting a friend for a cup of coffee means navigating many physical, sensory, cognitive and digital challenges, including: getting dressed appropriately for the weather; finding how to get to the destination (and getting transport there); being able to arrive on time and find the friend; and choosing and paying for the refreshments. Some people might require specific assistive products to help with this activity. However, regardless of assistive product use there are elements of the environment that enable access to the activity and, by extension, elements of the environment that could prevent access. The importance of accessible infrastructure, information and services are illustrated in Box 6.2.

People's home environments can facilitate or hinder functioning, and people may be forced to move to alternative accommodation if their homes cannot be modified. Guidance for accessible housing is largely based on homes in higher income contexts, which can be very different from homes in lower income contexts. In addition, national accessibility design standards may only address public areas.

Solutions

Cognitive accessibility

Cognitive standards (e.g. ISO 2100-800-1) can help those involved in designing and creating spaces ensure they are accessible. Examples of cognitive cues – good and bad – in the physical environment are shown in Figure 6.1.

Practical ways to improve the built environment for people with cognitive difficulties can be the use of pictures and symbols instead of text; the use of short, easy-to-read information such as floor plans in public facilities that make use of symbols and signs

replicated within the public facility to aid recognition and orientation. Signage in buildings need to be accessible so that all people can find their way to the location they need to visit. Simple, easy-to-read fonts with international recognized pictograms are suggested for signage *(251)*. Sources to help design accessible information formats can be found online *(252)*.

Box 6.2 Towards enabling city environments (India, Mongolia and United Kingdom)

To develop enabling city environments that are accessible and inclusive, recommendations based on experiences from India, Mongolia and United Kingdom highlight the need for integrating: a supportive legislative environment; participation of people with functional difficulties in planning, design and decision-making; positive cultural change; an accessible and inclusive environment; and access to assistive technology. It is important to find out what matters to people and establish a shared vision for an accessible and inclusive city among stakeholders. Stakeholders need to know that inclusive design benefits everyone and contributes to a culture of inclusion. Inclusive design is more than technical standards. It needs to consider user experiences and journeys, and to respond to local climate, culture and geography. Moreover, it needs to be embedded in the implementation of all essential infrastructures and services, such as streets and alleys, water and sanitation, health and social services, and education, so they can be accessed and used by users of different assistive products, such as tricycles that require sufficient space and interactive travel support that requires an internet connection. Integrating and budgeting for inclusive design from the start is effective. The start can be somewhere and gradually the enabling environment can be expanded to eventually cover the entire city.

Sources:

Patrick M, McKinnon I, Mishra S, Gupta S, Roy P, Choudhury U et al. Inclusive Design and accessibility of the built environment in Varanasi, India. AT2030 Inclusive Infrastructure Case Studies. Prepared by the Global Disability Innovation Hub and partners for the UK Foreign, Commonwealth and Development Office; 2021.

Patrick M, McKinnon I and Austin V. Inclusive design and accessibility in Ulaanbaatar, Mongolia. AT2030 Inclusive Infrastructure Case Studies. Prepared by the Global Disability Innovation Hub and partners for the UK Foreign, Commonwealth and Development Office; 2020. doi:10.13140/RG.2.2.26922.44485.

Inclusive design standards. Global Disability Innovation Hub (https://www.queenelizabetholympicpark.co.uk/-/media/inclusive-design-standards-low-res-final.ashx, accessed 20 April 2022).

Figure 6.1. Good and bad cognitive cues

Sources:
Building for everyone: A universal design approach. Booklet 4 – Internal environment and services. Dublin: The Centre for Excellence in Universal Design, National Disability Authority (https://universaldesign.ie/Built-Environment/Building-for-Everyone/4-Internal-Environment-and-Services.pdf, accessed 20 April 2022). Imgur; 2014 (https://imgur.com/gEfpglb, accessed 20 April 2022).

Physical accessibility

Features that support physical access include ramps, automatic opening doors, dropped kerbs and elevators/lifts (Box 6.3).

Home modifications

When a person's home no longer supports their participation in everyday activities, it can be modified to better suit their needs *(253)*. There are numerous standardized assessment tools that can be used to assess home modification needs and recommend alterations or assistive products to enable people to stay in their homes *(254)*.

Smart homes

Emerging digital technologies that make the physical environment more accessible such as smart homes and home automation – including the 'Internet of things' – use digital technology to control lighting, indoor temperatures, entertainment systems, appliances and home security (such as access control and alarm systems). A variety of options from voice control to remote control are available (Fig. 6.2).

Legislation

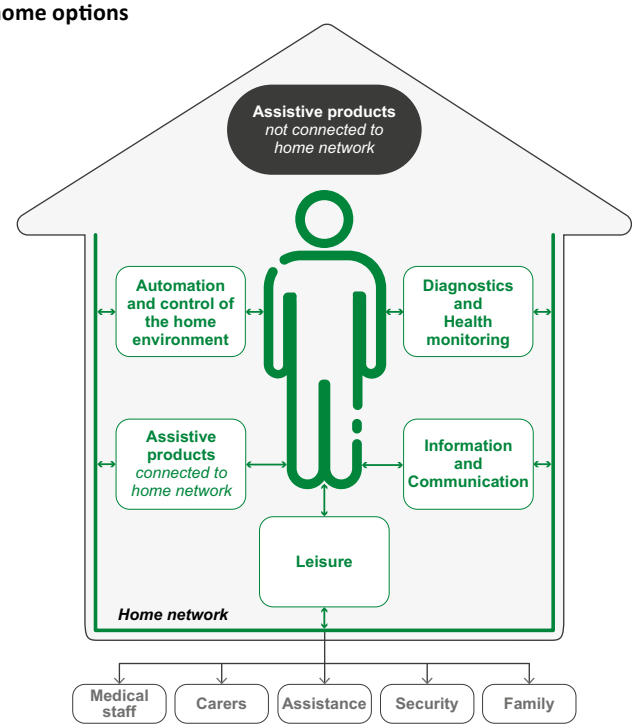
Many countries have laws that include minimum requirements to make the built environment accessible to all (e.g. Australia's *Disability Discrimination Act*, India's *Disability and Equality Act*, and United States *Disabilities Act*).

Digital environment

The digital environment comprises two components:

(1) hardware, comprising the tool/equipment that embodies the technology; and (2) software, consisting of an information base for the tool *(255)*. Hardware aspects of mobile phones and other digital devices present barriers to those with physical, sensory and cognitive difficulties (e.g. buttons that are too small to access and non-intuitive operations such as 'clicking' and 'swiping' that may not make sense to those with cognitive and cultural differences).

Figure 6.2. Smart home options



Source: Adapted from van Dijken F, van Hoof J, Kort HSM. Healthy buildings for older adults. In: E. de Oliveira Fernandes, M. Gameiro da Silva, J. Rosado Pinto (eds). HB2006: Proceedings of the 8th International Conference on Healthy Buildings (Volume III); 4–8 June 2006, Lisbon, Portugal.

Box 6.3 Accessibility in the Canadian Museum of Human Rights

Some of the features included in the design of the museum include universal keypads, which have simple tactile symbols and auditory output that can assist users with sensory or cognitive difficulties in finding their way around the museum and accessing information about its exhibits. Universal access points are small

metal features that are numbered with the numbers in braille. These access points provide information in about the museum in a variety of formats, and for those who cannot see them, a raised strip on the floor signals their location. Ramps connect all levels of the museum, so it is not necessary to take stairs to reach any of the galleries. Elevators are also available. And accessible washrooms are available throughout the museum. For visitors who are deaf or hard of hearing, a mobile app provided by the museum can be viewed in ASL or LSQ and includes additional sign-language content for several exhibitions. A final feature that makes exhibits and photographs accessible for all are tactile 3-D renditions of some of the gallery's contents.

Source: Botelho FHF. Accessibility to digital technology: Virtual barriers, real opportunities. Assistive Technology. 2021;33(suppl1):27–34. doi:10.1080/10400435.2021.1945705.

Despite these challenges, where mainstream digital technology is more affordable and acceptable to use than assistive products, it is important that such devices are made accessible to all *(256)*.

Hardware

The hardware aspects of the digital environment can be challenging. An example of a common household device that can be challenging to use is remote controls. Figure 6.3 shows two remote controls: one that is more complex and has smaller buttons (a), which can be difficult to use for those with motor and/ or sensory difficulties; panel (b) shows a simpler remote control design, with fewer, larger and more distinct buttons in high contrast colours.

Figure 6.3. Examples of device controls

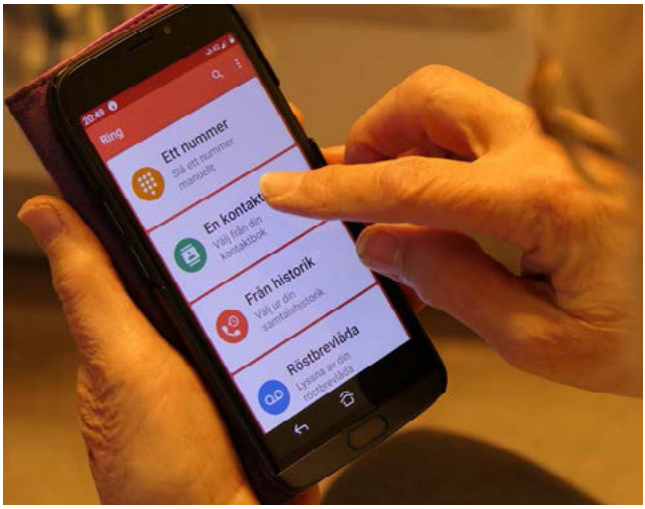
(a) more complex

(b) less complex

Phones are another example of potentially challenging devices, and simplified interfaces have been developed to make this critical technology accessible (Fig. 6.4).

Less complex interfaces with larger text and symbols, fewer larger buttons, and requirements to confirm executions of commands are more accessible.

Figure 6.4. An example of accessible designs of phone interfaces



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Box 6.4 Enabling health care services

The right to enjoy health care without discrimination is specifically mentioned in Article 25 of the UN Convention on the Rights of Persons with Disabilities *(2)*. In addition to this international declaration, various countries have legislation that mandates that health care be accessible to all. For example, in the United States, the Americans with Disabilities Act mandates that all health care facilities must be accessible to all people regardless of difficulties they may experience. This includes hospitals, physician and dental offices, pharmacies and other places that people receive their health care *(257)*. Despite these international and national policies, problems accessing health care still exist. Examples of environmental barriers to health care include lack of knowledge of health care services, lack of accessible transportation to get to health care providers, cost of services, inaccessibility of equipment such as scales and examination tables, and negative attitudes of health care providers towards people with physical and mental difficulties *(258,259)*.

Creating enabling health care environments can be accomplished by addressing these barriers. First transportation must be available and accessible so health care recipients can get to the service they need. Then people need to be able to get into the building where the providers practices *(260)*. Signage in the buildings need to be accessible so that all people can find their way to the office they need to visit. Simple, easy-to-read fonts along with international recognized pictograms are suggested for signage *(261)*. Also, exams rooms need to be accessible to all people. Once in the exam room, examination products such as adjustable height

exam tables and procedure chairs can allow people who have mobility difficulties to move from a wheelchair to the exam table or procedure chair instead of being examined or treated in their wheelchairs *(262)*.

Software

There are many initiatives at the organizational, national and/or international levels that aim to make digital technology accessible to all (an example is provided in Box 6.5). Driven by market demand, common operating systems have in-built features that increase accessibility.

There are also organizations that develop standards and training materials to encourage web accessibility for those who find difficulty using it (Table 6.1).

Table 6.1. Applicable examples of guidelines, policies or legislation on web accessibility

Initiative	Sources
International law and policy overview	www.w3.org/WAI/policies/
International web accessibility laws and policies	www.whoisaccessible.com/guidelines/international-web-accessibility-laws-and-policies/
The World Wide Web Consortium (W3C) is an international community that develops web standards.	www.w3.org/
Global Public Inclusive Infrastructure (GPII) aims to ensure that everyone who faces accessibility barriers can access and use the Internet	https://gpii.net/
WebAIM (Web Accessibility In Mind) provides comprehensive web accessibility solutions.	https://webaim.org/

Despite these initiatives, not all countries have effectively enforced laws that require that all digital environments to be accessible (see Box 6.6). Digital accessibility is often inadequate even in essential services such as education, health and public information websites.

Solutions

Usability assessment

There are tools that can help individuals and entities assess the usability and extent to which their digital environments comply with recommended guidelines *(263)*.

Cognitive accessibility

International Organization for Standardization (ISO) guidelines for cognitive accessibility in digital/virtual environments advise on: how such environments can be customized for people with cognitive difficulties (e.g. the Zac web browser for use by

children with autism); how pictures and symbols can be used to enable those with cognitive difficulties to navigate text-rich virtual environments (e.g. Symbolworld.org which uses both text and symbols to communicate its content, see Fig. 6.5); and support for completing tasks (e.g. ready-made sentences that can be inserted into emails *(264)* and autocomplete features when personal information is requested) *(265)*.

Box 6.5 COVID-19 pandemic experiences of DATEurope

To enable access to digital assistive technology for all, the Digital Assistive Technology Industry Association Europe (DATEurope) works on raising awareness about digital assistive technology, influencing legislation for digital assistive technology, enabling industry networking opportunities, fostering emerging technologies and stimulating innovation. Their experience is that the COVID-19 pandemic emphasized the role and value of digital assistive and accessible technologies.

Digital technology permeated provision, reflecting the nature and identity of the technology. Digital technologies remained consistently available to people as distribution was through downloads and personal installation. As a result, the availability of digital products remained consistent. This allowed many people with functional difficulties to continue working, learning and connecting to family and friends when physical and face-to-face activity was limited.

DATEurope also noted that digital connectivity allowed the wider assistive technology ecosystem to be maintained and was a vital component of resilient services. Accessible technologies such as video conferencing, collaboration and assistance solutions facilitated training and capacity building, evaluations and recommendations to meet needs, post-sales and technical support and ongoing dialogue to develop policy and practice. At the same time, accessible consumer technologies and mobile technologies demonstrated their power to create more appropriate environments and impact every aspect of the lives of people with a functional difficulty.

Source: Digital Assistive Technology Industry Association Europe (DATEurope) (http://www.dateurope.com, accessed 20 April 2022).

Providing on-screen contrast options can also be a useful adaptation to promote focus in virtual environments (Fig. 6.6).

ISO guidelines also acknowledge that sensory difficulties can impact cognitive abilities *(266,267)*. Text-to-speech output can provide access to those with visual and cognitive difficulties *(268)*. Tactile or haptic input can also be useful for those with hearing and/or cognitive difficulty. For example, vibration is a useful accessibility feature for those who have hearing difficulties. This tactile feedback can be an effective reminder feature for those with memory difficulties *(269)*.

Figure 6.5. Sample Symbolworld icons

Figure 6.6. Sample screens with and without contrast

Legislation

Countries should institute and enforce laws requiring all digital environments to be accessible (including for essential services such as education, health and government websites). As digital technology is a dynamic field, legislation and other tools used to ensure universal access must include periodic revisions to match ongoing technical developments (see Fernando's story).

Meet Fernando

United States

Fernando is 51 years old and has lived in cities worldwide in his capacity as a policy advisor on assistive technology. He has held numerous internships and professional positions and appreciates the opportunity to continue learning and contributing to making a better world.

With his white cane, Fernando can go where he needs to, accessing public transport, which is often the most efficient and affordable way to get around in most highly dense urban centres. He has also used his white cane in all weather conditions – even rain or snow.

While Fernando uses his white cane to get around the physical environment, he uses screen readers in the digital world. He uses screen reading software on computers and smartphones to read books, navigate the web, use a range of software applications, and to write letters, articles, and emails. He states, "It is fair to say that my screen reader has opened opportunities in the professional world just like my white cane has opened many paths in the cities where I have lived."

Despite Fernando's access to the best-quality screen readers, he still encounters inaccessible software programmes or websites that make it difficult to use his screen reader. Usability and accessibility challenges are common in the digital environment. For example, poorly structured websites are hard to navigate, and images and videos without alternative text or descriptions prevent full access to the content. When digital platforms are accessibly designed, he can operate efficiently and effectively in the virtual environment.

Upon reflection on the importance of assistive technology in his life, Fernando states, "Combined with training and hard work, assistive products have allowed me to enjoy family, a job, and wonderful friends. Thanks to assistive products, training, and my own efforts, I am blind, but not disabled."

Box 6.6 Access to technology among people with disabilities

"Considering the vast potential of technology to improve the lives of persons with disabilities and to contribute to the implementation of the Convention, as well as the role of persons with disabilities in designing, developing and producing ICTs, wider access to technology among persons with disabilities should be considered a priority. It is crucial to reduce the gaps in access to technology, digitalization and ICTs between persons with and without disabilities and to invest in assistive technology."

Source: Technology, digitalization and information and communications technology for the empowerment and inclusion of persons with disabilities. Note by the Secretariat. Conference of States Parties to the Convention on the Rights of Persons with Disabilities. Twelfth session; New York, 11–13 June 2019 (https://docslib.org/doc/11668246/convention-on-the-rights-of-persons-with-disabilities, accessed 20 April 2022).

Services and systems

Accessible services and their related systems and policies *(6)* across various sectors (and at local, regional, national and international levels) can help users and caregivers in many areas of life. For a public service to be accessible, the buildings or online platforms

that house them must be accessible, and the services must be designed inclusively, with staff receiving adequate disability equality and awareness training. For a service to be truly inclusive, everyone should be able to experience the service equally, without the need for 'special' treatment or provision.

A wide range of services, systems and policies relevant to users include those relating to the production of consumer goods, architecture and construction, open space planning, housing and utilities services, transport, communication, health, education, employment, and social security (see Box 6.7). While many local, national and international standards and policies exist to create inclusive services, lack of knowledge and practical application of these standards and policies creates barriers to inclusion. Added to this, awareness among service providers of the need for inclusive and accessible services can be low – the result of a lack of training and education on the topic.

Architects and urban planners who provide built environment services often receive little training in the concepts of accessibility and universal design, leading to their perception of accessibility being primarily about wheelchair access *(270)*. Similarly, those tasked with servicing and managing public open spaces may often not be aware of requirements to ensure spaces are accessible to all.

Box 6.7 Services, systems and policies: definitions

- *Services* provide benefits, structured programmes and operations, in various sectors of society, designed to meet the needs of individuals. Being public, private or voluntary, they can be established at different levels of society from local to international. An integral part of services are the people who provide them.
- *Systems* are administrative and organizational mechanisms designed to organize, control and monitor services. They can be established by governments at the local, regional, national and international levels, or by recognized authorities.
- *Policies* related to systems constitute the rules, regulations, conventions and standards established by governments at the local, regional, national and international levels, or by recognized authorities. Policies govern and regulate the systems *(6)*.

In the case of transport infrastructure and services, attitudinal barriers can be found in the shape of discriminatory practices or processes used by service staff and/or other service users.

Multiple factors impact the ability of those with functional difficulties to obtain housing, including affordability, accessibility and discrimination *(271)*. While national and international legislation protects people with functional difficulties from being discriminated against in housing, the problem of lack of access to affordable and accessible housing persists. For example, young adults with disabilities may live in nursing home facilities because they cannot find accessible supportive housing in the community.

Additionally, those with mental health problems experience stigma, safety concerns, inaccessible design and lack of adequate caregiver support among the environmental factors, which jointly impact their ability to obtain community-based housing.

Creating inclusive digital services is promoted by two factors: 1) ensuring people have access to affordable digital devices; and 2) ensuring the physical digital products – and software that powers them – are accessible to users. By the end of 2020, 67% of the global population subscribed to mobile phone services, leaving over 30% without access to this vital technology *(272)*. Overall use levels are predicted to rise, but there remains a digital divide that leaves some excluded – especially those who have physical or cognitive difficulties, live in rural areas and/or are financially disadvantaged.

While improving, the inability to connect to the Internet varies across communities, presenting additional access issues. While government systems have committed to increasing communication access, there is still unequal distribution across countries *(273)*.

Solutions

Education and awareness-raising

Education and ongoing awareness campaigns on how to create accessible services at multiple levels are critical approaches to facilitate inclusion for all. Monitoring the practical application of policies is also needed to ensure that they are implemented across services and systems to provide access for all.

To address the need for service personnel education, there are multiple resources available that can be included in educational curricula and continuing education to provide this information. And the WHO *Age-friendly cities framework (271)* includes recommendations for making outdoor spaces accessible for people who have functional difficulties and can be useful to increase awareness at service, system and policy levels regarding how to make and maintain public and outdoor spaces that are accessible to all (see Box 6.8).

Knowledge of services and how to obtain them

Whether it is, for example, accessible voting booths available for political elections, or access to transportation services, people who need accessible services must know they exist and how to access them. Those providing the services need to have adequate disability equality and awareness training. And the service needs to be physically, sensorily and cognitively accessible to all who need it *(274)*.

Coordination and collaboration

To operate efficiently, systems need to collaborate and be coordinated, for example, when a service user is moving from an educational to a vocational setting. Including multiple stakeholders is a good strategy to ensure systems are accessible. Involving users in designing services to support their community-based living needs can also improve this experience *(275)*.

Box 6.8 Built environment panel and park accessibility (United Kingdom)

At Queen Elizabeth Olympic Park in London, a Built Environment Access Panel – formed of people with disabilities – provides expert guidance on the inclusive design of the park and surrounding areas. Inclusion is built into service contracts for partners, including: the requirement for staff to receive disability equality and awareness training; targets for inclusion of persons with disabilities as park employees; and requirements that park events must meet the park's inclusive design standards. The park also provides a park mobility service that supports visitors with functional difficulties with equipment, information, tours and sighted guide services.

Sources:

Inclusive Design Standards updated for 2019 [website]. London: Global Disability Innovation Hub, Queen Elizabeth Olympic Park and London Legacy Development Corporation; 2019 (https://www.disabilityinnovation.com/news/inclusive-design-standards-updated-for-2019, accessed 20 April 2022).

Park Mobility Service [website]. London: Queen Elizabeth Olympic Park (https://www.queenelizabetholympicpark.co.uk/the-park/plan-your-visit/accessibility/park-mobility-service, accessed 20 April 2022).

Establishing and enforcing adequate policies

While many policies exist that protect people with functional difficulties from discrimination, there is great variability across organizations and agencies about what is included in, and covered by, these policies. For standards and policies to be effective, mechanisms to ensure implementation and accountability are essential. Regular access audits can help governments to: monitor compliance with legislation; strengthen codes or standards; make recommendations to modify or improve a facility; develop an access handbook for buildings and other facilities management; or simply provide information on accessibility for building or service users. A survey conducted by the UN Economic and Social Commission for Asia and the Pacific (UNESCAP) in 2017 found that, among its Member States, only 66.5% of government buildings in 15 countries and 59.8% of polling stations in national capitals in 18 countries were accessible *(276)*. Access audits are essential to provide such vital information, which can be used to support persons with functional difficulties to participate in public life.

Implementing national strategies and legislation at the local level

It is important that national strategies are supported by local action. Implementation of national policies often takes place at local levels, and so implementation challenges are common *(274)*. Participation and engagement with the public and civil society can support more enabling and inclusive infrastructures and service provision.

Support and attitudes

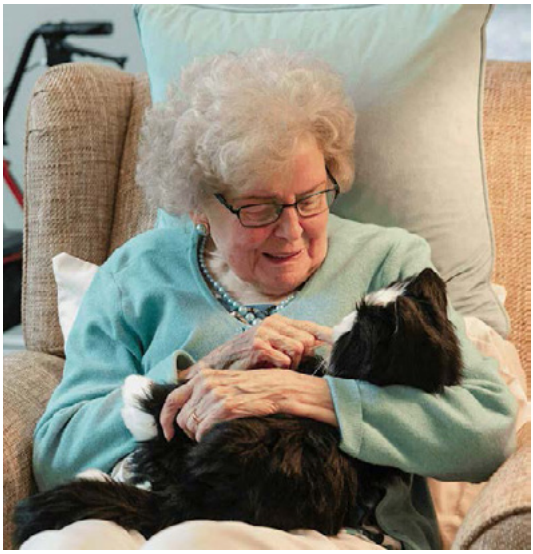
© being patient

Figure 6.7. Digital therapy cat

Support, relationships and attitudes are social aspects of the environment *(6)*. People or animals can offer practical physical or emotional support, nurturing, protection, assistance and relationships. This may influence the need for, and use of, assistive products in the home, school or place of work; at play; or in other daily activities. For example, in circumstances where human company may not be available or is unwanted, an assistive product in the form of a social animal robot (Fig. 6.7) may provide the desired relationship.

Attitudes – in particular how customs, practices, ideologies, values, norms, factual beliefs and religious beliefs etc. manifest themselves *(6)* – may influence individual behaviour and social life at various levels, from interpersonal relationships to community associations and political, economic and legal structures, and may motivate positive or negative practices, which may in turn lead to inclusion or exclusion. At the policy level, the attitudes of a society towards people with functional difficulties may be reflected in legislation related to their access to assistive technology.

At the personal level, the presence or the design of assistive products may lead to stigmatization, marginalization or neglect of users, which may make users reluctant to use them. It is therefore important that assistive products are designed to reduce stigma.

Many users obtain information about and adopt assistive products based on information provided by family and caregivers. Attitudes and values towards assistive products among people with functional difficulties are also factors affecting its adoption and implementation, and related trust *(38)*. Ethics and privacy concerns are linked to this *(277)*. In cases where caregivers are knowledgeable and feel positive about assistive products, the use of assistive products has been shown to be acceptable and have positive health outcomes for users *(278)*. Positive attitudes of both users and caregivers towards assistive products are critical for successful adoption of these devices. Education and awareness about assistive products is therefore an important strategy to improve their uptake *(239)*.

Natural environment

Living and non-living elements of the natural environment, and components of that environment that have been modified by people, affect the use of assistive technology *(6)*. The accessibility for people with functional difficulties to physical geography – whether natural or human-made – can be improved, for example, by adapting and applying design

recommendations for the built environment. This may include ensuring that slopes are not too steep, paths are sufficiently wide, and surfaces are sufficiently hard and smooth. In woodlands and national parks, accessible pathways can be provided. Ramps and matting on beaches can allow users to access popular recreational environments with friends and family *(279)*.

Box 6.9 Enabling education environments

The right to education has been documented in international, regional and national legal documents – including, Article 26 of the *Universal Declaration of Human Rights* and Article 24 of the UN *Convention on the Rights of Persons with Disabilities*. Despite all countries having ratified at least one treaty covering rights to education for all *(280)*, there are still access and equity barriers that prevent children with disabilities from obtaining an education. Barriers include disabling environments, difficulty accessing educational materials, inflexible education systems and attitudinal stigma and discrimination *(281)*. Principles of universal design have been applied to educational settings to ensure that a diverse group of students can participate in the educational process. Universal design promotes "the belief that the broad range of human ability is ordinary, not special. … [universal design] reduces stigma and provides benefits for all users" *(282)*. While the concepts of universal design have been applied both to the physical environment and adapted to make the educational curriculum accessible, access efforts reflect a narrow understanding of accessibility *(281)*.

To access an education, it is critical that students are able to get to school, so accessible public transportation and school buses can be crucial. Transportation options are a challenge in remote rural villages and countries where travel to school may be dangerous or public transportation is not available. Creating community-based schools is one way to enable access to the school environment *(283)*.

The school environment must be inclusive as well. Applying the principles of universal design to school buildings and classroom design can create inclusive spaces. Entrances to and hallways in the school need to be wide enough to accommodate all students, and directional signs to classrooms and other school spaces must be visible and simple to read, with recognizable symbols.

In the classroom, seating near the front of the room may help students with visual, hearing or cognitive difficulties to better focus on the what the teacher is saying or writing on the board. Classrooms can have an overwhelming level of sensory stimulation. Reducing distracting noise by using earplugs or noise-cancelling headsets may help some students attend to what is going on in the classroom. Providing a variety of seating options such as floor pillows, seats and ball seats that fit various body sizes and shapes can make learning environments more inclusive *(284)*.

Using desktop cardboard privacy dividers can help focus attention of students who are easily distracted *(285)*. Slant boards – which allow a student to put reading or writing assignments at an angle on their desks, tables or laps – can promote healthy neck, shoulder and arm positions *(286)*.

Classroom products, such as writing tools, can also be designed with universal design principles in mind. Different sized writing implements to accommodate students' varying hand-grips and strengths can be made available. Local recycled materials can be useful for making classroom activities inclusive for all *(287)*.

It is suggested that governments ensure that schools have access to: (a) electricity; (b) Internet for pedagogical purposes; (c) computers for pedagogical purposes; (d) adapted infrastructure and materials for students with disabilities *(281)*. These features can support the devices and technologies that can help support students with difficulties accessing the curriculum to overcome the barriers they may experience.

Finally providing teachers with education on how to incorporate universal design and other inclusive principles into the classroom can help promote an understanding of how to use simple to high technology solutions to make educational environments enabling for all students *(288)*.

Animals and plants can act as barriers to participation of users, for example, by creating barriers for users of mobility devices or by being a fall hazard if they get underfoot.

Climate, such as temperature, humidity, rain, wind and seasonal variations, can affect the use of assistive products. For example, keeping paths free from rainwater or snow facilitates wheelchair use, while providing shelters can protect travellers from harsh weather when using public transport *(271,289)*. Moreover, weather protection at entrances is a universal design suggestion to protect people from the weather when entering and leaving their buildings *(290)*.

Natural events (e.g. earthquakes, tornadoes, hurricanes, typhoons, floods, forest fires, volcanos and ice-storms) and human-caused events (including events or conditions linked to conflict and wars, environmental disasters, and land, water or air pollution) can cause disruptions, alterations or disturbances in the physical environment. These events often increase the need for assistive technology, while at the same time hindering access to and use of it.

Box 6.10 Enabling environments in humanitarian crises

A humanitarian crisis can damage the physical and communication infrastructure, disrupt services and personal support networks, and alter the natural environment in ways that make accessing and using assistive technology more challenging, if not

impossible. Enabling environments in humanitarian crises are necessary to reduce the need for, improve access to, and facilitate the use of assistive technology. Strategies that can be employed in preparing for humanitarian crises to improve assistive technology access include *(204)*:

- In emergency preparation planning it is important to empower individuals and their support systems – by engaging users in the development of emergency preparedness plans. These plans can include back-up resources or equipment, and alternative support necessary for managing environmental challenges.
- Humanitarian response efforts at all levels – local to international – can be prepared to address weaknesses in infrastructure and challenges in the natural environment. For example, adequate funding can be in place to provide accessible transportation to those with mobility limitations affected by a crisis.

During and after a crisis, strategies are needed to ensure users are not excluded from humanitarian assistance. Access to reliable information is of utmost importance during the acute phase. Communities require timely and accessible information to be aware of a crisis situation, and how and where to access support and services. Addressing the digital divide experienced by people with functional difficulties and marginalized groups is needed to ensure equal access to information during a crisis. Mobile phones offer access to information and a range of mobile-based technologies *(291)*. When life-saving decisions are made quickly by frontline humanitarian workers, people with disabilities and elderly have been left out when rationing of care is necessary. It is thus important to ensure that decision-making protects rights of vulnerable groups and is not influenced by prevalent biases (e.g. ageism) *(292)*. In cases where communities must evacuate and temporarily relocate, humanitarian facilities, housing, latrines, paths, supports and services can be designed to ensure accessibility. For example, waiting in line for long periods to receive food may not be possible for everyone, so alternative methods to deliver food are needed. Numerous humanitarian situations are long-term, such as long-standing refugee camps that provide ongoing housing and a range of services. Inclusive environments can be achieved through:

- Raising awareness about assistive technology and inclusive attitudes among broader refugee community and humanitarian staff *(293)*.
- Ensuring that assistive products provided are suitable within the local environment *(294)*.
- Ensuring physical facilities and environments are accessible (e.g. latrines *(295)*, shelters *(296)*).