ASSISTIVE TECHNOLOGY TO SUPPORT INCLUSIVE EDUCATION

Series Editor Chris Forlin
Edited by Dianne Chambers

INTERNATIONAL PERSPECTIVES ON INCLUSIVE EDUCATION

VOLUME 14

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ASSISTIVE TECHNOLOGY TO SUPPORT INCLUSIVE EDUCATION

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SERIES EDITOR PREFACE

Series Introduction Volume 14 edited by Dianne Chambers

The adoption internationally of inclusive practice as the most equitable and all-encompassing approach to education and its relation to compliance with various international declarations and conventions underpins the importance of this series for people working at all levels of education and schooling in both developed and less developed countries. There is little doubt that inclusive education is complex and diverse and that there are enormous disparities in understanding and application at both inter- and intracountry levels. A broad perspective on inclusive education throughout this series is taken, encompassing a wide range of contemporary viewpoints, ideas and research for enabling the development of more inclusive schools, education systems and communities.

Volumes in this series on *International Perspectives on Inclusive Education* contribute to the academic and professional discourse by providing a collection of philosophies and practices that can be reviewed considering local contextual and cultural situations in order to assist governments, educators, peripatetic staffs and other professionals to provide the best education for all children. Each volume in the series focusses on a key aspect of inclusive education and provides critical chapters by contributing leaders in the field who discuss theoretical positions, quality research and impacts on school and classroom practice. Different volumes address issues relating to the diversity of student need within heterogeneous classrooms and the preparation of teachers and other staffs to work in inclusive schools. Systemic changes and practice in schools encompass a wide perspective of learners to provide ideas on reframing education to ensure that it is inclusive of all. Evidence-based research practices underpin a plethora of suggestions for decision-makers and practitioners, incorporating current ways of thinking about and implementing inclusive education.

While many barriers have been identified that may potentially constrain the implementation of effective inclusive practices, this series aims to identify such key concerns and offer practical and best practice approaches to overcoming them. Adopting a thematic approach for each volume, readers will be able to quickly locate a collection of research and practice related to a topic of interest. By transforming schools into inclusive communities of practice, all children can have the opportunity to access and participate in quality and equitable education to enable them to obtain the skills to become contributory global citizens. This series, therefore, is highly recommended to support education decision-makers, practitioners, researchers and academics, who have a professional interest in the inclusion of children and youth who are marginalising in inclusive schools and classrooms.

Volume 14 in the *International Perspectives on Inclusive Education* series provides a wealth of ideas, research and practice about the use of assistive technologies to support inclusive education. Technology is no longer considered a novel option but is seen as fundamental to supporting inclusive education. The use of technologies encompasses all stakeholders including school staff, parents and the students themselves. Without guidance, though, participants may be faced with decisions about appropriate selection and application of technologies for which they are not prepared. The strong emphasis in this volume specifically on how existing and emerging technologies can be used to support inclusive education provides much needed guidance and direction for all involved with inclusive practices.

Technologies have the capacity to inspire teachers, parents and students to become inventive, imaginative and creative. At the same time, they can also instil fears or anxiety if the user is unfamiliar with the technology or feels threatened by it, due to a lack of knowledge or understanding about how it can be best used to support a child. This volume carefully addresses this issue empathetically by having a very strong focus throughout on presenting the use of technologies in a clear and concise way so that regardless of prior experience the reader will be able to gain a better understanding of what works best in which situation. Each chapter incorporates best practice approaches that are practical and authentic in the use of assistive technologies for supporting learning for all children and youth. The highly acclaimed internationally representative authors go beyond the initial identification of options to exploring the reality of how these may be best applied in the inclusive classroom to enable improved and effective access to the curriculum regardless of student need.

The myth that more expensive technologies are always best is defuncted. Low-, mid- and high-technology alternatives are all considered as to their effectiveness depending upon the need of the child and the availability and sustainability of introducing more complex equipment in schools. This volume specifically considers how technologies may be identified, selected and used effectively across a range of diverse contexts within developed and less developed countries.

Not only do the authors in this volume identify and evaluate the usefulness of a range of assistive technologies for supporting learners to access the curriculum, but also they consider the sustainability of use. Providing appropriate services to schools to support the use of technologies is a critical aspect of selection and application. The authors address this through discussing a variety of approaches that can be employed to provide support across both city and more remote districts. Information on establishing support networks and monitoring and evaluating their effectiveness are all included and provide extremely useful models for ensuring that assistive technologies can sustain the purpose for which they are being introduced.

While the emphasis in this volume is on the use of assistive technologies for supporting academic learning for children and youth with special educational needs, the importance of technology for social inclusion is also paramount. The authors throughout this book offer a valuable balance between how assistive technologies can assist in supporting learners to access the curriculum while also

encouraging and supporting the development of distinctive and unique personalities. In many instances, technologies are key elements for enabling effective communication and social interactions within families and with teachers and other support staff. Of equal importance is that choosing the correct communication device will encourage independence and peer interaction, thus allowing the social-emotional development of individuality and preparation for living in society.

I unequivocally endorse Volume 14 for all school staff, district coordinators, peripatetic personnel and parents who are engaged with finding the best assistive technologies to support their learners with special educational needs. This volume will also appeal to university academics, students and researchers who are tasked with understanding best practice technologies for preparing them to work within inclusive schools. Within the book, selected chapters enable the reader to choose a specific area of interest and to locate best practice ideas grounded in research, as explored by leading international and local experts in the field of assistive technologies. This volume will be an excellent resource across many disciplines and international regions.

Chris Forlin
Series Editor

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ASSISTIVE TECHNOLOGY SUPPORTING INCLUSIVE EDUCATION: EXISTING AND EMERGING TRENDS

Dianne Chambers

ABSTRACT

This chapter describes assistive technology (AT) and inclusive education and examines the juncture where AT works to support the inclusion of students with disabilities in mainstream settings, including classrooms, home and community settings. AT consists of a range of devices and services which work to support students to augment existing abilities, compensate for or bypass difficulties they may experience. Some AT has been specifically developed for functional use, while other, particularly emerging technology, can be adapted for, or used, in an assistive capacity. Where the AT promotes social interaction, curriculum access and the ability to express understanding, there is the potential for heightened inclusion in the classroom.

Keywords: Assistive technology; inclusion; inclusive; education; practices; belonging; students with disability

INTRODUCTION

It is evident that the impetus to include students with disabilities in mainstream settings is continuing to gain momentum in both developed and developing countries around the world (Forlin & Chambers, 2017; UNESCO, 2019). Along with this drive is the requirement for teachers, schools and school systems to plan for, teach and evaluate all students in a manner that is appropriate to meet their needs, regardless of their circumstances (Ministerial Council on

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Education, Employment, Training and Youth Affairs, 2008; UNESCO, 2009, 2019). A combination of the increased inclusion of students with disabilities, and the need to address all students' needs effectively, has led to the development of an internationally supported framework for appropriate curriculum design, Universal Design for Learning (UDL) (CAST, 2020), which includes a focus on the use of technology to ensure access by all students is attained. Using AT and UDL to promote inclusive education will be examined. In addition, the development and implementation of international and national legislation and policy in many countries has also reinforced the use of AT for inclusive education. These will be discussed further later in the chapter.

Technology is integral to many inclusive education strategies used to enhance students' learning. In particular, AT can be utilised to support students with a variety of needs in areas as diverse as physical disabilities, intellectual disabilities, neurological (cognitive) disabilities and sensory disabilities (Chambers, 2019). This chapter will define and describe both inclusive education and assistive technology (AT) and discuss the role they play in ensuring that students with disabilities receive the best possible education which prepares them for a full, active and involved life in school and the community. In addition, it will highlight the range of technologies available, including emerging technologies which are specifically developed for people with disabilities or which have potential to be utilised as assistive devices.

ASSISTIVE TECHNOLOGY

In many countries AT is gradually finding its way into regular classrooms to support the learning needs of students with disabilities. In addition to learning, AT is a tool for communication, social interaction and physical access to resources (Koch, 2017). A wide variety of AT can be utilised by staff and students. The selection of AT, along with appropriate services and supports, is of vital importance to ensure that students not only learn and communicate with peers and teachers but also are welcomed as part of a mainstream classroom, with similar expectations and considerations as their peers. While some schools and teachers embrace AT to support students with disabilities, others are yet to see how the technology enhances inclusive education for these students (Schaaf, 2018).

Defining Assistive Technology

While there is no standard, agreed-upon definition for AT, one often cited in research is that embedded in legislation from the United States, the *Individuals with Disabilities in Education Act* (IDEA, 2004) describes AT as

> …any item, piece of equipment or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of children with disabilities. (Section 300.5)

While broad, it is a beginning around which to start a conversation about AT. The UNESCO Institute for Statistics (2019) also uses this definition in relation to

the Sustainable Development Goals for education and literacy. Defining AT is often important for funding purposes, and the above definition is broad enough to encompass a wide variety of devices, ranging from no or low-tech to high-tech devices. The reference to the functional nature of the AT is also important to note, as this should be a primary consideration in selection and use. The AT should have a defined purpose and role in the educational setting for the student and should also enhance their daily functioning (e.g., communication device, wheelchair). There are a range of AT devices that exist on a continuum as illustrated in Fig. 1. Those responsible for the selection of AT devices should consider the full continuum of AT (beginning at the low-tech), rather than simply choosing the most high-tech device available. Low- or mid-tech devices and programmes are generally more obtainable and simpler for the teacher to use (Shaw, 2016).

Low-tech Assistive Technology

No or low-tech AT consists of devices and tools that support the student, but that do not require extensive training or high cost and which are often easily accessed and replaced (Chambers, 2019). In many ways, low-tech devices are highly suitable for any setting and may be of value in regions where access to high-tech devices is difficult and too costly, for example, in some parts of India, Bangladesh and Africa (Ismaili & Ibrahimi, 2017; Matter, Harniss, Oderud, Borg, & Eide, 2017; Scherer, 2019). Low-tech devices include pencil grips, graphic organisers, adapted paper and highlighting pens and incorporate specially made devices that have specificity for an individual's needs. These devices may include iPad supports/stands (Wilkomm, 2014), plastic cups with a rounded section removed for a person who cannot tilt their head, foam page-turning supports and individualised visual schedules (van Niekerk, Dada, & Tönsing, 2019). Low-tech devices have many benefits including their accessibility for all and the ease with which they can be replaced, generally requiring no maintenance or training to use. When considering the use of AT, low-tech devices should be considered first to determine if they would meet the students' needs, rather than investing in costly devices that may address the same function for the individual.

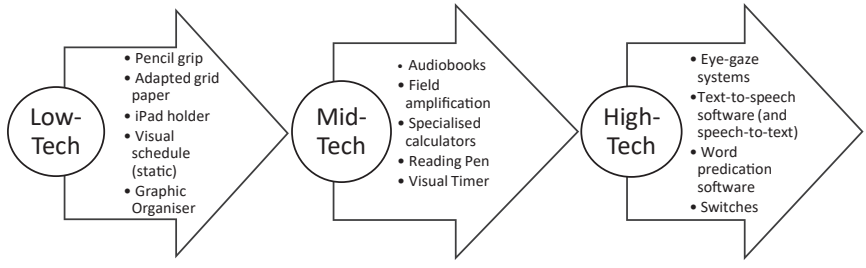

Fig. 1. Continuum of Assistive Technology (Examples Only).

Mid-tech Assistive Technology

Mid-tech devices are those which do not generally require extensive training to use and are reasonably priced. They have a power source (often using batteries) but are not overly complex (AdaptABLE World, 2012). Examples of mid-tech devices include single-phrase communication systems (i.e., GoTalk™) and digital recording devices. Other mid-tech devices include enlarged or talking calculators, electronic visual timers (i.e., TimeTimer™) and audiobooks. Some technology, such as tablet devices, may also be included in the mid-tech category, as they may be used without extensive training and have a power source. These devices may be considered high-tech if the user must programme the device, as is the case if a more complex communication system is required (e.g., Proloqo2go™). Mid-tech devices should be considered after determining that there is no low-tech device available to meet the functional needs of the individual.

High-tech Assistive Technology

High-tech devices are generally best suited for people with significant disabilities or who have extensive functional needs (Conderman, 2015). High-tech AT generally requires training and is often more costly than low- or mid-tech devices. Due to the more complex needs of the individual, the devices are designed to ensure that even those with minimal movement or control over their bodies can communicate or adjust their environment (AdaptABLE World, 2012). High-tech devices include computer mouse alternatives such as eye-gaze systems and head pointers, environmental controls such as powered wheelchairs with navigation software and room controls, speech-to-text (and text-to-speech) software and complicated communication systems that may be accessed using alternative controls. High-tech AT may be difficult to access due to the high cost. The high cost is often as a result of the (relatively) small market and the large research and development costs that are incurred in the design and manufacture of these devices. New technologies are emerging all the time and, as can be seen by the rise in tablet technology combined with affordable software for communication, may assist to overcome some of the cost issues in future.

It is important to note that even if a high-tech device is selected for use with an individual, a low-tech alternative should always be available in case of technological difficulties (Chambers, 2019; Conderman, 2015). A low-tech alternative for a communication device may be picture cards or a communication placemat, which can be used if a device is broken or suddenly runs out of power. Another example includes a manual wheelchair to temporarily replace a powered chair that has malfunctioned or run out of power and is not able to be charged immediately.

Selection of Devices

The selection of devices requires the person determining the selection to have appropriate knowledge of the device and also sufficiently detailed knowledge of the needs of the individual, while working collaboratively with all stakeholders to

ensure appropriate match for the individual (Conderman, 2015; Scherer, 2017, 2019; Wong, 2018; Zabala, 2005). There are many considerations when selecting AT, including the:

- Budget available and cost of the technology;
- Scope of training that may be required by the user and facilitator;
- Environment in which the AT will be used;
- Capacity to modify or personalise the AT;
- Preferences and attitudes of all stakeholders towards the use of the AT (Bouck, 2016; King-Sears & Evmenova, 2007; Scherer, 2019; Simpson, McBride, Spencer, Lowdermilk, & Lynch, 2009).

The selection of AT is very much an individual experience as some of these considerations will be of greater importance to the individual user and their environments than others.

To assist in the selection of AT, there are several models and frameworks that are available to those involved in the selection process. The use of these is dependent upon the needs and experience of those selecting the AT and the time available to them (Wong, 2018). A popular model used by teachers and schools to determine AT tools which are appropriate is the SETT (Student, Environment, Task, Tool) framework (Zabala, 2005, 2010). The Matching Person and Technology (MPT) model (Scherer, Jutai, Fuhrer, Demers, & Deruyter, 2007) is another commonly used model and describes the personal and environmental factors which must be considered when selecting the devices. Personal factors include the resources (family and financial) that are available to the person, their expectations of the AT and their personal preferences. Environmental factors include the cultural expectations, legislation and policy and attitudes towards AT of other key stakeholders. In addition, a functional assessment of need and an assessment of the individual's predisposition towards the technology are also conducted. Together, the information obtained allows a selection to be made which will potentially have the best outcomes for the individual using the AT.

As a result of legislation and the requirement to consider AT in a student's individual education programmes (Jones & Hinesmon-Matthews, 2014), the United States has many state-based AT centres/institutes that have produced guidelines and frameworks to support teacher and school choice and the implementation of AT. Many of these centres have produced varying forms and guidelines to assist teachers and schools through the process of selecting and implementing AT. Some of these programmes include the Wisconsin Assistive Technology Initiative (WATI, 2018); the Kansas Partnership for Accessible Technology (KPAT) (Office of Information Technology Services, n.d.) and the University of Kentucky Assistive Technology project (UKAT) (University of Kentucky, 2003). The resources produced consist of checklists and guidelines for teachers and schools. These are freely available and are worthwhile examining for those who are new to the area of AT selection and use or those who would like to extend their knowledge. The range of frameworks and selection processes allow

practitioners to select one (or a combination) that best suits their situation (Marino, Marino, & Shaw, 2006).

Assistive Technology Service and Supports

In addition to the devices, services to support the selection, use and maintenance of devices are essential to avoid misuse, underuse or abandonment of the AT (Federici & Borsci, 2016). Similar to instructional technology, which requires appropriate pedagogy, teacher training and support to be utilised successfully in the classroom (Magana, 2019), successful AT use also requires that teachers are supported and assisted in ensuring it is used to best effect. Services to support AT are described in the USA Assistive Technology Act of 2004 as any service which assists the person with a disability to select, acquire and use a device (P.L. 108–364, Section 3). Tasks that are described within the services area include evaluation of functional need of the individual, purchase, loan or acquisition of the technology by the service for the individual, customisation, repair and fitting of devices, coordination of therapists or other services, training for all stakeholders and increasing access to technology.

The services which surround the students with disabilities are vital to ensure that they are provided with appropriate AT and that their use is supported. Arthanat, Elsaesser, and Bauer (2017), in a review of AT service providers in the United States, report that training is an area that requires attention, with many service providers rating their professional education in the area of AT as inadequate. Similarly, Federici and Borsci (2016) found that in Italy, AT service provider procedures, including follow-up after consultation, impacted on the abandonment of AT devices. They advocate a person-centred approach to services to ensure that the individual is not only matched to the technology, but also that the services are provided appropriately based on need. The World Health Organisation [WHO] (2015) notes that lack of services, particularly in less developed countries, is a significant barrier to the use of AT and that access to AT is 'one of the most important requirements for children with disabilities to flourish…' (p. 7).

Emerging Assistive Technology

Technology is advancing at a rapid rate, with new advances and upgrades in technologies becoming available at increasing regular intervals (Forbes Technology Council, 2018). These advances bode well for people with disabilities, as the advances also occur in the area of accessibility and, subsequently, AT. Mainstream technologies being developed are also increasingly looking to include all potential users, making the need for separate assistive devices and tools less necessary (Ismaili & Ibrahimi, 2017). This development has a twofold benefit. Firstly, it means that the technology is mainstream so that students in educational settings are not seen as 'different' to their peers, potentially enhancing acceptance of the AT and social outcomes. Secondly, the costs of the technology are reduced by economy of scale; the more devices produced, the lower the cost (Amadeo, 2019). Amadeo, for example, suggests that costs of manufacturing fall 70%–90% when production output is doubled.

Many mainstream technologies, developed to make tasks easier for people without disabilities, may be utilised as ATs for those with specific functional needs. A common example is the use of speech-to-text recognition software. This software began to be developed as far back as the 1950s (Kikel, 2019); however, it has now advanced sufficiently to be used as a voice assistant (e.g., 'Hey Siri', 'OK Google'), for environmental control and for communication purposes. In the educational sector, speech-to-text recognition software, which automatically displays the speech on a personal device or the whiteboard, allows students who are deaf or students with English as a second language to 'see' what is being said by the teacher (Shadiev, Hwang, Chen, & Huang, 2014). Shadiev et al. (2014) suggest that use of the speech-to-text recognition software also aids in deeper comprehension of the material being delivered. Writing using speech-to-text recognition software supports those with motor difficulties to be able to complete assessments and to communicate more rapidly and effectively with others through email and social media.

Ludlow (2014) has written an interesting editorial on the 'blurring of the lines' between assistive and mainstream technology, and she suggests that perhaps people with and without disabilities are moving closer to integrating with technology so that it becomes a seamless part of everyday interaction. This thought is echoed by Dale and Grut (2015) who worked with students with attention deficit hyperactivity disorder and mainstream devices and software to assist students to plan, organise and manage activities during the day. While there were some difficulties in ensuring the technology worked appropriately, they also found some encouraging indicators that mainstream technology could be used to support daily living activities.

In addition to the more ubiquitous mainstream technology that can be used in an assistive capacity, other more readily available (but with potential use not always fully recognised) technology includes virtual reality (VR), augmented reality (AR) (Bonasio, 2019) and artificial intelligence (AI) (Aglio & Aglio, 2019). However, without effective integration into the pedagogical practices of the classroom, these technologies may not have great impact on the learning in a classroom (Magana, 2019). Bonasio (2019) suggests that the use of immersive technologies, such as VR and AR, can '…broadly engage multiple learning and performance systems in the brain in synchrony' (para. 2). This engagement may be beneficial for students who experience cognitive difficulties and ensures a multisensory experience for those who have modality issues. VR used repetitively allows students with autism spectrum disorder to experience and practice social scenarios by enhancing motivation to be engaged with visual scenarios and providing appropriate feedback (Ghanouni et al., 2019).

Brain–computer interfaces (BCI), such as those that allow wheelchair or keyboard access via electroencephalogram (EEG), are advancing to the point where they could soon provide greater access to learning for students with disabilities (Millán et al., 2010), particularly when combined with existing AT. This technology will continue to advance to the point where the user will not look any different (a current concern when using BCI) and will be able to have enhanced mobility, communication and socialisation, using their thoughts.

AI is currently used in education mainly in the role of interactive learning environments or one-to-one tutoring, where the technology adapts to the responses from the user (How & Hung, 2019). Timms (2016) identifies two areas of research which he suggests will increase the use of AI over the next 25 years: robotics and 'smart classrooms'. Timms states that the use of robots loaded with AI (he uses the term cobot) in the classroom may be more attuned with people's biological need to interact and be social, making them more effective than a screen interface for learning.

The development of AI 'smart classrooms' centres around the use of sensors and application of the Internet of Things (IoT) to increase access to large amounts of data. The IoT refers to the connections between objects, devices and the people who use them, similar to a smart home. The devices and people who use them '…are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction' (Timms, 2016, p. 707). In education, use of the IoT may take the form of AI responses to learning tasks in the classroom. For example, if students were manipulating tangram shapes on a lightboard to make specific patterns, the shapes could communicate with the lightboard and light up when they were correctly placed, or the board could indicate where a shape might be placed, based on the AI's knowledge of the level of support required by the student. There are many possible applications of AI that may be seen in future settings that support learning and access for students with disabilities.

Technology developments are increasingly evident and many are centred around the needs of people with disability (i.e., prosthetics, communication, mobility) either explicitly or within the technology. Educators should strive to be abreast of the technological advances to ensure that they are addressing the needs of the students in an appropriate manner. There are many web-based organisations that can assist teachers to maintain an awareness of currently available technology (i.e., Ablenet, Independent Living Centres Australia, GATE (WHO)), although many of these are not specifically education-focussed.

INCLUSIVE EDUCATION

Inclusive education is a term used to describe educational environments which accommodate for the needs of all students within mainstream classrooms (UNESCO, 2017). 'Inclusive schools and classrooms should prevent marginalised and excluded groups being discriminated against and denied what is readily available to others in the mainstream' (Forlin & Chambers, 2017, p. 560). There is no singular definition which is used consistently across nations (or even within countries), and as such, there is often debate about the definition of inclusion, inclusive education and inclusivity (Berlach & Chambers, 2011). The Salamanca Statement (UNESCO, 1994) was devised as a result of a meeting of 192 countries in Salamanca, Spain, and suggests that in inclusive schools '… all children should learn together, wherever possible, regardless of any difficulties or differences they may have' (p. 11). Furthermore, inclusive schools need to be able to ensure