

Digital Technologies for Inclusive Education

Recommendations for promoting
an ICT-based learning environment
for resource centres and schools



Digital Technologies for Inclusive Education: Recommendations for promoting an ICT-based learning environment for resource centres and schools

This publication was developed within the UNESCO IITE–Chengdu project ‘Integrating Artificial Intelligence and Digital Innovations to Strengthen Inclusion and Equity of Education in Africa’ and aims to equip resource centres and organizations dedicated to inclusive education with the tools and methodologies to harness the capacity and benefits of ICT and AI-driven learning technologies in the education and socialization of persons with disabilities and special education needs. The recommendations strive to tangibly support committed professionals and stakeholders in their unwavering efforts to enhance the accessibility and quality of education in inclusive and special educational settings.

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PREFACE

We are delighted to present the strategic recommendations developed under the UNESCO-Chengdu project, 'Integrating Artificial Intelligence and Digital Innovations to Strengthen Inclusion and Equity in Education in Africa,' an initiative realized with the valued support of the Chinese National Commission for UNESCO. The recommendations are expected to empower inclusive resource centres (RCs) by harnessing the potential of learning technologies to significantly enhance the quality and accessibility of education for students with disabilities and special educational needs (SEN).

This document offers a detailed blueprint for creating robust information and communication technologies (ICT) infrastructures in RCs and developing accessible learning environments. It also includes actionable guidelines for boosting teachers' ICT competencies and motivation to leverage technology. Special emphasis is placed on using practical, learner-centred pedagogical approaches in inclusive and special learning needs education to ensure that every student receives the support they need to succeed.

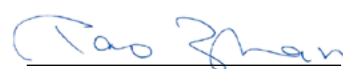
Our recommendations are rooted in a comprehensive analysis of best practices, case studies and success stories from educational institutions, RCs and special education schools worldwide. Collected in 2023 as part of the UNESCO-Chengdu project, these insights demonstrate the profound benefits of approaches to education and socialization for persons with disabilities and SEN that are technology-enhanced, ICT-supported and

empowered by artificial intelligence (AI). The core ideas in this document were inspired and substantiated by the results of extensive online surveys and in-depth interviews with representatives of inclusive organizations that have contributed greatly to the project.

Given the diverse demands faced by educational institutions, schools and RCs that are trying to establish adequate ICT infrastructure and the varying levels of staff's proficiency in using ICT, the methodological approaches described in this document offer a solid framework for the successful implementation of education-related technologies. They detail the anticipated outcomes for each activity domain and the essential resources required to achieve them.

We believe that these recommendations will be a valuable resource for educators, administrators and policy-makers who are committed to fostering an inclusive, equitable and high-quality education environment for all learners. By embracing the transformative potential of technology, we can create more accessible and effective learning environments that meet the diverse needs of all learners.

Yours sincerely,



Tao ZHAN
Director of UNESCO IITE

GLOSSARY

TERM	DEFINITION
Artificial intelligence (AI)	‘There is no universal definition of artificial intelligence (AI). AI is generally considered to be a discipline of computer science that is aimed at developing machines and systems that can carry out tasks considered to require human intelligence. Machine learning and deep learning are two subsets of AI. In recent years, with the development of new neural network techniques and hardware, AI is usually perceived as a synonym for “deep supervised machine learning”. (WIPO. n.d. Frequently Asked Questions: AI and IP Policy Basics: What Is Artificial Intelligence?)
Assistive technology (AT)	‘An umbrella term for assistive products and their related systems and services. Assistive technology is of fundamental importance for persons with permanent or temporary functional difficulties as it improves their functional ability and enables and enhances their participation and inclusion in all domains of life. Assistive products may be physical products such as wheelchairs, spectacles, hearing aids, prostheses, walking aids or continence pads; or they may be digital, occurring in the form of software and apps that support interpersonal communication, access to information, daily time management, rehabilitation, education and training etc.’ (WHO and UNICEF. 2022. Global Report on Assistive Technology.)
Best practice	‘Commonly defined as “a technique or methodology that, through experience and research, has proven reliably to lead to a desired result”. The term is used frequently in areas such as health, government administration, the education system, project management, and others... The use of the word “best” should not be considered in the superlative sense. In other words, the term “Best Practice” is not about “perfection”, the “gold standard” or only elements that have been shown to contribute towards making interventions work or successful.’ (WHO Regional Office for Africa. 2008. Guide for Documenting and Sharing “Best Practices” in Health Programmes.)
Equity	‘In education, the extent to which access and opportunities for children and adults are just and fair. This implies reduction of disparities based on gender, poverty, residence, ethnicity, language, and other characteristics... This criterion refers to a universally accepted goal of schooling: the quest for fairness in access to educational opportunities, resources and outcomes by gender, social class, race, language origins and geographical location of students.’ (UNESCO-IIEP Learning Portal. n.d. Glossary: Equity.)
ICT competency	Confident and critical use of electronic media for work, leisure and communication. These competencies are related to logical and critical thinking, to high-level information management skills, and to well-developed communication skills (United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development (UN-APCICT/ESCAP). 2016. Briefing on ICT Competency Standards.)

TERM	DEFINITION
Information and communication technologies (ICT)	‘A diverse set of technological tools and resources used to transmit, store, create, share or exchange information. These technological tools and resources include computers, the Internet (websites, blogs and emails), live broadcasting technologies (radio, television and webcasting), recorded broadcasting technologies (podcasting, audio and video players, and storage devices) and telephony (fixed or mobile, satellite, video-conferencing, etc.).’ (UNESCO Institute for Statistics. 2009. <i>Guide to Measuring Information and Communication Technologies (ICT) in Education</i>.)
Inclusive education	‘An inclusive approach to education means that each individual’s needs are taken into account and that all learners participate and achieve together. It acknowledges that all children can learn and that every child has unique characteristics, interests, abilities and learning needs.’ (UNESCO. 2024. <i>What You Need to Know About Inclusion in Education: How Does Inclusion Relate to the Right to Education?</i>)
Innovation in education	‘Innovation in education is about more than new technology. It’s about solving a real problem in a fresh, simple way to promote equity and improve learning. Innovation in education comes in many forms. Programmes, services, processes, products and partnerships can all enhance education outcomes in innovative ways... Solving a real problem in a new, simple way to promote equitable learning.’ (UNICEF. n.d. <i>Strengthening Education Systems and Innovation</i>.)
IT infrastructure	‘The combined set of hardware, software, network resources, and services (like CRM solutions) required for the operation, management, and support of an organization’s IT environment. This includes servers, storage, networking devices, and software applications.’ (Gunnell, M. 2024. <i>IT infrastructure</i>. <i>Technopedia</i>.)
Mainstreaming/mainstream education	‘The inclusion “of learners with special needs into general educational settings or regular schools” (IBE-UNESCO, n.d.). Mainstream education settings should ensure that the needs of all students are addressed and that all barriers which can potentially hinder their participation be removed.’ (UNESCO-IIEP. n.d. <i>Mainstreaming/Mainstream education/settings</i>. <i>Education Policy Toolbox</i>.)
Resource centre (RC)	‘Also known as a learning resource center or educational resource center, a centralized hub that offers a diverse range of materials, tools, and services to facilitate teaching, learning, and research activities. These centers are typically found in schools, colleges, universities, libraries, and other educational institutions. RCs serve multiple functions that cater to the needs of students, educators, and the community.’ (Learning Corner. n.d. <i>Education Glossary: Understanding Resource Centers in Education</i>.)

TERM	DEFINITION
Social inclusion	‘The process by which efforts are made to ensure equal opportunities — that everyone, regardless of their background, can achieve their full potential in life. Such efforts include policies and actions that promote equal access to (public) services as well as enable citizen’s participation in the decision-making processes that affect their lives.’ (UN DESA. n.d. Social Inclusion.)
Special needs education	‘Education designed to facilitate the learning of individuals who, for a wide variety of reasons, require additional support and adaptive pedagogical methods in order to participate and meet learning objectives in an educational programme. Reasons may include (but are not limited to) disadvantages in physical, behavioural, intellectual, emotional and social capacities.’ (UNESCO Institute for Statistics. n.d. Glossary: Special Needs Education.)
Technology-enhanced learning (TEL)	‘Any technology that enhances the learning experience. The term can be used to describe both analog and digital technologies, but more recently, we see that digital TEL is taking over education in the form of different types of educational software.’ (Cullen, E. 2023. What is technology-enhanced learning? Mentimeter.)

ACRONYMS

ADHD	attention deficit hyperactivity disorder
AI	artificial intelligence
AR	augmented reality
ASD	autism spectrum disorder
AT	assistive technology
ATA-C	assistive technology capacity assessment
ATA-I	assistive technology impact assessment
BoF	Bag of Features
Chengdu	Chengdu Culture and Tourism Development Group LLC
CNN	convolutional neural network
CoP	community of practice
DigCompEdu	European Framework for the Digital Competence of Educators
DLD	developmental language disorder
ICT	information and communication technologies
ICT-CFT	UNESCO ICT Competency Framework for Teachers
IEP	Individual Education Programme
IT	information technology
ITU	International Telecommunication Union
LMS	learning management system
LSP	Livescribe Pen
NGO	non-governmental organization
PC	personal computer
rATA	rapid Assistive Technology Assessment
RC	resource centre
SATs	Standardized Achievement Tests

SEL	social-emotional learning
SEN	special educational needs
STT	speech-to-text
SURF	Speeded Up Robust Features
TAP	'Training in Priority Assistive Products'
TTS	text-to-speech
UDL	Universal Design for Learning
VR	virtual reality
W3C	World Wide Web Consortium

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- Access to Communication and Technology Unit (ACTU), Aġenzija Sapport, Malta
- Asociación en Defensa del Infante Neurológico (AEDIN), Argentina
- ASSIST — Assistive Technologies Foundation, Bulgaria
- Assistiva Tecnologia e Educação, Brazil
- Assistive Technology, Disability and Inclusive Education Multi-Disciplinary Research Unit (MRU), Cyprus
- Beit Issie Shapiro (BIS), Israel
- Bridge AI, The Hong Kong Special Administrative Region (HKSAR) of the People's Republic of China
- Centre on Inclusive Technology & Education Systems (CITES), United States of America
- Centro de Desarrollo de Tecnologías de Inclusión (CEDETi), Chile
- Information and Training Centre for Persons with Disabilities, Digital Innovations Academy, The Kyrgyz Republic
- Kara + BJANA Vision Skills Lab, India
- Mada — Assistive Technology Center, Qatar
- Outcomes First Group, United Kingdom
- Regional Centre for Assistive Technology, Italy
- Regional Centre for Support of the Inclusive Education Process in the Targovishte Province, Bulgaria
- Resursni centar Milan Petrović, Novi Sad, Serbia
- Rodney House Specialist Support School, United Kingdom
- Specialized Information Technology Training Centre for Hearing-Impaired Children, Uzbekistan
- Territorial Support Centre for Disabilities through Technologies (CTS Bologna), Bologna, Italy
- Türkiye Spastik Çocuklar Vakfı, Türkiye (TSCV)/Cerebral Palsy Türkiye
- Young Power in Social Action (YPSA), Bangladesh

The above-mentioned teams' genuine commitment to sharing their real-life experiences and insights has been instrumental in demonstrating the meaningful and impactful use of ICT, AI and assistive technology (AT) in empowering persons with disabilities and SEN and enabling and enriching their education and socialization.

Our earnest thanks go to IITE's Senior Consultant, Ms Natalia Potapenko, for her commitment and dedication to this publication. She made a substantial contribution to the research-related conclusions and the development of the present recommendations. The first-hand information that was collected provided a solid foundation for the outcomes, conclusions and recommendations presented here. Ms Potapenko's active engagement, didactic experience and empathic concern have been invaluable and are deeply appreciated.

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Finally, we extend our deepest gratitude to our partners and donors for their continuous support. Your belief in the importance of this work has enabled us to undertake and complete this significant endeavour.

EXECUTIVE SUMMARY

This publication contains the recommendations developed as part of the UNESCO IITE–Chengdu project ‘Integrating Artificial Intelligence and Digital Innovations to Strengthen Inclusion and Equity of Education in Africa’. The recommendations should equip RCs and organizations dedicated to the provision of inclusive education with the tools and methodologies they need to harness the potential of learning technologies driven by ICT and AI and to enhance the quality and accessibility of education for persons with disabilities and SEN. They delineate strategies for establishing ICT infrastructures within RCs and fostering inclusive learning environments for persons with disabilities and SEN, and provide guidance on enhancing teachers’ ICT competencies and fostering their motivation to integrate technology into their educational practices. Particular emphasis is placed on practical methodologies for learner-centred pedagogy in the context of inclusive and special needs education.

The recommendations were created in the wake of an extensive examination of best practices, case studies and success stories gathered from relevant educational institutions, RCs and special education schools worldwide. This information was compiled during 2023/24 as part of the UNESCO IITE–Chengdu project to highlight the benefits of technology-supported and AI-empowered education and socialization of persons with disabilities and SEN. The recommendations draw on an analysis of online survey findings and outcomes from interviews with representatives of engaged RCs, educational institutions and special education schools.

**GUIDING PRINCIPLES
OF PROMOTING
AN ICT INFRASTRUCTURE
FOR RESOURCE CENTRES**

1.1. Building an ICT infrastructure for inclusive education

Modern technologies have the potential to foster inclusion in education, but many barriers to their widespread and successful implementation — in particular, digital inequality — persist. The lack of an accessible and inclusive digital infrastructure hinders persons with disabilities' participation in the digital world and consequently limits their education, employment and social engagement opportunities.

To address digital inequality, digital services in inclusive education must adhere to accessibility standards and make accessibility a central part of the design process. This would ensure that all digital services, irrespective of their origin, can be used by a wide audience, including students with disabilities.

However, addressing digital inequalities does not automatically ensure inclusion and equity in education. Even if students have access to various technologies, they will not necessarily use them equally successfully to participate in education or increase their opportunities to socialize.

RCs' experiences with inclusive education in many countries offer valuable lessons that can help us support the ICT-empowered transformation of mainstream schools into inclusive educational communities to provide equal access to education, including e-learning. However, many countries face another major barrier to the widespread and successful implementation of technologies in education: a lack of qualified staff and effective specialized services for families (caregivers) with children (learners) who have disabilities. The research study implemented by UNESCO IITE within the Chengdu initiative revealed that RCs working

in the area of inclusive education have collectively accumulated vast experience in integrating ICT and AI. However, not all countries have an RC, and among most of those that do, one centre is not enough to meet their needs.

The guiding principle of integrating ICT to promote inclusion is to minimize the gaps in access to education for persons with special learning needs and maximize their chances of reaching typical milestones in their development. Technology-based screening and assessment procedures can help identify difficulties or challenges early and provide students with the support they need immediately. Therefore, the implementation of the aforementioned guiding principle should include:

- provision of education-related technology that is both available and affordable to all learners and their families (caregivers), and
- provision of ICT in education that encourages participation and strengthens rehabilitation and social inclusion.

ICT infrastructure refers to hardware, software and the information and telecommunication networks that transmit, store and deliver information. The infrastructure in the context of inclusive education includes various standard and specialized equipment, platforms and software. For example, a work area for the education of a student with a visual impairment will include a standard personal computer (PC)/laptop with Braille keyboard, text-to-speech (TTS) software and a portable digital magnifier electronic reading aid.

The main principle of infrastructure design for the purpose of inclusive or special needs education is to establish an ICT-enriched educational environment from the user's perspective. The environment should support daily education

activities and meet diverse learning needs. To ensure that the infrastructure is selected appropriately, it is imperative to monitor and regularly evaluate the quality of educational services provided by an RC before and during the infrastructure planning phase.

The proposed approach to designing the infrastructure of an ICT RC should be integrated at several stages of the planning, implementation and monitoring/evaluation stages, including the development of the centre's mission, vision, objectives and strategic plan; the selection of appropriate premises; and monitoring and evaluation of the results. Ideally, at the beginning of the implementation process, learners with disabilities and SEN who are willing and able to participate in the model's launch and pilot-testing should be identified and subsequently involved in the process.

The activities related to the infrastructure development will include, among others, establishing an internet connection and local network; integrating a learning management system (LMS); selecting and installing appropriate platforms, hardware, software and workplace equipment; developing teaching and learning materials; modifying the curriculum in accordance with individual learning needs; and developing learning and instructional and tutorial resources in appropriate formats. Special attention should be given to teachers' and students' ICT-related competencies, and parents (caregivers) should be provided with instructions and guidance on using IT devices and online platforms.

1.2. Selecting technological solutions and platforms for an RC

RCs can choose between two primary types of ICT infrastructure: traditional (conventional)

infrastructure and cloud (online) infrastructure. The most important requirements for both types of infrastructure are that they operate seamlessly with various AT devices, they are accessible to persons with a range of disabilities and the information they contain is easy to navigate. Online platforms should be developed in line with W3C standards.

A traditional IT infrastructure is made up of standard hardware and software components: facilities, data centres, servers, networking hardware, desktop computers and enterprise application software solutions. Typically, this infrastructure set-up requires more electrical power, physical space and financial resources than other types of ICT infrastructure.

A cloud-based computing IT infrastructure is similar to a traditional one. However, end-users can access the infrastructure via the internet and can therefore use digital resources without their being installed on-site. Virtualization connects physical servers maintained by a service provider at any or many geographical locations. It further divides and extracts resources, such as storage, to make them accessible to users almost anywhere via an internet connection. Many educational institutions use cloud-based platforms for conducting classes, sharing resources, performing assessments and managing standard daily activities.

The design of RCs for inclusive education must adhere to three principles: accessibility, universal design, including Universal Design for Learning (UDL), and sensory development. These principles underlie all the activities undertaken by RCs that are involved in the education and socialization of persons with disabilities and SEN (see Table 1).

Table 1. Three principles of design of RCs for inclusive education

Accessibility	<p>All users, regardless of their physical ability, must be able to access information. One of the central principles relating to the education of students with SEN is that all technologies that are used to access information resources should be tailored to meet the needs of various users. Many countries have already established legal frameworks that require reasonable accommodations and equal access to information for a wide range of users with SEN. Design-for-all principles play a major role in improving the accessibility of living environments for persons with disabilities and should be used throughout the development life cycle, starting at the invention phase. Some governments have introduced mandatory measures and developed specific guidelines to fulfil this objective.</p>
Universal design	<p>Universal design is a fundamental principle of inclusive infrastructure development. It requires the creation of products and environments that can be used by people of all abilities without any need for adaptation or specialized design. A well-designed educational ICT infrastructure provides a consistent interface across its functions: interoperation with various AT devices, easy access and navigation to content, a single ID and log-on, and a single point of contact for technical support and course-related enquiries. Managers and administrators also need a simple means of tracking individual user performance and viewing individual user records. The most appropriate way to ensure the usability of applied technologies is to involve end-users at all stages of the planning, development and implementation phases.</p>
Sensory development	<p>Sensory tools are intended to promote the regulation of emotions, improve focus and increase participation, all of which help a student be receptive to learning. Students who have disabilities may also have unique needs related to lighting, acoustics, visual signs and other external stimuli. An inclusive infrastructure addresses these considerations by having adequate lighting, soundproofing (including in computer rooms) and visual aids to support students in the learning process. In addition, the computer area of an inclusive environment should be equipped with various sensory tools, including, but not limited to, flexible/alternative seating arrangements (i.e. tables and chairs that can be arranged as required), manipulatives or fidget toys, desk-top or table-top partitions, privacy boards, etc. Large areas such as classrooms are often equipped with wireless assistive listening systems based on radio frequencies, infrared systems or an audio induction loop to help students hear better and more easily.</p>

The principles of flexibility, affordability and cost-effectiveness should also be taken into consideration at the design stage of the IT infrastructure development.

The interactive facilities of IT-based resources allow teachers to conduct various collaborative activities, organize group work that includes discussions and presentations of the outcomes of those discussions and effectively monitor and assess educational progress. Specific applications of ICT in education are extremely varied, but they can be grouped into four main categories:

- 1. ICT tools to access information and learning materials.** The use of both standard and specialized technologies enables students with disabilities to participate actively in the educational process. For example, children who have difficulty holding a pencil can use appropriate hardware and software to help them draw and write; children who have visual impairments can use various technologies to access information through auditory perception or touch. In other words, the technology is essentially a substitute for a natural function.
- 2. ICT tools to compensate for functional limitations and skills development.** Some technologies can be used to rehabilitate students who have disabilities or help them compensate for functional limitations. These technologies have significant potential to enrich the students' life experiences. Various types of specialized training devices and software programs for the development and correction of visual/auditory functions, attention and memory, speech and language disorders, and cognitive skills are available. Typically, such products are used by teachers or psychologists within

Individual Education Programmes (IEPs). Additionally, various types of hardware and software can be used for identifying, assessing and monitoring an individual's personal development and skill levels.

- 3. ICT tools for didactic purposes (instructional technologies).** ICT applications can be used to great effect to support the adaptation of a curriculum to make it suitable for a diverse range of students with disabilities. Instructional technologies can increase independence, personal productivity and empowerment, and can be used to introduce a variety of new teaching and assessment strategies for students who have different educational needs. These technologies help to reduce environmental barriers by transforming static curriculum resources into flexible digital media and tools based on UDL principles. Moreover, students who cannot attend regular classes because of health reasons can access distance education through ICT.
- 4. ICT tools for communication and interaction.** IT-based communication devices and software facilitate communication and enable persons who have communication-related disorders to interact with others more easily. Technologies are seen as mediators in the communication process and the user's needs should guide the choice of which one to use. An individual who has severe speech or language impairments may be able to communicate only through ICT. An individual who has motor or visual disabilities — and rarely leaves their home — but does not have specific speech or language disorders may find that ICT is their most accessible way to connect with the world.

To identify the gaps in AT provision, we recommend that teachers and other specialists use two tools developed by WHO: [the rapid assistive technology assessment \(rATA\)](#) and [the assistive technology capacity assessment \(ATA-C\)](#). The rATA ‘is a population-based household survey that measures the need, demand, supply, user satisfaction, and barriers to accessing assistive technology’. It can be used to collect data, inform policy and programme design, and raise awareness. ‘The assistive technology capacity assessment (ATA-C) is a system-level tool to evaluate a country’s capacity to finance, regulate, procure, and provide assistive technology’. This tool enables countries to better understand the current status of AT use and implementation and identify key actions to improve access to it. It can be used for awareness-raising, policy and programme design and ongoing monitoring and evaluation.

Another useful instrument developed by WHO is the assistive technology impact assessment tool (ATA-I). The ATA-I is a population-based household survey to measure the impact of AT on individuals. It was designed to collect information about the impact of AT on a person’s empowerment, inclusion, participation, quality of life, dignity and enjoyment of human rights.¹

Stakeholders need adequate information about their choice of AT and other tools so they can choose the right technology for their situation. Information dissemination and awareness-raising are essential for encouraging good practices and wider acceptance of inclusive policies. Table 2 contains a selection of good examples of international and national associations and networks that promote AT research and information.

Table 2. Associations and networks that promote AT research and information

NAME OF ORGANIZATION	MISSION
Global Alliance of Assistive Technology Organizations (GAATO)	‘To advance the field of assistive technology (AT) and rehabilitation engineering (RE) to benefit people with disabilities and functional limitations of all ages.’
Global Assistive Technology Information Network (GATIN)	‘[...] to create the most comprehensive information service on assistive technology (AT) serving older and disabled people, their families and carers across the globe.’
Association of the Advancement of Assistive Technology in Europe (AAATE)	‘To foster the role of Assistive Technology (AT) and inclusive design to create a world where all people can equally enjoy their human rights.’
Australian Rehabilitation and Assistive Technology Association (ARATA)	‘To build and sustain an inclusive assistive technology community of practice.’

¹ WHO plans to pilot the tool in several countries in 2024.

NAME OF ORGANIZATION	MISSION
<u>Rehabilitation Engineering Society of Japan (RESJA)</u>	‘The RESJA is an organization concerned with application of science and technology in the rehabilitation process. The membership includes rehabilitation professionals (engineers, medical staffs, teachers for handicapped children, etc), providers (makers and dealers), and consumers (disabled persons). A purpose of RESJA is to promote mutual understanding among these groups so that they comprehend and serve the actual needs of the people with disability who shall get benefit from the application of rehabilitation engineering. The RESJA has a membership of almost 1000 and still growing continuously.’
<u>Rehabilitation Engineering and Assistive Technology Society of North America (RESNA)</u>	‘To maximize the health and well being of people with disabilities through technology.’

The availability of assistive solutions varies by disability type, school grade level and country. In low- and middle-income countries, the availability of assistive solutions is limited, but there are free initiatives to support creative and cooperative learning environments and promote the inclusion of students with disabilities. Initiatives to support digital inclusion and the appropriate use of AT for learning include, but are not limited to, [Google accessibility tools](#), [Apple accessibility tools](#), [Microsoft accessibility tools](#) and [W3C](#).

Key Recommendations

Resource centre leadership teams should:

- Establish a clear procedure for selecting AT for students that is based on constructive dialogue between the end-user, parents (caregivers) and one or more professionals (educators, physicians, rehabilitation psychologists, physical and occupational therapists, etc.).
- Select and purchase technological solutions, including standard ICT and AT, according

to the needs of the centre, placing a particular focus on SEN and the age of the target group of students and established educational goals.

- Ensure the establishment, installation and maintenance of technological solutions are in line with the centre’s goals and activities.
- Provide a high-speed internet connection (both hard-wired and wireless connection) where possible.
- Provide a local network in the centre that reflects environmental conditions and administration and educational demands.
- Establish a technical support team, which will support technology integration into the educational process, and plan and leadership demands associated with technical upgrades.
- Consider cybersecurity issues in line with international and national requirements.

ICT & AT
COMPETENCY DEVELOPMENT
AND NETWORKING FOR TEACHERS

2.1. Teachers' ICT competency development

Basic ICT literacy can be seen as a prerequisite for education for all in the digital age. However, it is important to note that ICT competency is more than simply the ability to find, evaluate and communicate information by typing and using various digital platforms. It involves 'the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), intellectual property related questions, problem solving and critical thinking' (Council of the European Union, 2018).

The application of advanced technologies and AI in inclusive education to perfect learning outcomes requires the continual upgrading of specialists' experience and qualifications, access to expert knowledge and guidance, and access to professional advice to provide learner-centred education. All professionals working in the domain of inclusive education should be properly supported to help them use innovative ICT tools and AI to widen participation and increase learning opportunities for learners who have disabilities. The [UNESCO ICT Competency Framework for Teachers \(ICT-CFT\)](#) can be used as a first step to guide pre- and in-service teacher training on the use of technologies across the education system. Another good resource is the [European Digital Competence Framework for Educators \(DigCompEdu\)](#). It has integrated facets of inclusion at different competence levels. Teachers and other relevant professionals must

be aware of both the possibilities and the limitations of access through digitalization when they are choosing and creating resources and reflecting on strategies for providing equal access to digital education (Punie and Redecker, 2017).

While ICT competency is important for all educators, it is particularly important for subject teachers. They are primarily responsible for learners' skills development, and so they need guidance and skills to develop inclusive digital approaches to learning. Findings from research studies and communities of practice (CoPs) can be very helpful for this.

2.2. Teachers' competency development in the use and application of assistive devices and tools

All education professionals should receive training in general ICT competency development. Training opportunities on accessibility should be available for the various professional groups in an RC through the ICT ecosystem. General approaches to accessibility training opportunities for educators should include the following:

- Basic training on the accessibility features of traditional PCs and mobile devices (using accessibility features to adapt the device in accordance with the end-user's needs).
- Professional training in the application of AT in education.

For basic training, various corporations and non-governmental organizations (NGOs) have developed trainings and guidelines on accessibility features to aid access to education and information among persons with disabilities.² For professional training, many professional associations and experts have developed

² Trainings and guidelines are available on the websites of organizations such as Google, Apple, Microsoft and W3C.

recognized AT training programmes. Useful training courses are available at [Coursera](#), [edX](#), [Khan Academy](#) and other online platforms.

The [United Nations System](#) places special emphasis on accessibility issues and trainings.

WHO has produced multiple reports and trainings on accessibility. The WHO online course 'Training in Priority Assistive Products' (TAP), for example, is designed to prepare staff to assume an AT role. The responsibilities of this role could include identifying people who might benefit from AT; providing simple assistive products such as magnifiers and transfer boards; and making referrals for clients for more complex products and services. The training blends online learning with a practical component supervised by local mentors. The provision of simple assistive products, as taught in the course, follows a four-step process: select, fit, use and follow up. TAP is a flexible, modular training resource that can be tailored to accommodate the needs of local health systems. For example, in Papua New Guinea, nurses and nurse assistants in primary health facilities learned to use TAP to screen their patients for vision, mobility and self-care needs. They also learned how to provide appropriate simple assistive products. With the support of national tertiary-level vision and mobility device services, these primary health care personnel are now able to provide reading glasses, walking aids, and toilet and shower chairs. They also have a better understanding of referral pathways and can refer people who would benefit from tertiary-level rehabilitation or [AT services](#).

The International Telecommunication Union (ITU) developed a set of self-paced online modules for a training course titled '[ICT Accessibility: The Key to Inclusive Communication](#)'. This course is designed to develop a good understanding of ICT accessibility among all relevant stakeholders, with a particular focus on related policies,

regulations, technology trends and public procurement rules. The modules are titled 'Enabling Communication for All through ICT Accessibility', 'ICT Accessibility Policy Regulations and Public Procurement Standards' and 'Achieving ICT Accessibility through Public Procurement'.

UNESCO recognizes that achieving inclusive and sustainable societies as presented in the 2030 Agenda requires urgent changes to eliminate persistent disparities in education access and achievement, improve educational quality and provide learners with the knowledge, skills, attitudes and behaviours they need to succeed in the modern world.

IITE is contributing to the implementation of the UNESCO strategies on education through two training courses on ICT for inclusive education: 'Introduction to Inclusive Education with ICT' and 'Open and Distance Learning Solutions for Students with Disabilities'. The training materials cover pedagogical aspects of ICT, AI and the application of AT. Both courses are available at the [UNESCO IITE E-library for Teachers](#) platform.

2.3. Support for practice

• Identifying and sharing best practices

National agencies are being asked to increase their research into the use of digital technology, obtain evidence of the effectiveness of policies and practices, and evaluate the impact of the current initiatives, interventions, programmes and emerging perspectives for learners with disabilities. We recommend that ICT RCs follow the so-called user-involved and user-centred approaches in the search for new inclusive digital tools that are appropriate for learners with disabilities. Research and database systems that monitor the results of ICT integration into inclusive education are useful for identifying best

practices and model approaches to networking. Research labs, knowledge-sharing platforms and CoPs can facilitate the widespread application of well-documented best practices.

• **Promoting networking**

Networking is an important factor for effective inclusion. A network is basically a community of people, organizations or both that come together to pursue common interests and goals. Networks can be organized in many ways, from highly formalized (detailed constitution, rules and regulations) to very informal (flexible, with agreed-upon rather than written rules, or without strict regulations).

Networks usually have three main types of activities:

1. **Communication:** Activities to communicate with stakeholders to keep them informed about the network's activities and the results of those activities. Regular newsletters, briefings, a website, social media accounts, etc. are all good ways of communicating within a network.
2. **Consultation:** Activities to enable stakeholders to give feedback to the network and offer ideas for accelerating progress towards the achievement of its goals — for example, meeting regularly with stakeholder groups, holding discussions with external organizations, seeking stakeholder views and opinions through feedback forms, comment boxes, etc.
3. **Participation:** Activities to encourage and enable stakeholders to become involved in the work of the network — for example, becoming a member of, or adviser to, its governing body or mentoring new or less experienced members of the network.

RCs can play a vital role in network development as educational hubs by supporting research

activities, promoting workshops and discussions, facilitating knowledge exchange and raising awareness of the impact of ICT and AI on the achievement of equitable quality education for all. The main goal of promoting ICT RCs in inclusive education is to combine innovative technology with a new pedagogy to achieve digital inclusion and adequate opportunities for an appropriate education regardless of capacity, circumstances and conditions. To achieve this goal, educators need systematic support and regular trainings in digital technology and pedagogy from experienced supervisors.

Key Recommendations

Educators and trainers should:

- Acquire basic digital ICT and AT competencies, including accessibility knowledge, and periodically update them, and have access to opportunities for practical experience in the use of technologies in inclusive learning environments.
- Learn how to design accessible online services and lessons.
- Learn about copyright and data protection.
- Increase their awareness of different technologies, platforms and accessibility tools that could improve their practice.
- Collaborate with parents (caregivers) and peers while using new technologies to demonstrate progress and to ensure support for a student and increase their motivation.
- Share with colleagues and the wider educational community the examples of the positive impact that digital assistive technology can have on individuals with disabilities to assist them to be more independent and build digital skills.

**ENSURING ACCESS AND EQUITY
IN EDUCATION WITH ICT AND AI:
MEETING THE INDIVIDUAL NEEDS
OF STUDENTS
WITH SPECIAL EDUCATION NEEDS
AND DISABILITIES**

3.1. Selection of educational approaches, methods and tools to foster the education of students with disabilities or SEN

Every teacher involved in inclusive or special needs education must be aware of the students' needs and put in place all the necessary accommodations listed in the students' IEPs. Those accommodations will require the use of various tools, including assistive and instructional technologies.

- AT is used to promote access to information and learning, correct functional limitations, facilitate skills development, and support communication and interaction.
- Instructional technologies include applications and technology-based supports helpful for instruction and learning — for example, content enhancements or tools for explicit and online instruction.

To conduct appropriate diagnostic interventions and monitor the progress of students with disabilities and SEN, teachers can approach assessment not as an isolated procedure but as a continuous process within the regular monitoring process. When learning problems are detected early, teachers can step in and make the appropriate changes to IEPs and continue to help students. When problems are not detected early, specialist intervention will become more likely and students will be at higher risk of failing. While assessment may not prevent a child from failing, it establishes a path to mitigate the emotional and motivational repercussions of learning setbacks. Therefore, the focus of an assessment must be on understanding the problems affecting students' overall behaviour and constructing specialized intervention methods.

3.2. Facilitating digital inclusion through a learner-centred approach

To support the social engagement of students with special learning needs and help them successfully acquire relevant knowledge and skills, education policies and initiatives should embrace an interrelated set of principles related to technology use. Effective digital inclusion based on a learner-centred approach will improve the quality of and access to education, ensuring access to education for all learners anytime, anywhere and contributing to the health and well-being of children and youth.

Learner-centredness applies to teaching approaches, attitudes and relationships. A variety of methods and approaches for technology-assisted inclusive practices, based on the learner-centred approach, have been proposed. Some examples are described below.

• Adaptive learning

The best instructional strategy to meet the particular learning needs of students with disabilities is to provide customized learning support or adapt the available learning materials (Sharif and Elmedamy, 2022).

Teachers can integrate technology into their classroom practice to teach social-emotional learning (SEL), emotion management and relationship skills. Using AI in the classroom makes it easier to accommodate and meet the needs of different SEN. For example, certain AI can 'explain' the meaning of a facial expression in words or by means of an emoji to a child with communication challenges; some apps can provide immediate translations between a wide range of languages; and chat apps can help students who have autism spectrum disorder (ASD) communicate and interact. Students with attention deficit hyperactivity disorder (ADHD)

or physical disabilities can all benefit from the use of augmented reality (AR) and virtual reality (VR). For example, AR/VR can help improve the memory and concentration skills of children who have ADHD, and certain games can help students with physical disabilities improve their hand-eye coordination and fine motor skills or participate in virtual field trips (Lamsa et al., 2018). Overall, the gamification of class activities makes students more engaged in classroom activities (Moreland University, 2023).

- **Facial expression analysis**

Teachers need to ensure that students with disabilities are participating in class. AI-based facial expression analysis can help them do this. Tools such as the Bag of Features (BoF), Speeded Up Robust Features (SURF), support vector machines and convolutional neural networks (CNN) can detect changes in students' facial expressions and provide important data to teachers (Ouherrou et al., 2019).

- **Social-emotional development**

When students with disabilities have technology-based learning support, they tend to be more enthusiastic about participating in class. Technologies can generally transcend physical boundaries, and so they have the potential to expand access to education and promote independent learning among students. They can also help increase students' self-efficacy, confidence and self-esteem (Chiang and Jacobs, 2010; Ghazi Abed, 2018; Harper et al., 2016). Furthermore, technology-based asynchronous communication facilitates more efficient and flexible communication between students with disabilities, teachers and students who do not have disabilities and promotes the development of social skills. Commonly used hardware devices for this purpose include key guards to improve typing

accuracy, individual switches, trackballs and other specially designed items such as head- or eye-pointing systems for students who have difficulty typing. Communicating via email or in online forums not only helps ease communication problems but also helps minimize, or even prevent, psychological problems caused by insufficient communication, such as low self-esteem and loneliness.

- **Monitoring progress and tracking performance**

Technology enables teachers to collect data instantly. Teachers can choose from a wide range of online progress-monitoring tools to help them track and monitor student progress. These tools can be used to input data on student performance, generate reports and share progress with parents (caregivers) and other members of the school team. It is helpful to use a variety of monitoring tools to create a more comprehensive view of a student's progress. Students with disabilities can use mobile devices such as tablets and mobile phones/smartphones for self-monitoring. Self-monitoring increases academic productivity and attention skills.

- **Enhancing reading skills**

Assistive reading and writing apps (primarily with TTS and speech-to-text [STT] functions) can help students with disabilities improve their reading comprehension. For example, Android Reading Mode and ALEXZA are mobile apps that allow users to customize their reading experience. The apps can read text out loud, but users can also choose to have text presented in chunks or highlighted on screen, to name only two options. These apps are very helpful for students who have dyslexia, low vision or a developmental language disorder (DLD) (Abdul Hamid et al., 2018a, 2018b; Bjekić et al., 2012; Nordstrom et al., 2018; Rajapakse et al., 2018).

• Enhancing writing skills

Persons with disabilities can choose from a selection of tools to help them proofread and polish their writing. For example, Kurzweil 3000 is a program that checks spelling and offers other literacy-based help. The Livescribe Pen (LSP) program offers learners suggestions on developing their vocabulary, manages texts with bullet points and writes in a comprehensive manner. Word processing tools such as word processors and TTS programs are also reliable tools that support and enhance the writing of learners with disabilities. Teachers have continuously confirmed that students with disabilities improve their reading comprehension and vocabulary, both of which are essential for high-quality writing, when they have technology-based support.

3.3. Assessment methods

The individual approach in inclusive education is based on the use of multiple modalities — for example, visual, auditory and haptic — and applies to not only the methods of presentation but also appropriate methods of assessing and evaluating students.

Assessment can be categorized into two main types: summative and formative. Summative assessment is primarily about creating a formal record of students' progress in relation to a specific stage of the curriculum. It can be carried out by watching students while they work or using the results of tests, examinations or statutory assessments such as Standardized Achievement Tests (SATs). Formative assessment represents a continuous evaluation process and is used to provide the necessary feedback for supporting students' learning and understanding. The assessment methods described below illustrate how ICT can be used in formative assessment:³

- Real-time communication and interaction: Zoom can be used to assess students' daily progress based on real-time communication. For example, the teacher can ask questions and see how each student responds. Teachers can also use Zoom to monitor their students while they work to see how they are learning and behaving, and adapt the learning content accordingly if necessary.
- Simple projects/assignments: WeChat parents groups can be used to assign homework tasks for children (such as dressing, making their bed, etc.). Parents are responsible for uploading videos of their children after they have completed these assignments. Meanwhile, teachers can provide encouragement or suggestions so that children will continue learning during these activities.
- Quizzes: Kahoot! can be used to create simple quizzes for an easy interactive learning experience for students.
- Open-book exams: Open-book exams are a useful tool when assignments are provided online and students can refer to their learning materials (e.g. courses) to find the answers. This approach to assessment can encourage students to participate more actively in their learning and indirectly practise their literacy skills.

Key Recommendations

Educators should:

- Ensure all students with disabilities receive an appropriate initial assessment so that they have full access to learning programmes that reflect their needs.
- Take a personalized approach to providing ICT-enhanced education and evaluation activities.

³ Adapted from Huang et al., 2020.

- Provide students with opportunities to develop the skills and attitudes they will need to use new technologies successfully.
- Respect all students' learning styles and capabilities and use technologies and digital materials accordingly.
- Ensure assessment and evaluation approaches are accessible, relevant and based on the use of relevant technologies and materials.
- Use a variety of ICT-based methods and approaches while rewarding students' achievements and identifying both gaps and progress.
- Consider ethical, legal and safety issues when promoting ICT literacy among students.
- Provide opportunities for students with disabilities to maintain their health and well-being during the educational process.

CONCLUSION

While ICT can be empowering, opening up extra opportunities for life and education that might not be otherwise accessible, it can also create barriers that hamper the social inclusion of persons with disabilities and SEN. If a particular technology or service is not adapted to meet the needs of certain groups within the wider community of persons with disabilities, and if information is presented in a way that excludes some stakeholders, the digital divide will widen and intensify social exclusion.

The focus of education systems today is on inclusive education with an emphasis on technology-based inclusive teaching and learning, social integration and vocational education and guidance. Assistive and instructional technologies can help address accessibility and availability issues and mitigate the negative impact of the difficulties some students face.

To reduce the digital and educational divides and achieve systemic change, adequate policies must be in place. The current recommendations for systemic transformations include using RCs to provide inclusive digital education, identifying which activities contribute most effectively to the creation of an impactful ICT infrastructure, developing competency in ICT and AT and promoting the adoption of accessible learning environments that meet the needs of persons with disabilities. However, we will not achieve long-term objectives and sustainability by simply following these recommendations. Monitoring, evaluation and relevant continuous improvements will be critical to facilitating ongoing improvements in policies relating to the use of ICT in inclusive education — and subsequently, the quality of education for persons with disabilities. Everyone involved in this process must reflect on lessons learned and put those learnings into practice.

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