

Information and Communication Technology for Inclusion

Research Literature Review



European Agency for Development in Special Needs Education

INFORMATION AND COMMUNICATION TECHNOLOGY FOR INCLUSION

Research Literature Review



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**Lifelong
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This publication has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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Extracts from the document are permitted provided that a clear reference to the source is given. This report should be referenced as follows: European Agency for Development in Special Needs Education (2013) *Information and Communication Technology for Inclusion – Research Literature Review*, Odense, Denmark: European Agency for Development in Special Needs Education.

An electronic version of this report is available on the Agency's website:

<http://www.european-agency.org>

ISBN: 978-87-7110-466-0 (Electronic)

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INTRODUCTION

This literature review is one of the information collection activities within the Agency Information and Communication Technology for Inclusion (ICT4I) project (<http://www.european-agency.org/agency-projects/ict4i>). The main focus of the project is upon country policy and practice for Information and Communication Technology (ICT) in inclusive education settings in the compulsory school sector. An inclusive education setting is understood to be where a learner with a disability or special educational need follows education in a mainstream class with their non-disabled peers for the largest part of the school day.

The ICT4I project activities provide an update to the *Information Communication Technology in Special Needs Education* project that ran from 1999 to 2001 and involved 17 Agency member countries. The project also builds upon work conducted as part of the practice review on the use of *ICTs in Education for People with Disabilities* conducted in 2010/2011 jointly by the Agency and the UNESCO Institute of Information Technologies in Education (<http://www.european-agency.org/publications/ereports/ICTs-in-Education-for-People-With-Disabilities/Review-of-Innovative-Practice>).

This review examines currently available research literature that focuses on the use of technology to support inclusive teaching and learning. It mainly covers school age state funded compulsory education, but also makes reference to research information on wider inclusion and technology issues, in recognition that learning continues outside of formal education. Therefore the use of ICT for inclusion in pre-school, vocational learning, further and higher education as well as lifelong learning settings is touched upon in this review. To complement this research literature review, there is a review of European and International Policy for ICT and Inclusion (European Agency for Development in Special Needs Education, 2013a).

For the purpose of this review, the UNESCO definition of inclusive education is used. Within this definition, inclusive education is considered:

an on-going process aimed at offering quality education for all while respecting diversity and the different needs and abilities, characteristics and learning expectations of the students and communities, eliminating all forms of discrimination (United Nations Educational, Scientific and Cultural Organization – International Bureau of Education, 2008, p. 3).

The main focus of the ICT for Inclusion project – and this literature review – is using ICT to support learning opportunities of any learners. However, a particular emphasis is placed upon the use of ICT to support learners who may be vulnerable to exclusion from educational opportunities.

As a central theme, this review considers the use of ICT as a means to supporting the rights of learners with disabilities and/or special educational needs to education. Article 23 of the United Nations Convention on the Rights of the Child (1989) makes reference to children with a disability and their right to a full and decent life in conditions that promote dignity, independence and an active role in the community. It stresses that governments must do all they can to provide education, free care and assistance to these children.

The United Nations Convention on the Rights of Persons with Disabilities (UNCRPD, 2006) defines a person with a disability as:



... those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others (UN, 2006, p. 5).

Article 24 of the UNCRPD (2006) says that States Parties should provide an inclusive education system at all levels, ensuring that children with disabilities are not excluded from the general education system on the basis of disability and that they are able to access inclusive, quality and free education on an equal basis with others in the communities in which they live. Furthermore, persons with disabilities should receive the support required, within the general education system, to facilitate their effective education, with individualised support measures in environments that maximise academic and social development, consistent with the goal of full inclusion.

The wider recognition of a rights-based approach to inclusive education is outlined in detail in the Agency's recent literature review, Organisation of Provision to Support Inclusive Education (European Agency for Development in Special Needs Education, 2013b), which highlights the challenges and barriers that still exist. The report documents the move from a medical or needs based model to a social model of disabilities where all stakeholders need to identify institutional barriers at all levels (political, economic, social and educational) and ultimately put learners' rights at the forefront of planning and provision.

Across Europe and more widely the term special educational needs (SEN) is used to describe learners who encounter barriers to learning, either temporarily or in the long term. Some may be learners with disabilities or who for other reasons do not make the same level of progress as their peers. Learners with SEN are therefore a wider group than those with disabilities and it is estimated in many countries that they at any one time represent 20% of the school age population (European Agency for Development in Special Needs Education, 2012a).

Throughout this review, it is emphasised that the effective use of ICT for the inclusion of learners with special educational needs (SEN) is widely recognised as good practice, not only for those learners who are formally identified as such, but also for other learners with any form of additional needs.

Methodology

The methodology for this literature review involved systematically searching internet resources, databases of academic research and journal content listings. Searches were also made of relevant websites of the European Union, European Commission, European Council and international sources. Online reports as well as conference papers and theses, where relevant, have also been taken into consideration. Material was organised around a framework of key propositions – outlined below – providing the main section headings for this document.

This literature review focuses on the evidence from research findings. It complements the comprehensive review of international and European policy information, which covered in particular recent Council of Ministers statements and resolutions in relation to ICT (European Agency for Development in Special Needs Education, 2013a) and can be downloaded from the ICT4I project web area: <http://www.european-agency.org/agency-projects/ict4i>

The research literature relating to the use of ICT in inclusive education considered for the review covers international sources (such as UNESCO and OECD work), but also European and national level information from the participating countries (please see below).



The initial search terms used included: ICT for inclusion, accessibility, assistive technology, ICT in education, inclusive education, ICT and special educational needs/disabilities. Initial searches were widened to include specific areas of need and broadened to include major European level reports on ICT in order to identify (or as it proved in many cases the lack of) references to inclusive practice.

Research from 2000 in general terms has been taken into account; however, in recognition of rapid changes in both technology and resulting practice approaches, more recent research from 2008 onwards was given precedent for inclusion in the final report. The focus was on ICT for learners with special educational needs and disabilities, with particular attention to factors influencing classroom practice in using ICT.

Research into assistive learning technologies has grown and diversified significantly since the report by the Agency on ICT in Special Needs Education (European Agency for Development in Special Needs Education, 2001). Now research into specific topics can be found in many journals worldwide and is the focus of many specialist publications from a variety of disciplines. As McKnight and Davies (2012) note, there is an overload of information and as such, literature reviews are invaluable in bringing this together. However, even such review activities are recognised as increasingly becoming almost an impossible task. Edyburn attempted to bring together research into special education technology research and practice into a single publication, but had to abandon this approach in 2005 (Edyburn et al., 2005) and replace it with selective reviews (<https://pantherfile.uwm.edu/edyburn/www/what/background.html>).

It is not possible in this review to include all the research that focuses on all areas of inclusion, social, digital or e-inclusion, and all the groups of learners that may be at risk of being excluded. Hick (2005) brought together many of these aspects but the technology has moved on since then, and other researchers question the nature of the e-inclusion proposing that in many countries it is more about appropriate in-school support and training, rather than physical access to technology that needs to be addressed (Elwick et al., 2013). However, it would be remiss not to acknowledge the importance, and often overlapping nature of these different aspects of inclusion, and the potential ways in which technology can help to provide support. These overlaps will be referenced throughout the report where possible.

Country research information

In addition to the resources – primarily in the public domain and published in English – accessed through desktop research, this review has been supplemented by contributions from Agency member country representatives in the form of English language abstracts of research published in their country's language.

Abstracts were received from Belgium (Flemish speaking community), Cyprus, France, Greece, Italy, Lithuania, Malta, Norway, Portugal, Sweden and United Kingdom (Scotland). The important contributions of Agency country representatives to this activity are gratefully acknowledged.

Nearly one hundred abstracts were provided and most of them have been integrated into this review. The majority of these abstracts focused on the first two themes of this publication – *equity* and *access*. Many of the abstracts provided focused on the use of ICT to support specific special educational needs or disabilities, the use of specific technologies or interventions, as well as a few on teacher education, user education and policy. A number also addressed wider areas of educational inclusion, such as the use of



ICT to support highly mobile learners or those who are in hospital. Very few provided a holistic view of using ICTs in inclusive education.

All of the country research literature abstracts collected during the project are available to download from the ICT for inclusion project web area: <http://www.european-agency.org/agency-projects/ict4i>

Structure of the review

This literature review gathers research findings together under the five key propositions that can be identified within the UNCRPD (2006) in relation to the use of ICTs in education. These five propositions were clearly outlined in the publication *ICTs in Education for People with Disabilities* (European Agency for Development in Special Needs Education and UNESCO IITE, 2011).

They are:

1. ICT should be considered as a key tool for promoting equity in educational opportunities;
2. Access to appropriate ICTs should be considered an entitlement;
3. Training of educational staff in the use of general and specialist ICT must be considered a priority area;
4. The promotion of ICT research and development requires a multi-stakeholder approach;
5. Data collection and monitoring in the use of ICT in inclusion should be considered an area requiring attention at all levels of educational provision.

These propositions were the focus of information collection throughout the ICT4I project and this literature review provides evidence of research that supplement the reports and innovative examples of ICT practice provided by participating countries.

The five propositions form the main framework for the chapters that follow this introduction:

Section 1: Promoting equity in educational opportunities

Section 2: Access to ICT as an entitlement

Section 3: Training of educational staff in general and specialist ICT

Section 4: Multi-stakeholder research and development into ICT

Section 5: Monitoring the use of ICT for inclusion

A final section presents overall conclusions emerging from the literature review.

A full reference list for all resources cited in the review is provided at the end of this document.



1. PROMOTING EQUITY IN EDUCATIONAL OPPORTUNITIES

The use of ICT is widely recognised as an everyday part of many people's lives that has an impact on many aspects of society, including education, training and employment, the economic prosperity of individuals and countries, as well as media, information transfer and leisure activity. Significant effort and investment has been put into maximising the benefits of ICT within education and training across developed and developing nations. As is reported in the review of *European and International Policy for Supporting ICT for Inclusion* (European Agency for Development in Special Needs Education, 2013a) although there are country variations, increasingly the focus of policy is on how to move from a situation where there is a sufficient infrastructure (numbers of computer devices available and widespread reliable high-speed internet connectivity) to one of effective use of ICT by all concerned.

ICT is a particularly valuable tool for people with disabilities and can improve their quality of life, reduce social inclusion and increase participation. This is internationally recognised, as are some of the barriers – social, economic and political – that inaccessible information technology can create (WSIS, 2010).

Balanskat et al. (2006) in their review of ICT impact in schools in Europe, highlight evidence of the impact ICT can have on motivation, engaging low achievers, supporting differentiation and improving behaviour. Blamire (2009) provides extensive evidence that ICT increases learner motivation, confidence and engagement.

UNESCO, in a recent global report (UNESCO, 2013a) dedicated a chapter to using ICTs innovatively in education to improve affordability, accessibility and adaptability. Although the focus is primarily on access to information and knowledge, rather than education per se, it provides a useful analysis of the issues around emerging technologies and the challenge of ensuring that information and content is accessible to people with disabilities. The report highlights that the promotion and use of products that follow open standards can be beneficial in mainstreaming assistive technology and assistive features into products.

Although there is still a recognised digital divide, this is now considered less about having personal access to internet connected technology and more about the skills and digital competencies necessary to maximise the use of digital media (WSIS, 2010). The digital divide does not appear to be closing and education is a key exclusion factor (European Commission, 2008). The report from the European Commission in 2008 highlighted the need to promote e-inclusion, noting that there were at that time 50 million disabled people at risk of e-exclusion and 98 million at risk of poverty, including 10 million working poor and 15 million foreign-born residents.

1.1 Systems of inclusive education

The *Organisation of Provision to Support Inclusive Education* project literature review (European Agency for Development in Special Needs Education, 2013b) highlights that provision to support learners in inclusive settings vary a great deal. The review cites the World Health Organisation (WHO) / World Bank *World Report on Disability* (2011), which suggests that no one model of support is likely to work in all contexts and meet all needs.

The review proposes that there are some overarching principles regarding systems of inclusive education that need to be shared by all countries:



- Support should be provided in the community and not in segregated settings (UNCRPD, 2006);
- Support and services should be person-centred (WHO/World Bank, 2011) so that individuals with disabilities are more involved in the process of decision-making concerning the support they need (UNCRPD, 2006; European Agency for Development in Special Needs Education, 2011b);
- Support should take account of permanent human relationships and should be provided throughout an individual's life (Ebersold, 2012), not only in terms of additional material and economic resources at a specific point in time (Medeghini and D'Alessio, 2012).

The review suggests that: 'A supportive system, which promotes the development of inclusive education, has to align with a principle of inclusion that moves away from a debate on how learners fit into schools or services towards designing approaches and services around every child' (p. 12).

1.2 ICT and inclusive practice

D'Alessio, Donnelly and Watkins (2010) identify the progress across Europe in moving to inclusive education for all, but also note the lack of agreement on the meaning of this term, highlighting the wider definition of inclusion in terms of the ability of individuals to participate and to both benefit and also contribute to the development of society. They conclude that inclusive education is concerned with the 'transformation of the education system in general into a system capable of responding effectively to the totality of learner's diverse needs'. Inclusive education, the authors state, is not about the placement of learners into mainstream settings by responding to their individual needs, but is about reforming schooling, 'to support education for all and remove barriers to participation and learning for disadvantaged groups, essential links must be made between the reform of the education system and other policies such as those to alleviate poverty, improve maternal and child health, promote gender equality and ensure environmental sustainability and global partnership.' (D'Alessio et al., 2010, p. 116).

D'Alessio and colleagues also highlight the need for caution in adopting models from elsewhere due to the wide range of socio-economic, political, cultural and other issues that influence models of inclusive education across Europe. They conclude by stating that although there are differences in approaches and pace of adoption of inclusive education across European countries, there is a shared belief that this is an educational imperative to be pursued as a human rights issue. By implication, this means that the use of ICT to support inclusive education is also likely to be subject to the same caveats about wholesale adoption of models.

It is interesting to note that the areas highlighted by D'Alessio et al., in the context of the language used in relation to achieving inclusive education for all, focuses on transformation of the structures – systemic change of pedagogy, assessment and curriculum. These are mirrored by others when referring to the transformational potential of ICT for schools (Barber and Mourshed, 2009; UNESCO, 2011a). Northen (2012) suggests that education needs technology designed for learning and teaching, not the remnants of systems designed for quite other purposes. He recommends the use of artificial intelligence system to personalise learning and the need to overcome the barriers to digital exclusion.

A report by the European Commission (2008) on ICT for innovation and lifelong learning for all highlighted that:



Learner-centred guidance, group work and inquiry projects result in better skills and competencies. Interactive forms of e-learning can lead to a more reflective, deeper and participative learning, learning-by doing, inquiry learning, problem solving, creativity, etc. All this plays a role as competencies for innovation and can be enriched and improved by using e-learning. The challenge is to nurture new and innovative learning approaches, to ensure that teachers and parents are aware of their potential and to support them in curricula, teaching guidelines, and teacher training (European Commission, 2008, p. 11).

The report examined technological innovation and highlighted opportunities afforded by:

- digital content,
- networking,
- mobile technologies,
- the convergence of digital media (digital broadcast media, interoperability).
- simulations, gaming and immersive environments (potentially offering new learning tools from pre-school to specialised professional training),
- intellectual property rights and the role of the commercial sector, as well as the value of open educational resources (OER),
- changing nature of educational institutions with a move towards learning centres – the role of universities as learning service providers, companies as learning organisations and the need for more collaboration (European Commission, 2008).

The need for promoting equity and responding to diversity of needs is acknowledged by European ICT lead practitioners in a report on lessons learned from activities they carried out in 2006–2009 (*Knowledge System for Life Long Learning*, 2010). In particular, they recommend the development of open and inclusive policies which enhance the full integration of ICT in education and training. The ICT cluster group who developed these recommendations acknowledged the need to mainstream e-learning objectives (both at policy and implementation level) into the mainstream education and training agenda. It may be possible therefore to conclude that, by extension, the use of ICT for inclusion, including appropriate policies and practice regarding the use of assistive and mainstream technologies, should also be integrated.

This integration needs to be research and evidence based, closely aligned with mainstream innovations. There is also a problem that exists in the language of assistive technology for people with disabilities and the use of simpler and clearer language and terms (i.e. learning in a digital networked society rather than ‘e-learning’) should be considered. The *Knowledge System for Life Long Learning* report authors recommend learner-centred approaches, with digital competencies acquired by all, and the need for teacher education to embrace more open and flexible learning environments.

In some countries lack of infrastructure can be a significant barrier that results in teachers not using modern technology by necessity, and in turn learners not having access or positive models of ICT use. In these circumstances, individual teachers or enthusiasts tend to promote the use of technology beyond its potential ‘assistive’ functions and view it as necessary requirement for teaching and learning (Tsermidou and Zoniou-Sideri, 2012). Wastiau et al. (2013) reported that school leaders and teachers consider lack of infrastructure as the major obstacle to ICT use. However, their research (European Commission, 2013) did not find any overall relationship between high levels of infrastructure provision (as defined in the survey) and student and teacher use, or



confidence and attitudes, suggesting that provision, access and connectivity do not, in themselves, lead to ICT use in learning and teaching.

The use of *ICT for learning* – or e-Learning – is a widely recognised term and refers to:

... a learner-focused approach to the use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources and services, as well as remote exchanges and collaboration (European Commission, 2008, p. 5).

The report by the European Commission goes on to highlight the importance of *digital literacy*, which in turn leads to *digital competence*. This is defined as:

... the confident and critical use of information society technology for work, leisure, learning and communication. It is underpinned by basic skills in ICT and the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet (European Commission, 2008, p. 5).

The report notes that there are:

... broad positive benefits of ICT for learning such as cognitive processing, independent learning, critical thinking and teamwork and that ICT enhances a student-centred learning approach. However, while these benefits would lend themselves to new pedagogical approaches, the majority of teachers have not used ICT in such a way. If ICT has a positive impact on learning, it has yet to revolutionise processes at schools (European Commission, 2008, p. 8).

The report highlights the challenge of ICT for innovation in 3 areas: pedagogical, technological and organisational innovation. It notes that although ICT has transformed society and the economy, it has yet to have a transformation effect on the provision of education and training. This message is reflected at country level as well, for example the *Four in Balance* report on the use of ICT in Dutch schools and vocational education and training (Kennisnet, 2011) reports that there has been good progress in the use of technology for knowledge transfer, but less so in its use for knowledge construction.

1.3 Assistive Technologies

Many learners – children, young people and adults – particularly those with special educational needs, have a need for additional technology so that they are better able to use mainstream technologies to access learning and other activities. Although, as is discussed below, mainstream ICTs increasingly come with features that make it easier for people with special needs to use them, there is often the need for additional technology to ensure access.

1.3.1 Definitions of assistive technology

Specialist ICTs to support children and young people with disabilities, as well as adults, are commonly referred to as *assistive technologies* (AT), although there is no one single internationally accepted definition for this term.

Abbott (2007) suggests that a wider definition allows for a more flexible and inclusive approach and goes on to propose the term *e-Inclusion*, suggesting that a focus on the social model of inclusion is supported in the learning context by a focus on three areas of ICT usages:

- technology to train and rehearse,

-
- 
- technology to assist learning,
 - technology to enable learning.

The British Assistive Technology Association (BATA), a social enterprise that focuses on assistive technology (AT) for inclusion in education, proposes the following definition:

AT is any item, equipment, hardware, software, product or service, which maintains, increases or improves the functional capabilities of individuals of any age, especially those with disabilities, and enables them more easily to communicate, learn, enjoy and live better, more independent lives.

<http://www.bataonline.org/further-assistive-technology-definition>

Another definition of AT is offered by Winter and O'Raw (2010) as:

... any item, piece of equipment or product system that is used to improve the functioning of individuals with disabilities and is cited as providing students with the following key inclusive benefits:

- *greater control over their own learning experience,*
- *can participate in and contribute more fully in classroom activities and complete assignments independently,*
- *can interact to a greater extent with their typical peers, improving social skills and enhancing acceptance* (p. 87).

Other definitions help to make it clear what enabling or assistive ICTs can do in terms of providing equality of educational opportunity. ICT can help young people to learn at the speed that suits their needs, can help to minimise the boundaries between subjects and also improves creativity. In inclusive education all aspects of the use of these technologies are important, but as many commentators have observed, it is *how* they are applied that is important.

1.3.2 Potential benefits of assistive technologies

Assistive technologies can provide the means for many learners to engage in educational activities equitably alongside their peers. Along with standard, mainstream technology and more accessible mainstream technology, AT are being increasingly used for formative and high stakes summative assessment, providing a means for learners with special educational needs to demonstrate their progress and achievements (Nisbet, 2012).

AT can be used as a tool and a means for: teaching, studying, communication, aiding therapy and diagnosis of need (Molnár et al., 2008). Winter and O'Raw (2010) identify the following features of ICT that supports learners with SEN in accessing the curriculum and facilitates inclusive practice:

- Individual attention: in areas such as reinforcement of understanding it can provide structure and variety as well as information-rich multimedia content to support subjects such as geography and history (citing Shaw and Lewis, 2005). Research indicates significantly improved accuracy of responses and on-task behaviour when computers are used by learners with attention deficit disorders (ADD).
- Spell-checker: as a support for young people with dyslexia but also inclusive tool to encourage the production of writing.
- Text-to-speech: supporting a wide range of text disabled young people both through computer based systems and low tech devices such as digital dictation devices.



- Training specific skills: often literacy and numeracy focused and may have assessment of progress/understanding built into the software which modifies the pace and complexity of tasks presented to the learner. This type of software can also to provide feedback to the teacher on learner's time on tasks etc.
- Planning tools: visual organising or mapping tools to support the structuring of information, for example when planning an essay.

Nisbet (2012) reported on the use of digital examination papers for candidates with disabilities, which were introduced by the Scottish Qualification Authority 2008. There was a fivefold increase in requests for their use up to 2011, and this fact is accompanied by some evidence digital examination papers provide a more independent and less costly alternative to reader/scribes. Nisbet, Aitken and Wilson (2011) also examined different speech recognition software systems in assessments and reported that they may have considerable potential for some candidates.

Assistive technology that supports writing through prediction or abbreviation expansion has been proven to support learners with special educational needs, and was recognised as a huge benefit to those using communication devices (Garcia and Oliveira, 2008). It is now widely used on computers of all types, including mobile devices, as a mainstream technology.

Couteret (2009) proposes that not using ICT presents a real barrier to the education of young people with specific language difficulties, including dyslexia, dyscalculia, and attention deficit disorders. Trivaudey and Renaud (2009) while recognising there are a number of disadvantages, highlight the value of speech recognition technology to assist learners who have motor disabilities or dyslexia in the production of text. However, it is argued that providing such technology to a young person with dyslexia is not the answer to their difficulties; a combination of software that can support reading, writing, and organisation is now widely recognised as invaluable support for learners with dyslexia. It is also acknowledged that technology is only part of the solution and that there also needs to be a focus on perceptual, cognitive, behavioural and motivational aspects of learning that underpin the use of ICT (Pinnelli and Sorrentino, 2012).

Assistive technologies can provide opportunities not only for accessing curriculum content, but to developing understanding of concepts. Examples of this include the use of mainstream ICT for teaching mathematics to learners with physical disabilities and some of the specific methodologies employed (Garnier, 2012; Dantec and Jacquet, 2008; Martinegro and Curatelli, 2011), as well as using digital technologies with learners who have dyscalculia (Laurillard and Baajour, 2009).

Symbol supported learning approaches that use ICT have moved from being recognised as a tool for remediation to that of supporting inclusive learning with multidisciplinary collaboration by professionals from teaching, speech and language, and occupational therapies creating resources (Abbott et al., 2011). There is also emerging evidence that the use of symbols in mainstream early years settings may also increase the number of spontaneous questions asked by young people, enhance comprehension, and help to make the understanding and use of concepts more permanent (Mavrou, 2013).

McKnight and Davies (2012) in their report on assistive learning technologies, although broadly agreeing with Abbott's (2007) categorisation of assistive technologies, suggest there is potentially notable overlap between technologies to assist learning and technology uses to enable learning. They feel this is particularly true of compensatory technologies, which accommodate a particular learning challenge in order to provide a more equal



learning environment, such as voice recognition software, which may provide an easier way of producing text while at the same time may enable a person to work independently. Their report goes on to propose that a category of technology to enable access to learning might helpfully be considered in this context. They also suggest that access to information (or information accessibility), although important, should not be viewed as synonymous with access to learning.

1.4 Innovative use of accessible technologies

Accessible technologies can be defined as those designed to allow learners to use mainstream technology without any disadvantage, while assistive technologies (AT) aim to specifically support learners with a disability or impairment (McKnight and Davies, 2012). There is, however, considerable overlap; ICT developers apply inclusive design approaches which means the technology can be used in place of dedicated AT, with 'methods designed to make technologies or information accessible, therefore may be counted as assistive technology approaches, as the approach is assistive, even if the technology is not necessarily so' (McKnight and Davies, 2012, p. 13).

Research into mainstream developments in technology usage in schools can provide valuable insight for considering the use of accessible ICTs in education. A survey commissioned by the European Commission (EC, 2013), carried out by the European Schoolnet and the University of Liege, has benchmarked access, use and attitudes to ICT in schools. The findings include the following:

- although there are notable variations across Europe, generally the use of ICT may not have risen as much as might have been expected, and has remained at a fairly constant level since 2006.
- the presence of virtual learning environments in schools is increasing rapidly and there is high but not universal use of ICT at home.
- mobile technologies are mentioned throughout this report, but it is interesting to note the survey found that significant number of grade 8 and 11 learners indicated they use their own mobile phone to support their learning.
- there is a low level of use of digital resources and tools, for example digital textbooks or multimedia tools, with only 30% using items frequently, and more than 50% of all grades never or almost never using such resources.

These findings provide a useful backdrop when considering the potential of accessible ICTs in education.

The development of Web 2.0 technologies and the adoption of virtual learning environments (VLEs) in a growing number of European countries are providing wider, anytime-anywhere access to formal learning for many young people. These web-based systems provide opportunities for young people to access multimedia rich resources that can support learners with specific needs, and also provide a richer learning experience for all. However, course material and content developed for such environments will only be inclusive if legal requirements and standards around accessible web content, such as Web Content Accessibility Guidelines (WCAG) 2.0 (<http://www.w3.org/TR/WCAG/>) are observed (Abbott, 2011). Such systems, as Galloway (2011) has reported, originated in many cases for the Higher Education market, are often international products and do not always have the full range of accessibility features built in.

The integration of location-aware sensing technology into mobile devices (using global positioning system), which lets users know exactly where they are, is becoming



increasingly common and innovative use of this facility has potential benefits for learners with special needs. Garcia and Oliveira (2011) for example explored a vocabulary prediction approach based on the location of the user that suggests words or sentences which can be used to support increased writing. Fernandes (2010) carried out an analysis of different systems that inform blind people of what surrounds them, and some experts, such as Robin Christopherson, AbilityNet's Head of Digital Inclusion, are excited about the inclusive possibilities that systems such as Google Glass may offer them (<http://www.abilitynet.org.uk/blog/why-google-glass-is-clear-winner-blind>). Systems using neural or brain control to control a computer or environmental systems are opening up new possibilities for people with severe motor disabilities (Pires et al., 2012).

1.4.1 Accessible technologies as an indicator of developments in inclusive education

One measure adopted globally to indicate progress in the use of technology for inclusion is the use of digital accessibility and assistive technologies. The Global Initiative for Inclusive Information and Communication Technologies (G3ict, <http://g3ict.org/>), an Advocacy Initiative of the United Nations Global Alliance for ICT and Development, is tasked to facilitate and support the implementation of the intentions behind the Convention on the Rights of Persons with Disabilities (UN, 2006) and promote digital accessibility and assistive technologies. They developed an ICT Accessibility Self-Assessment Framework and Digital Accessibility Inclusion Index that is used to monitor the progress of countries that have signed the Convention.

Their report (G3ict, 2011) indicates good progress has been made, with 78% of the countries surveyed having some form of ICT accessibility policies or assistive technology programmes in place for education. The report highlights that universities and schools around the world are often at the forefront of AT research and implementation and are an indispensable partner in any significant policy or programme. However, they go on to note that many innovations conceived by universities do not result in viable commercial products, and recommend that more effective relationships are developed between universities and industry.

The increasing proliferation of mobile devices that connect to the internet and the development of apps (applications) are already having an impact on education. The value of mobile technologies for education is highlighted by numerous researchers (for example Passey, 2010) and Renaud (2012) suggests that current ICTs provide excellent tools to help teach autistic pupils (as long as the devices are set up appropriately) and teachers are encouraged to use them as the costs are low and the technology less stigmatising.

There is a small but growing body of research into the educational value and impact of tablets and apps, and a number have highlighted the inclusive potential of this technology (Clark and Luckin, 2013; Burden et al., 2012). Jellinek and Abraham (2012) report on the growing number of apps that provide not only access to systems (for example for those with physical or sensory disabilities), but also as a means of engaging with others through social networks or crowd-sourcing (where information or the services of a number of people are obtained, typically online). They particularly highlight the value of:

- geographic specific information,
- augmented reality,
- the potential for the mobile device to control other pieces of technology (for example the digital TV or set top box),



- the potential for the mobile device to be personalised to an individual's requirements (including access/AT), so that for example it could be used to read out loud the TV guide or replicate it on the device so it can be viewed close up.

An appendix to the report by Jellinek and Abraham proposes seven principles based on inclusive design, for developers to follow in order to create accessible apps:

- Learn about accessibility
- Quick accessibility check
- Publish an Accessibility Statement
- Provide a Contact Us function
- Ensure reading sequence is logical and comprehensible
- Create a user interface that is easy to understand and operate
- Ensure text formatting can be altered.

The value of web standards for accessibility design and multimedia content are also highlighted. The report considers not only education applications, but provides a useful overview of how mobile technology can reduce social isolation as long as developers consider the needs of all users, including the access needs of those with disabilities. Pieri (2011) in an analysis of Italian and international literature observed that in the field of mobile learning, accessibility is still in its infancy. She highlights that it has great potential to avoid discrimination between learners, with benefits for schools, social inclusion and a move towards universal access to education.

Research into the use of accessible ICT in Norwegian schools highlighted a mixture of technical and human barriers, the latter related both to competences and attitudes, as well as system level issues, such as collaboration and administration (Söderström, 2012). The author observes that when assistive technology works as intended and is integrated into classroom teaching, it facilitates participation and inclusion. However, when this is not the case, or is used in segregated settings, it hampers inclusion. Brodin (2010), who interviewed parents and learners at two schools that used ICT as pedagogical tools to promote inclusion, reported on the need for both technical and social support, if ICT is to function as a bridge for the inclusion of all learners.

1.5 Emerging technologies

The term *emerging technologies* is widely used, but there are few academic definitions. In addressing this issue, Veletsianos (2010) proposes that they are 'tools, concepts, innovations, and advancements utilized in diverse educational settings to serve varied education-related purposes'. He goes on to suggest that 'they are potentially disruptive, not yet fully understood, and not yet fully researched' (p. 3–5).

1.5.1 Perceived benefits of emerging technologies for education

The rapid pace of technological development provides a significant challenge for teachers to adapt their practice to capitalise on the potential it provides for learning. As is highlighted in various parts of this report, over the past 5–10 years, technologies that were previously used in higher education, business or at home have been adopted within schools. Examples of these include interactive whiteboards, virtual learning environments and portable computers.



Researchers and others continue to predict which technologies will be adopted in education, identify trends and suggest how this will impact on teaching and learning and on education systems. The Horizon reports (New Media Consortium, 2012, and 2013) predict which emerging technologies that are likely to have a large impact on teaching, learning, research or creative expression within education around the globe. In 2012 and again in 2013 they highlighted mobile learning (discussed in more detail in a later section). This is linked with possibilities for *cloud computing*, where there are clear advantages for mobile users, either where these are supplied by the school or where learners are encouraged to bring their own devices. Jacquet (2010) highlights that cloud based solutions have the advantage of being available to all and can be useful for learners both in mainstream or remote learning situations, but points out that there is a need for exchange, co-operation and co-ordination for this to be useful in supporting learning. Overall, trends in emerging technologies worth monitoring, in addition to mobile learning and cloud-based solutions, include the use of *game technologies* for learning (UNESCO, 2012).

The educational and social benefits of some emerging technologies are being investigated and researched, and the implications for inclusion – particularly of those learners with disabilities – being highlighted. One example is E-accessibility 2020 (Koumpis and Crehan, 2012) which highlights the wider benefits of smartphones for people who are blind or deaf, and argues that the development of innovative new applications – for all users or groups of people with specific needs – can be developed quickly and is not expensive. They identify the barriers as being:

- the realisation of the needs of those with specific needs (and the need to involve them in the idea creation phase of developments),
- the highly fragmented market with many operating systems and new devices released frequently, (the challenge of highly accessible operating systems often being on high end and costly devices),
- the challenge of compliance with legislation around equity and rights (which goes beyond a lack of understanding to real technical difficulties in meeting what developers often feel as ambiguous standards or protocols, or where tools are provided that are maybe less than fit for purpose.

The report authors call for more work by tool developers to help ease the technical process and training for many of the players involved, from web developers, business executives, designers, to content developers. An additional challenge is that significant volumes of shared user-generated content is not made by professionals but by the general public, with little understanding of how to make what they produce accessible. The business case for accessibility is now increasingly recognised, but relatively few web-design courses, for example, include awareness or training in the techniques of accessibility.

Collaborative learning through the use of new technology is a recurring theme in terms of the impact of ICT (Balanskat et al., 2006; UNESCO, 2011) with increased motivation, better pupil performance, and more efficient learning process often quoted as benefits (Kennisnet, 2013). Research looking at pairs of disabled and non-disabled learners in mainstream schools, observed positive outcomes of peer acceptance and interaction when they were working together on a computer using multimedia software (Mavrou, 2012; Mavrou et al., 2010).



Through a public–private partnership, the International Telecommunication Union (ITU) has established ‘Connect A School, Connect A Community’, an online platform to promote understanding and awareness among government decision makers, donors and partners on the need for coordinated policies, regulations and practices that promote school connectivity and community benefits. This is the intended target set at the World Summit on the Information Society (WSIS): of connecting all primary, secondary and post-secondary schools to ICTs by 2015. ITU together with partners have created five toolkits of best practice and policy advice, one of which focuses on using ICTs to promote education and job training for persons with disabilities (ITU, 2009), and also highlights the potential benefits of cloud computing, mobile learning (smart phones and other devices), virtual learning environments and Open Education Resources. It highlights, for example, that blind users could access screen reading and other technologies via the cloud, rather than from a dedicated device – enabling anytime anywhere use, and the tensions between high cost proprietary software and low cost or free, open source or alternatives. They cite projects which address this and have the potential to remove a key barrier – the lack of affordability of AT for people with disabilities. The report goes on to recommend that a range of current and near-future technology developments should be monitored by government and schools such as cloud computing, e-learning and the development of accessible Open Educational Resources.

The rate and pace of adoption of technologies for education is varied across Europe (European Commission, 2013), although learning platforms, mobile technologies and tablets are increasingly present in most countries. The potential benefits of these devices for inclusive education are explored below.

1.5.2 Learning Platforms

Jewitt et al. (2010) define *learning platforms* as:

an integrated set of interactive online services that provide teachers, learners, parents and others involved in education with information, tools and resources to support and enhance educational delivery and management. It is not a single ‘off the shelf’ product but a collection of tools and services designed to support teaching, learning, management and administration (Jewitt et al., 2010, p. 4).

Their review identified one of the benefits of learning platforms as supporting additional educational needs and inclusion, by providing enhanced schools’ capacity to cater for learners who had greater difficulty in learning than the majority of their peers, and a differentiated range of resources and online content and communication tools that allowed learners to express themselves and interact with teachers and peers in non-verbal ways.

They noted, however, providing a range of learning resources meant that schools and teachers had to put considerable and on-going time and effort into maintaining awareness of the variety of online resources and content and ensuring these were accessible, in order to meet the needs of their learners.

The potential to personalise electronic learning environments to support specific needs is exemplified by research (da Silva et al., 2012; Corn, 2012) that explored the benefits for young people with autistic spectrum disorders (ASD). Alcorn et al. (2011) found that using the ECHOES (developed through the Exploring e-Learning and Communication Tools for Improving Children's Language Usage in Social Interactions project) learning environment, pupils learned to follow a virtual character's gaze and gesture cues indicating a potential for virtual characters to support social interaction, both within the platform between learners and others. They found that the children frequently initiated social sharing while



using the environment. The ECHOES II project (<http://www.esrc.ac.uk/my-esrc/grants/RES-139-25-0395-A/read>) also investigated adding sign language to the environment to support deaf learners (Farrow and Lemon, 2011). Other examples highlight the benefits of sharing SEN teaching and learning resources, communication tools for hearing impaired and deaf learners (European Agency for Development in Special Needs Education and UNESCO IITE, 2011). However, it is important that accessibility issues around learning platforms, for example through the use of meta-data standards to match resources to learner preferences, are fully addressed in order to support the needs of all learners (UNESCO IITE, 2011). The issues of information accessibility are reported and are being further explored in the Agency ICT for Information Accessibility in Learning (ICT4IAL) project (please see <http://www.european-agency.org/news/developing-guidelines-for-ict-for-information-accessibility-in-learning-ict4ial> for more details).

1.5.3 Mobile technologies

A report from GSMA (Groupe Speciale Mobile) and McKinsey Company (2012) highlights that *mobile technology in education* has the potential to transform teaching and learning as it 'personalizes education solutions for individual learners, helping educators customize the teaching process, using software and interactive media that adapt levels of difficulty to individual students' (p. 4). The report also highlights the impact mobile technology is already having in improving oracy in pre-school learners. The benefits of the mobile phone for education are also recognised in a recent policy briefing from UNESCO IITE (2010).

There is now a significant volume of research highlighting the educational value of mobile learning, where every learner has access to a device which is mainly for their exclusive use both in school and at home. The benefits of the ability to personalise a device and to use it to extend learning beyond school is well documented (Naismith et al., 2006). Often learners with special needs have been given access to laptops or word processing technology before there was wider adoption with all learners. This has led to some resistance being identified as this made the young person stand out as needing something different or using something that wasn't a 'real' computer (Söderström, 2013; Foley and Ferri, 2012).

Corn and colleagues (2012) cite a teacher who said that 'there are a lot of ways that computers can mask a disability, or help you compensate for one.' The increased adoption of mobile technology in classrooms provides more of a level playing field, supporting learners both with undiagnosed special needs, as well as providing a personal learning tool for all. Passey (2012) observed learners with special educational needs using mobile technologies felt more a part of the general educational activities, but goes on to caution that implementation of mobile technologies is unlikely to be achieved in isolation. He proposes four parallel paths – termed *learning activity*, *technical*, *political*, and *cultural paths* – as all being important at all stages of implementation, but with the emphasis being placed upon learning activity.

The value of mobile technology for learners with dyslexia in providing a 'virtual technology toolkit at their fingertips' through both applications and accessibility features built into the operating system, highlighted by Reid et al. (2013). Examples are provided of ways that these can support reading, composing text, note taking, organisation as well as meta-cognition and studying skills. It could be argued that these potential support possibilities would benefit not only those with dyslexia but also others who encounter difficulties in these areas.



Although there is a growing shift toward the use of mobile technology in education (Kennisnet, 2013; European Commission, 2013) there is a reluctance to allow mobile phones or learners' own devices in schools. UNESCO (2012a) notes that although there have been a number of major mobile learning projects, in some European countries many show limited or no interest in the widespread use of mobile technology in education. This is due mainly to concerns by schools over misuse of the technology, e-safety issues and the perceived potential for disruption and bad behaviour (UNESCO, 2012a).

The report provides examples of good practice provided by researchers and pilot projects highlighting that mobile technologies can be used to establish continuity in learning experiences across different contexts. The report authors argue that this helps learners align the learning they engage in outside of school with the learning they do in school, switching from one learning context to another easily and quickly using their personal mobile device as a mediator.

Some researchers have highlighted areas for guidance on the effective use of mobile technologies. Examples include the Handywissen initiative in Austria (<http://handywissen.at/>) and the Cloudlearn project (<http://www.cloudlearn.net/>) which investigated the use of mobile internet devices and reported on the benefits of schools actively engaging with social media rather than blocking access (Heppell and Chapman, 2011).

1.5.4 Tablet and multi-touch devices

The rapid take up by educational establishment of highly portable touch-screen tablets has accelerated the observed trend towards personal ownership. In the USA 1.5 million iPads have been deployed in education programmes (Reid et al., 2013). However, strategies for effective deployment, management and support for learning using one-to-one (1:1) computing approaches are still developing. As Bocconi et al. (2013) acknowledge, although there has been considerable investment in such technology across much of Europe, there is a need to move the focus towards the learner and pedagogies, i.e. from 1:1 computing to 1:1 learning. These authors highlight that more recent initiatives have gone beyond increasing ICT provision, improving learners' digital skills and motivation, towards building upon learner-centred, ubiquitous, and personalised learning, addressing innovative 1:1 pedagogical strategies and narrowing the digital divide.

However, Bocconi and her colleagues conclude that at best there has been only incremental moves towards innovation; there remains a knowledge gap about the deeper learning practices of learners using their own digital devices. They also note the mismatch between the potential of technology to enable and facilitate innovative assessment practices that are an integral part of the learning process and the types of assessment – mainly summative – which are used in real settings. Twining, Professor of Education (Futures) at the Open University in England, provides an online synthesis of international research into emerging technologies as well as case studies of current practice (see Edfutures, <http://edfutures.net/>).

Corn et al. (2012) reporting on the use of 1:1 computing with learners with SEN, found that the laptops initiative which ran from 2008–2011 in 18 highschools in North Carolina, provided learners with the tools to feel as capable as mainstream learners, particularly in areas of reading, writing and comprehension. The technology was found to support individualised learning, with benefits reported in communication, organisation, confidence, reading ability and assessment.



Reports on the use of tablet devices tend to be very positive in terms of the value and potential impact on teaching and learning for all learners. Clark and Luckin (2013) in their review of literature to date, state that there is evidence that use of tablets ‘enhanced the learning experience and transformed teaching practice’ (Clarke and Luckin, 2013, p. 3), with teachers enabled to promote independent learning, to differentiate learning more easily for different learner needs.

1.5.5 Other technologies

Research in Finland (Karna-Lin et al., 2007) highlights the use of *robots* and *programmable objects* as an area for development of support for young people with special educational needs. They found that teachers, although challenged by the use of these technologies, were also encouraged by the way in which it motivated and engaged young people, and how it provided a means of developing autonomy and creative experiences. Karna-Lin and colleagues recommended an interdisciplinary approach to the design and analysis of technology for learners with special needs. They highlight that teachers and researchers need to be aware of unintended benefits and outcomes, and cite as an example the novel and surprising observation that learning programming skills contributed to improving social skills.

Greff (2013) reminds practitioners that the use of simple programmable devices such as Roamer is based on a proven pedagogy. They enable an approach combining auditory, visual and kinaesthetic aspects and support a range of skills development including the construct of space and time and logical reasoning.

Researchers suggest technology may be particularly effective for people with ASD, as they may benefit from predictable and highly visual environments and clearly defined activities and reward structures which can be personalised to a user’s particular needs (McKnight and Davies, 2012). A range of new technologies are highlighted as being more effective than standard social skills training for this group, including the use of large multi-touch surfaces, such as interactive whiteboards, tablets and table-top technologies, and tangible technologies (such as digital construction toys), all with a focus on collaboration and social interaction through game-play.

Some researchers have also focused on the use of communication devices as a means of supporting social interaction (Solari, 2009). Electronic visual scheduling systems are mentioned as being an invaluable support for young people with learning difficulties and ASD. McKnight and Davies (2012) reference research into a system that presents a visual timetable for the day both on learner’s individual tablets and also on a large screen display showing all learners’ timetables, so they can see what their peers will be doing. It also tracked reward tokens and helpfully for the teachers logged progress of individuals over time.

Reiser (2012) highlights the work in Canada of a multidisciplinary team that have been using a technology-supported approach to inclusive learning using interactive whiteboards. They took a problem-solving participatory approach, and involved both education professionals, the learners who had complex learning and communication needs and their parents/carers. By examining the barriers to effective communication, educational and social inclusion, they developed a goal focused approach supported by used assistive technology and informed by Universal Design for Learning. The small scale pilot (Smart Inclusion Team, 2010) reported improved engagement, attendance and behaviour and models of uses with individuals through to the whole class. The Smart Inclusion wiki details examples of this approach also supported by other technologies such as tablets,



interactive touch-screen tables, and games machines (<http://smartinclusion.wikispaces.com/Smart+Inclusion+Home>). Multi-sensory rooms combining sound and image control in real time are widely used for therapeutic and curriculum related activities to provide a creative alternative to repetitious exercise or practice (Sá et al., 2011).

1.5.6 The challenges posed by emerging technologies

Virtual Learning Environments (VLEs) have been shown to provide significant value for the delivery and management of teaching and learning where imaginatively implemented, but can create barrier for some learners (Chowcat et al., 2009). This is especially true for assessment for learning, recording and reporting, parent portals and collaborative learning spaces where other interactive features are integrated into the VLE. Research indicates that newly qualified teachers tend to have a lack of awareness of the many barriers to inclusion that exist in the classroom or wider environment being replicated in VLEs (Beacham, 2011) and this often restricted readiness for learning, resources and learning opportunities.

Train and practice software is widely used, often with those young people identified as having special educational needs, but there has been little research, apart from single product evaluations often undertaken by those with a close interest in the product (Abbott et al., 2011). Abbott calls for wider thematic product evaluations.

The work of Levinson (2010) focused on changing the understanding and approach to reading and writing using ICT, founded on an inclusive understanding of education. Her research worked with a mixture of teachers who were early and late adopters of technology and recognised that teachers' perceptions and views were a significant factor influencing a young person's attitudes about themselves and what they were able to achieve. Taking such a perspective leads to an acceptance that to read or write may mean using text-to-speech or speech-to-text technology.

Benigno et al. (2007) highlights that new technological developments are creating barriers for some people, giving examples of the reduced size of portable computers and different interfaces where buttons may have multiple functions. They cite research that indicates that new multimedia software incorporating motion, special effects and 3D imagery, tend to leave aside principles of design for all. The authors warn that although assistive technologies play an important role, it should not be viewed as reason to ignore the fundamental principles that make such products accessible to both those with and without disabilities.

Redecker (2009) noted in his research on social computing in educational contexts that of the projects evaluated, participation and use were often linked to the learning and inclusion objectives of the initiative, and were affected by the scale, type of learning tools used, complexity and perceived attractiveness as well as the quality and quantity of human support and appropriateness of the educational approach (Redecker, 2009, p. 88). He cites a project involving students at the Spanish Open University, which although only having 10% (400 out of 4000) disabled students was successful in providing new learning opportunities, improving social integration as well as providing a voice within the student community. The use of an accessible learning platform enabled access to learning materials and learning activities, but most importantly provided access to peer support – which was reported to bridge the isolation often felt by the students with disabilities, and enhanced subjective learning experiences.



In the area of high tech communications aids, such as *voice output communication aids* (VOCAs), the benefits of the provision of this technology for some individuals is widely reported and is by many people considered a basic human right. In addition, the case has been made for the benefits such technology can have to society and the economy. One estimate indicated that 'every disabled young person whose employment status changes from permanent unemployment to permanent employment as an adult as a result of use of communication aid will realise benefits in the order of £500,000 over a working lifetime' (Gross, 2010, p. 26 – citing Department for Education impact analysis report, 2010).

Inclusion is about equal opportunity and access and in terms of all possible uses of ICT – this includes access to leisure, as well as learning opportunities. The use of *game technology* by young people and adults has increased exponentially over the last 3 to 5 years. Although research is yet to prove conclusively that there are educational benefits, there are some indicators of the value they have for problem solving, communication and collaboration and the development of other skills.

Games are part of the social experience of many young people. In small scale research case studies, as part of the Molenet project, Douch et al. (2010) found that for the use of games on handheld devices such as the Sony PlayStation Portable (PSP) and Nintendo DS, and also using the Nintendo Wii there were positive outcomes in using games with young adults who had a range of learning difficulties or disabilities. These included increased social interaction and communication, encouragement to engage in therapeutic related movements, and increased motivation and engagement in learning tasks while using the devices.

1.6 Summary

ICT is internationally recognised as valuable tool for inclusion. It is also recognised that barriers to inclusive education needs to focus on designing approaches and services around the learner, not on the learner's disability. Although ICT has transformed many aspects of society and the economy, it has yet to have a transformational effect on education.

In the context of learning, for some people with special educational needs there will be a need for accessible technologies to be available consistently and without interruption in order for them to access education and society (European Agency for Development in Special Needs Education and UNESCO IITE, 2011). Augmentative and Alternative Communication (AAC) high tech devices are an example of where the personal ownership is recognised as important at transition points in education, from primary to secondary education and into training, work and in life generally (Bush et al., 2008).

The use of technology for inclusion is a lifelong requirement that extends beyond the classroom, college, university or other learning environments. For some people this may mean the need for information to be provided in a form that they can understand easily (for example in an easy read or symbol format) or an accessible website that can be read aloud using screen reading technology. For others this may be a device that speaks and thus support communication and social interaction, or – as is being developed – a device that translates sign language into text or provides automatic subtitles to video materials.

ICT supports inclusive learning in a range of ways, from providing physical access to the technology to a range of ways to engage in the learning process, including through practice and repetition, the exploration of concepts and ideas in multi-sensory ways, to collaboration and online interaction. It enables greater control over learning experiences, increased opportunities to participate and contribute, and for independence.



Assistive technologies have become increasingly sophisticated. Increasingly, accessible technologies can support learners with SEN to access learning and enable learners with complex needs.

Mainstream ICTs have increasingly added accessibility features for people with disabilities making them more inclusive. This is particularly true of mobile devices, where the design of the operating systems, and the proliferation of low cost software in the form of apps, mean that assistive features and tools are more developed and now widely available. Learning platforms which have been widely adopted across Europe potentially provide extended educational benefits, with access to significant number quality resources, learning able to take place outside of school and interaction with peers and teachers. However, as with interactive whiteboards, there still remain accessibility concerns which limit here potential for inclusive education. One-to-one computing has been shown to provide benefits for inclusive learning, although the supporting pedagogy has still to fully develop.



2. ACCESS TO ICT AS AN ENTITLEMENT

In order for technology to support inclusion, it has to be available when it is needed and be fit for purpose in meeting individual needs, not only in terms of the technologies but also the methods and processes used for implementing it. Ideally, the individual will have had direct control over the choice of technology. In order for this to be achieved, a range of factors need to be considered or be in place, including positive attitudes of all involved, and ensuring that the technology is available in a range of contexts. For example assistive technology for use by a person with a disability in the home may need the input of a range of professionals to ensure the technology is safe and appropriate, and to assist in overcoming financial barriers (European Agency for Development in Special Needs Education and UNESCO IITE, 2011).

The *Policy Review* (European Agency for Development in Special Needs Education, 2013a) that complements this review outlines certain policy expectations – including enacting legislation that protects the rights of people with disabilities. The Convention on the Rights of Persons with Disabilities is central to these, and makes clear reference to the fact that signatories should provide equality of access to information and communications, and ICTs and systems to support independence and participation (United Nations, 2006). This implies not only a moral obligation to provide accessible and inclusive education environments, but also a legal one, where compliance is built into national legislation and associated advice and guidance on how to achieve it.

This section examines whether learners can access the technologies necessary for them to participate in inclusive education and the challenges confronted in receiving that entitlement. Furthermore, it examines factors which affect whether learners with special educational needs are accessing the appropriate technologies to maximise the learning opportunities, not only in terms of accessing information and knowledge, but also in participating in learning.

2.1 Challenges in providing appropriate technology for learning

The WSIS (2010) report on an expert forum of multiple stakeholders, expressed the view that there is a global crisis in relation to the continued development of inaccessible ICTs, increasing prices coupled with decreasing availability. The report notes that ‘technologies are still not available for each disability and for each person with disabilities’ (p. 51). The report goes on to recommend ‘Emerging cloud-based infrastructures and the ability to personalise applications and content should be used to enable digital inclusion and address barriers of physical, sensory and cognitive access to online systems’ (p. 51).

2.1.1 Involving learners in the choice of assistive technologies

Many young people with disabilities use assistive technologies (AT) regularly in their everyday activities, supporting and enhancing their communication and providing a means to engage in social interaction, entertainment as well as learning. Lindstrom (2011) argues that young people with physical disabilities need AT to be integrated into educational practice and to experience benefits that do not affect their social participation in every day school activity. Such young people are often not being involved in the choice of AT. There can be a problem of reconciling the wishes of the young person, the parents/carers and the recommendations of professionals resulting in technology being rejected or not used.



2.1.2 Accessible technology and school priorities

The Agency paper *Implementing Inclusive Assessment* (European Agency for Development in Special Needs Education, 2009) reports that schools cannot change and improve without a good leader whose role is fundamental in promoting ways of working and thinking that are in line with the principles of inclusion. This is reinforced by the findings of a subsequent Agency report, *Key Principles for Promoting Quality in Inclusive Education* (European Agency for Development in Special Needs Education, 2011c), which states the need for visionary school leaders who value diversity among staff as well as learners, encourage collegiality and support innovation. The Achievement for All project in England reinforced the point that leadership in inclusive practice in an institution needs to come from the head teacher or a member of the senior leadership team (Humphrey, 2011).

Research also points to the need for a whole school approach to the adoption of ICT, with the key driver for change being vision and leadership, which needs to be provided by the head teacher and leadership team (Groff, 2013). A school ICT strategy can provide the driver for change in the use of technology for teaching and learning and other aspects of technology for the management and running of the school (Balanskat et al., 2006; Becta 2010). The introduction of learning platforms, reported to support inclusive practice were most effective when integrated into the whole school ICT strategy (Jewitt et al., 2010).

In the majority of schools across Europe formal school policies about using ICT precisely in general or in subjects exist and concern around 50% of the students at all grades. Holistic school policies, covering ICT use in general, precisely in teaching and learning, and in subjects, are much rarer, with only around 20% of students in such schools (European Commission, 2013).

2.1.3 Lack of access to ICTs at home

Young people with special educational needs or disabilities often come from socially disadvantaged families and their educational attainment and life outcomes are likely to be affected by this (Punie et al., 2006). From a technology perspective this group is at increased risk of being part of a digital divide – by having less direct or no personal access to the Internet or the skills required to maximise the use of online technologies for social, economic and learning purposes. Although there is still a recognised digital divide this is now considered less about having personal access to internet connected technology, and more about the skills, digital competencies to maximise the use of digital media (WSIS, 2010).

The digital divide does not appear to be closing and education can be seen as a key inclusion or exclusion factor (European Commission, 2008). The report highlighted the need to promote e-inclusion, noting that there were at that time 50 million people with disabilities at risk of e-exclusion and the 98 million at risk of poverty, including the 10 million working poor, and the 15 million foreign-born residents' (p. 10). A United States government report (Office of Scientific and Technology Policy and The National Economic Council, 2013) highlights this is still a major issue for schools in the USA, not only in terms of lack of sufficient infrastructure but also the need for training in effective use of ICT in lessons. A recent report (Elwick et al., 2013) also focuses on the need for schools to develop partnerships with parents to maximise the use of technology available in the home and proposes more targeted support and prioritising digital literacy through the curriculum.



2.1.4 Access to assistive technology assessment services and to accessible technologies

Research commissioned by Becta, the British Educational Communication and Technology Agency, (Atkins, 2009) found that across England there were varying models for the assessment of assistive technologies, and that not all children were receiving the appropriate assistive technology required due to professionals' varying skills at identifying and matching needs with solutions. It highlighted how different timeframes for assessment can prevent a child from accessing appropriate assistive technologies, which can impact on the inclusion of that child, and that re-assessments do not follow a standard process, leading to learners not being reassessed often enough and consequently using old technology that may no longer match their needs. Efficient digital management systems may decrease the time required for assessment procedures, storing evaluation findings and reporting outcomes (Guerreiro et al., 2011).

The reasons for this disparity in provision was highlighted as due to expertise within local authorities differing greatly (with some using innovative models of practice and others having no in-house expertise) and assistive technology and its uses changing at a fast pace, resulting in educational professionals struggling to keep up with advances. The report highlighted that there is no consistent approach for inclusion training and knowledge sharing for schools, leading to a varied experience for learners.

The need for more educator training – both initial and on-going – in the use of technology to support learners with speech, language and communication needs, is reinforced by reports by the English government's Communication Champion (Gross, 2010 and Down, 2011) which focused on specialist technology for those with speech language and communication needs. The report highlighted the inconsistencies both in commissioning of Augmentative and Alternative Communication (ACC) services and technology for young people and of access to assessment services, equipment and independent training. A survey of schools in England in 2010 found that many mainstream schools did not have access to technologies to support young people with physical, sensory or cognitive disabilities and a high number indicated that they did not know if they did or not (Becta, 2010).

2.2 Access to information and learning content

ICT enables participation in the Information Society, which UNESCO cites as being based on 'technological innovations giving new broad access to information'. They differentiate this from the concept of knowledge societies, which encompass much broader social, cultural, ethical and political dimensions that also reflect universally accepted values of openness and public and equal participation enshrined in the Universal Declaration of Human Rights (UNESCO, 2013b).

Access to information is a fundamental right of every learner, with or without disabilities and/or special educational needs. In a society that increasingly relies on ICT to communicate and share information and knowledge, it is essential that information is provided in a way that ensures every person has the opportunity of participating on an equal basis (European Agency for Development in Special Needs Education, 2012b, p. 7).

This recent report examined why it is that although policies and legislation exist to ensure information is accessible for all, this does not translate in practice. The conclusions were that there were sufficient policies in place as well as ICT solutions available, however,



there is a need to join up policies, develop the capacity of all stakeholders and evaluate and monitor if this is happening. Recommendation in the area of lifelong learning included:

- the need to develop at a European level a core curriculum of key competencies for education training programmes, and at a national level ensure accessibility is covered in education programmes for professionals.
- at an organisational level there is a need for continuing professional development (CPD) and support for professionals to ensure that not only is the accessibility and ICT knowledge of education professionals' up to date, but they are supported in developing new teaching approaches in this area.

Reporting on the progress made since the World Summit on Information Society (<http://www.itu.int/wsis/index.html>) which took place in 2003 and 2005, on promoting the digital inclusion of persons with disabilities, Leblois highlights that there still remains major barriers for people with disabilities in participating fully in the knowledge society (UNESCO, 2013b). The report makes five recommendations, of which number 4 is: 'Promoting accessible and assistive information and communication technologies in support of Inclusive Education'. The recommendation proposes a number of actions and identifies governments, supported by others, as having a leading role. In particular, it suggests that governments should ensure that assistive technologies are made available to students with disabilities throughout their education system; that teachers are trained and supported in their implementation; and that there should be more research into how technology can assist students with disabilities in excelling in inquiry based learning and becoming proficient in participating in all aspects of knowledge societies.

Making teaching materials (in particular traditional textbooks) available to text disabled learners in an appropriate electronic form along with access technologies to read them can 'make a significant difference to their reading, writing, confidence, development and inclusion. The same electronic materials can also provide substantial productivity savings for staff in schools and local authorities who support, in particular, visually impaired pupils' (Dolphin Inclusive Consortium, 2011, p. 6). The Accessible Resources Pilot project report went on to recommend the establishment of a national textbook and advisory service to oversee production and distribution of the electronic texts along with training and support on the technology to access them, as well as the sharing of good practice. The authors recommend that textbook producers should systematically provide electronic versions of their publications to this service while working on accessible versions of their products and provide a production specification for electronic textbook to support that process. Podcasts have also proved of great benefit to many users, particularly those with visual impairment, providing a resource that can support learning at a time and place that suits the learner (Bottentuit, Jr. et al., 2009).

Open standards have been developed by international and national organisations to make digital books (e-books) accessible for a wide range of learners. These standards, DAISY (<http://www.daisy.org/daisy-standard>) and EPUB3 (<http://idpf.org/epub/30>) are increasingly being used by commercial publishers to provide electronic publications that have built in accessibility. In addition, developers of e-readers are building in features to the devices themselves that make them more accessible.

Provision, training and on-going support for accessible ICT usage should be ensured by joined up approaches at a policy level and locally, with educators having access to general information on technology to support learning diversity as well as more detailed information for particular learners' needs. A 'team effort' is required, which involves learners, parents and carers in the provision and exploitation of accessible ICTs to enable



the integration of assistive technologies outside the classroom. To achieve this, along with ensuring an inclusive curriculum, the use of accessible ICT needs to be an integrated part of the schools ICT plan (UNESCO, 2012b).

The right to freedom to express and to seek, receive and impart information and ideas through any media and regardless of frontiers, is a legal entitlement under human rights legislation (see the Universal Declaration of Human Rights, http://www.un.org/en/documents/udhr/index.shtml_article_19, and the European Convention on Human Rights http://www.echr.coe.int/Pages/home.aspx?p=basictexts&c=article_10). The right to an education is also enshrined in the same legislation and many charities and advocacy groups argue that technology to enable that right should be provided by the state, in line with the UN Convention on the Rights of People with Disabilities (UN, 2006). However, that does not necessarily mean it is provided, as research from charities such as Scope, a disability charity that supports disabled people and their families in England and Wales, demonstrates. Scope, which campaigns for the rights of people with disabilities, identified the barriers to the provision of Augmentative and Alternative Communication (AAC) as including a lack of training and development needs of professionals, few co-ordinated, cross-sectoral policies, fragmented and inconsistent coverage of services, and especially the lack of funding for equipment, support and services (Bush et al., 2008).

2.3 E-safety and vulnerable learners

Recent reports highlight the extent of the use of the internet by young people in general, and in particular for those who can be considered *vulnerable*. Coupled with this is the growing issue of bullying of these young people in social networks. Research stresses the need for research and advice to teachers and learners in this area (Aston and Brzyska, 2012; Carrick-Davies, 2011).

Children and young people with learning disabilities are much more likely to be bullied than their peers. For example research in the United Kingdom (Mencap, 2007) indicated that 82% of children with learning disabilities were bullied. With the increase in availability of technology this is found to be an issue for vulnerable young people and adults on-line and is often referred to as *cyber-bullying*.

National strategies, advice, guidance and schemes have been developed in many countries across Europe, both for teachers to help them educate learners and their parents, and for the children themselves (see for example the EC Safer Internet Programme (http://ec.europa.eu/information_society/activities/sip/policy/programme/index_en.htm) and INSAFE, co-ordinated by the European Schoolnet <http://www.saferinternet.org>).

Children of parents who were less educated or do not use the Internet are potentially a significant group that experience higher risk to disturbing online material (Livingstone et al., 2011a and 2011b). However, there is a lack of specific research and advice relating to learners with disabilities (Livingstone and Palmer, 2012). An example of where the digital divide has a compound effect can be seen as occurring when the groups most vulnerable to cyber-bullying are also those most likely to find it difficult to access help in the form of support, guidance or resources.

Cyber-bullying has a severe impact on vulnerable young people and can interrupt their education, with research indicating that for some groups the impact and risk is significantly increased. Socio-economic or educational disadvantaged, disability, minority ethnic origin



(of some groups) and lesbian, gay, bi-sexual or transgender are groups considered by some researchers as being potentially of a high risk for cyber-bullying (Cross et al., 2012).

Carrick-Davies (2011) researched young people excluded from mainstream schools and who attend alternative education settings. He found that their off-line behaviours often translated to the on-line environment. He also discovered that most of this group of young disaffected people accessed the internet, in particular social networks via mobile phones. This technology was viewed as essential to them to give them identity, connection and a sense of community. Carrick-Davies recommends that e-safety is embedded into the wider teaching of emotional, social and digital literacy in all schools from an early age.

A report outlining the discussions of an expert group seminar on e-safety and vulnerable learners found that 'It should be clear that there is no single or simple definition of vulnerability to be obtained. Rather, many factors combine to render some children vulnerable to online risk, under particular circumstances, and with diverse consequences. ... we still lack a thorough understanding of when, why and how children become vulnerable.' (Livingstone and Palmer, 2012, p. 9–10). They also noted that despite there being some e-safety guidelines aimed at learners with special educational needs (see for example Childnet International, Know IT All for Teachers – SEN (<http://www.childnet.com/resources/know-it-all-for-teachers-sen>), there is very little published research on e-safety for children with special educational needs and the report calls for this to be urgently addressed.

2.4 Summary

The research evidence points to a continuing challenge in the provision of appropriate technologies for learners with special educational needs and disabilities.

There is variable access to support and expertise in the use of assistive technologies, or an understanding of appropriate teaching and learning strategies that incorporate ICT in order to meet the needs of learners with special educational needs. In addition, the provision of assistive technologies for learners with disabilities is variable.

There has been progress in the provision of accessible information and learning content for learners with disabilities. However, there is still much that needs to be done in this area, ranging from the education of developers and providers, including teachers, and the awareness and encouragement of the adoption of standards and good practice. Although there is a wealth of information on providing information in accessible formats, there is little evidence this is being applied or is translating into a better learning experience for those that require access to it.

There is a continuing digital divide, which significantly affects learners with special educational needs. It is now recognised less about access and affordability, and more about the skills required to get the most from online technologies for social, economic and learning purposes. Many young people access information and advice (sometimes through engagement with others) via the Internet and social media, but little research exists on the implications for learners with disabilities and SEN, with the e-safety implications for vulnerable learners not being fully addressed.



3. TRAINING OF EDUCATIONAL STAFF IN THE USE OF GENERAL AND SPECIALIST ICT

Teachers are essential in ensuring the successful exploitation of ICT in inclusive education and require education and training to equip them to succeed. Experience of ICT initiatives generally, and in the area of technologies for young people and adults with learning difficulties and disabilities specifically, demonstrate that providing the technology itself is not enough. The European Agency for Development in Special Needs Education and UNESCO IITE (2011) recommends that teachers are required to be educated/trained in: education and pedagogy; working in inclusive education settings supporting learners with diverse needs; using ICT for education, and using ICT for learners with disabilities and special needs.

Schleicher's (2012) report indicates that in the 18 OECD countries participating in TALIS (the OECD Teaching and Learning International Survey) the aspects of teachers' work with greatest need for development is 'teaching special-needs students', followed by 'information and communication technology teaching skills' and 'student discipline and behaviour'. The need for professional development in supporting learners with special needs can be especially challenging for schools in disadvantaged areas, as schools in these areas often have a wider range of abilities and needs. The combination of these factors is potentially a major challenge for teachers.

However, research shows that teachers widely recognise that ICT can enhance access and support the inclusive learning of children and young people with special educational needs, but continue to highlight the need for more information on how to choose and use them to achieve this goal (Benigno et al., 2007). Responses observed through country and European Commission level funded projects have often included the development of databases of hardware and software products that describe the capabilities of products, including their suitability or issues they may have for learners with SEN (Grant, 2006; Benigno, 2007). Some have also included case studies of practice or lesson delivery, but again focusing primarily on access to learning. This highlights the constant and on-going challenge faced by teachers wishing to provide an inclusive learning environment: ICT has the potential to support engage learners in ways not previously considered, but at the same time new technologies can become a barrier for some learners and may result in them being excluded.

Starcic (2009) reports on the use of a virtual learning environment (SEVERI) developed originally for learners with special educational needs in Slovenian schools, but later localised for six other European countries. This e-learning environment was designed to support young people by providing a bold, clear, well designed interface and personalised tools for learning and interaction. He researched the use of this environment by pre-service teacher education learners in an educational technology curriculum as a means of developing enquiry based planning and incorporating innovative use of ICT into their lessons to develop their competencies. Although noting that research indicates that inclusive practice and ICT skills are a recognised area of weakness by many teachers, Starcic found that this approach focusing on autonomy, inquiry, creativity and innovation was successful.

Lack of training for professionals working with young people who need Augmentative and Alternative Communication (AAC) is reported in various reports (Gross, 2010). In England for example, funded initiatives have been put in place to provide advice, guidance and



training materials as well as investment for the sustainability of centres which provide training due to the required high level of expertise in this field.

At a more fundamental level, Ribera et al. (2009) call for the need to include basic ICT skills training in initial teacher training before moving on to more complex aspects such as supporting inclusive learning. They highlight the need to focus on the features of the operating system and productivity tools, especially accessibility features that provide a 'no cost' solution before moving on to more expensive options.

The concerns about teacher training is not new. Nearly 10 years ago *eLearning: Designing Tomorrow's Education* (European Commission, 2003), a staff working paper examining research under Framework Programmes 4 and 5 concluded that: 'besides access to technology, a number of other factors determine the success or failure of ICT-related educational innovation. Teacher training appears to be a critical factor. ... Research demonstrates that educational institutions are social organisations that both influence the ways in which an innovation will be adopted and are influenced by that innovation' (p. 9).

Recent research (Innovative Teaching and (ITL) Learning Research, 2013) suggests that the following is required for innovative teaching identified to flourish:

- Teacher collaboration that focuses on peer support and the sharing of teaching practices;
- Professional development that involves the active and direct engagement of teachers, particularly in practicing and researching new teaching methods;
- A school culture that offers a common vision of innovation as well as consistent support that encourages new types of teaching.

Fullan, in the same research report (ITL, 2013), looks at the available research findings from the perspective of whole system change and notes that although there is a clear empirical framework for how technology and pedagogy can be effectively integrated, the available research also demonstrates that there is a long way to go for this to be achieved. He highlights the need for a focus on concrete, describable and innovative teaching practices, achieved through developing collaborative, focused cultures at the school level, a new role for the principal as lead learner and supporter, and the identification of lead teachers to play a supportive and collaborative role among peers. Fullan also suggests that at national level having a small number of ambitious goals, and developing a corresponding set of coherent, integrated actions to pursue the goals is necessary.

3.1 Initial teacher education

Underlying the process of inclusion is the assumption that the general classroom teacher has certain knowledge and understanding about the needs of different learners, teaching techniques and curriculum strategies. The need for 'high quality' teachers equipped to meet the needs of all learners becomes evident to provide not only equal opportunities for all, but also education for an inclusive society (European Agency for Development in Special Needs Education, 2012c). Reynolds (2009) says that it is the knowledge, beliefs and values of the teacher that are brought to bear in creating an effective learning environment for pupils, making the teacher a critical influence in education for inclusion and the development of the inclusive school.

Cardona (2009) notes that concentration on initial teacher education '... would seem to provide the best means to create a new generation of teachers who will ensure the successful implementation of inclusive policies and practices' (p. 35).



The OECD Report *Teachers Matter* recognises that the demands on schools and teachers are becoming more complex as society now expects schools to deal effectively with different languages and student backgrounds, to be sensitive to culture and gender issues, to promote tolerance and social cohesion, to respond effectively to disadvantaged students and students with learning or behavioural problems, to use new technologies, and to keep pace with rapidly developing fields of knowledge and approaches to student assessment (OECD, 2005).

It has been argued (European Agency for Development in Special Needs Education, 2013b) that although definitions relating to inclusion have broadened, which is reflected in legislation, researchers have questioned how much practice has actually changed. Often teachers may not feel well equipped for dealing with diversity within the classroom. Attitudes, beliefs, skills and knowledge are an important part of teacher education (Beacham and Rouse, 2012). The European Agency for Development in Special Needs Education and UNESCO IITE (2011) recommends that teacher education for all teachers should take a developmental, *competency* approach, as:

competences have the components of attitudes and beliefs, as well as knowledge and skills. Teacher competences need to cover general skills in education and pedagogy, as well as inclusive education approaches. Embedded within such training, there needs to be a consideration of the use of ICT in education generally, as well as the use of ICT for learners with disabilities specifically' (p. 89).

A Scottish University adopted a 'learning without limits' element, when investigating practice in initial teacher education. Researchers found that the pro-inclusive attitude was sustained once the teachers were in the school environment (counter to some other research findings). The authors suggest there is a need for inclusion specialists to support the process in much the same way as special needs co-ordinators are required (Beacham and Rouse, 2012). However, Beacham and McIntosh (2013) found that although there were strongly positive attitudes towards ICT and towards inclusive education, the impact of ICT as part of inclusive practice is not well understood by student teachers and their attitudes towards digital equality do not feature highly in inclusive practices. The authors go on to suggest that this seems to 'result in ICT being used less in terms of inclusive education and more from the perspective of accessibility to the curriculum' (Beacham and McIntosh, 2013, p. 1) and that 'it is the attitudes of many teachers that take precedence over the choices and preferences of a learner. Furthermore, in the case of inclusive e-pedagogies, digital technology is more likely to be used based on a teacher's attitudes towards ICT and not on inclusive practices' (p. 9).

Beacham (2011) recently observed this in new qualified teachers, all of whom had undertaken specific inclusive education training. He found that although they were well versed in inclusive education pedagogy and had a good understanding of e-learning principles, there were often significant barriers to putting this into practice. All seemed aware of how this could impact on access, but less so of how this can affect learner achievement and belonging. He also found limited understanding of the potential impact of digital exclusion (limited access to technology outside of school and poorer digital literacy skills). This limited the opportunities for inclusive processes within the classroom such as trust and working with or through others.

Research suggests that many student teachers in initial teacher education have not formed clear opinions about inclusive teaching and this stage provides an opportunity for influencing attitudes through provision of a carefully designed learning programme (European Agency for Development in Special Needs Education, 2010). A postgraduate



course for special needs and inclusive education developed by a university in Northern Ireland identified that online conferencing fostered professional dialogue and students reported positively on the blended approach which included interviewing experts online as well as meeting them in person. It was also reported as having potential for the development of communities of practice (Lambe, 2007).

A blended learning approach integrated into teacher training on learning disabilities in the Apulia region of Italy used an e-learning environment and reported real benefits for the learners in terms of motivation, independence and responsibility for their learning (Limone and Dipace, 2012). Albanese et al. (2011) also report positive outcomes from the collaborative use by student teachers of a support wiki and forum.

Teachers' positive attitudes towards inclusion depend strongly on their education, experience with learners having special educational needs and the availability of support (Benigno et al., 2007). Experts in accessible ICTs recommended that skills, attitudes and knowledge of this area is required by all teachers and should be provided during pre-service and in-service education and training. They state that teachers need training in accessible ICTs and need to know how specialised AT and mainstream accessibility features can support learners of all abilities as well as be able to produce adapted digital materials. As the technology is constantly developing, training teachers also needs to investigate and explore the use of technology both for the learners they teach and as part of their own lifelong learning (UNESCO, 2012b).

There are benefits of including challenging and engaging practical experience in real settings so that student teachers can then apply their knowledge and theoretical understanding, with responsibilities for every child (Mavrou, 2011a). As Hagger and Macintyre (2006) state: 'whatever student teachers need to learn to do as teachers in schools for their future careers, it is in schools that they need to learn to do these things' (p. 65). Although quality inclusive placements may be difficult to organise, the country reports show many examples of innovative practice where carefully planned experiences and quality support for student teachers address the theory to practice gap and provide them with an opportunity to examine their own beliefs and values and begin to develop the skills necessary to meet diverse needs in the classroom. The importance of larger scale, systemic change to develop more inclusive schools and the need for education and professional development for mentors and school-based supervisors of school practice, as well as teacher educators, are also raised (European Agency for Development in Special Needs Education, 2011d).

3.2 Continuing professional development

Governments are in an ideal position to promote national level training that can influence attitudes and practice to inclusive education. Lindsay et al. (2011) recently evaluated a number of overlapping national level English initiatives that ran from 2008–2011 that were designed to improve teacher workforce skills in relation to SEN and disabilities. The Special Educational Needs and Disabilities Training Toolkit and on-going professional development for teachers, the Inclusion Development Programme (IDP) both focused on meeting the needs of young people with SEN in an inclusive way. The research indicated that IDP-related continuous professional development (CPD) was effective in raising the knowledge, understanding and confidence to teach learners with SEN for the majority of teachers involved. The work suggests that measurable improvements in learners academic progress can be expected as a result of improved teaching and learning prompted or reinforced by CPD around inclusion.



A number of factors were identified as important, including developing inclusive education as a school improvement issue (reducing the likelihood of it being solely about learners with special needs) and also engaging school leaders in embedding SEN in whole school development. The programme also provided opportunities for those involved to share resources and ideas through websites and provided a forum for educational professionals to learn from each other.

Working in England, Male (2011) reports that far fewer teachers are accessing CPD relevant to the needs of learners with SEN and that the Salt Review (DCSF, 2010) respondents expressed concern that they were inadequately prepared to teach learners with more complex needs. Her research indicated that teachers feel a need for training to meet the needs of this group and also those learners with social emotional and behaviour difficulties.

The challenge of accessing appropriate training due to lack of time or distance of the training centre is addressed in a number of countries through the use of technologies for remote learning. One such example is 'Tailored Continuing Professional Development' in Portugal (see <http://nonio.es.ipsantarem.pt/crticsantarem/>).

Online open training materials commissioned by the Department for Education in England included some aspects of ICT to support learners with complex needs. However, use of these materials was voluntary and not linked to formal qualifications (see <http://www.education.gov.uk/lamb/> and <http://www.education.gov.uk/complexneeds/>).

The challenge faced by teachers in exploiting ICT for the achievement of all learners is reinforced by the expectations highlighted in the UNESCO *ICT Competency Standards for Teachers* (UNESCO, 2008 and 2011):

The use of new technologies in education implies new teacher roles, new pedagogies and new approaches to teacher education. The successful integration of ICT into the classroom will depend on the ability of teachers to structure the learning environment in new ways, to merge new technology with a new pedagogy, to develop socially active classrooms, encouraging co-operative interaction, collaborative learning and group work. This requires a different set of classroom management skills (p. 8).

The UNESCO *ICT Competency Standards for Teachers* set out six components and three increasing levels of competency, as well as detailing 18 study modules with curricular goals and the skills that teachers should demonstrate. The development/improvement model starts with digital literacy, with progression to knowledge deepening and culminates in knowledge creation and applies these to the main aspects of teachers work: understanding ICT in education, curriculum and assessment, pedagogy, ICT, organisation and administration and teacher professional learning.

The expectations and increasing complexity of teaching and learning, including the use of ICT and the diversity of learner needs, highlights the need for high quality professional development. Schleicher (2012) indicates this is necessary to:

...ensure that all teachers are able to meet the needs of diverse learner populations, effectively use data to guide reform, engage parents, and become active agents of their own professional growth. The development of teachers beyond their initial education can serve a range of purposes, including to:

- update individuals' knowledge of a subject in light of recent advances in the area;



- *update individuals' skills and approaches in light of the development of new teaching techniques and objectives, new circumstances, and new educational research;*
- *enable individuals to apply changes made to curricula or other aspects of teaching practice;*
- *enable schools to develop and apply new strategies concerning the curriculum and other aspects of teaching practice;*
- *exchange information and expertise among teachers and others, e.g. academics and industrialists; and/or*
- *help weaker teachers become more effective (p. 73).*

Mavrou (2011a) when reporting on the design of the design and implementation of an assistive technology course for a Masters degree on special/inclusive education, suggests that the design and development of a course related to technology and disability is not only challenging because of the rapid changes of technology, but is more challenging because of all the of historical, social, political, cultural and economic determinants that have already influenced the participants' state of mind.

Reporting on a survey of the use ICT in education of schools in Europe, Wastiau et al. (2013) observed that around 70% of learners at all grades are taught by teachers who have engaged in personal learning about ICT in their own time. They noted however, that although online resources and networks are widely available in Europe, they are a relatively new way for teachers to engage in professional development, and only a minority of these opportunities are used by schools.

A real challenge for many educators is the diversity and volume of advice now available on supporting learners with special educational needs. Although there was advice on using IT a decade ago, this has now increased significantly. Academics, software and hardware companies, parents, people with disabilities, charities and other groups, as well as teachers are providing information, advice and guidance more than ever before, both in print and online, through websites, blogs and online communities of practice. Some of the advice focuses on specific individual needs and touches on the use of ICT, while others sources examine assistive technology applications linked to a particular disability or impairment, while relatively few sources bring these together to focus on technology for inclusive learning (Abbott et al., 2011; McKnight and Davies, 2012).

This was also borne out by literature abstracts provided by countries involved in the ICT for Inclusion project (<http://www.european-agency.org/agency-projects/ict4i>). While nearly one hundred abstracts were provided, less than 10% focused explicitly on ICT for inclusive education, with the majority reporting on specific aspects of technology support for a disability or special educational need.

The interactive whiteboard, which has been widely adopted across Europe (European Commission, 2013) and internationally, and has been reported as a tool for inclusive learning, although some have concerns that it may not being used fully to meet individual needs (Cecchini et al., 2009; Bonaiuti, 2010) and that more on-going training is needed by teachers.

The *Four in Balance* report from Kennisnet (2012) for example reports that teaching using interactive whiteboard can provide a richer form of instruction with the multimedia principle, an effect which occurs when combining text, images and audio, shown to improve learners' motivation and help them grasp complex concepts more rapidly.



However, the report authors caution that the information structure should correspond to the way learners absorb information, and they should be stimulated to focus on the relevant information presented through the various media. When the right conditions are in place, however, learners receiving instruction in this way perform better (Kennisset, 2012; reporting Heemskerk et al., 2012).

In a small scale qualitative study the challenge for teachers in matching appropriate use of technology with the needs of some learners is again highlighted; Gauci (2011) in a small scale study found that positive intentions regarding ICT use with early years learners with ASD are not necessarily reflected in the most appropriate use, as educators also need to have appropriate skills and knowledge about the technologies use and application. Gauci found for example that the use of ICT with these pupils was often perceived as an isolating experience and that classroom assistants often used the technology rather than the learners themselves. She reported that teachers expressed the desire to receive more training to develop appropriate skills in using ICT.

Borg (2010), examining what makes an effective multidisciplinary team that can assess the assistive technology needs of individuals with cerebral palsy, highlights the need for reliable up to date information on the range of products to be available to all parties. This raises the issue of how to ensure experts in assistive learning technologies access and maintain high levels of professional knowledge. Bush et al. (2008) also highlighted that how professionals accessed professional development opportunities to ensure they exploited technology to meet the needs of learners with AAC needs was variable not only across England but also across different professions. This view is reinforced by other research (Atkins, 2009) highlighting the need for a more systematic approach to encourage both mainstream teachers and specialist teachers to access on-going CPD in technology for inclusion.

Most teachers are positive about the value and impact of ICT on teaching and learning and while convincing teachers and school heads is no longer a priority (Becta, 2010), equipping teaching staff with the digitally based teaching competences and experience they need for effective and efficient practice in the classroom is clearly a priority. Support at EU level could usefully look at capacity building, specifically in the area of new patterns of teacher professional development through online learning communities and other schemes closely integrated into teacher daily practice (European Commission, 2013).

3.3 Teachers' use of ICT to support their classroom practice

The value of ICT to support teaching and learning was reinforced by Sutton Trust-Education Endowment Foundation, who produced a summary of educational research on resources to improve the attainment of disadvantaged learners. It identified a wide range of interventions (33 and growing) with the toolkit summarising each in terms of impact on attainment, the strength of the evidence supporting them and their cost. Digital Technology was rated as having moderate impact for high cost, based on extensive evidence (Sutton Trust-Educational Endowment Foundation, 2013).

Mitchell (2012) also references a range of evidence based teaching strategies that he identified from the literature (Mitchell, 2008). He makes the point that although there are approaches that benefit learners with special educational needs, almost all have a general applicability. No single approach is advocated, rather that teachers develop a repertoire of best practice that is sympathetic with their context. It is interesting to note that although there is not always a direct match between those suggested Mitchell and those of the Sutton Trust-EFF Toolkit (2013), at the time of writing there were seven overlapping areas,



based on the Sutton Trust descriptors, with the majority having moderate to very high impact for low to moderate cost. There were:

- peer tutoring
- meta-cognition and self-regulation
- behaviour interventions
- social and emotional aspects of learning
- digital technology
- parental involvement
- phonics.

There was also agreement on the negative impact of ability group as a strategy, with the Sutton Trust-EEF indicating that although this has little cost implication, it has a negative impact (based on moderate evidence), with feedback, meta-cognition and self-regulation, and peer tutoring having high impact.

Reports into the use of ICT highlight the need to focus on these strategies along deep learning (Groff, 2013) and there is some evidence that ICT can support this along with helping to make hard to teach subjects more accessible using technology (National Association for the Teaching of English, 2008).

Meijer (2003) identifies key factors in transforming classroom practice to support inclusion:

- Co-operative teaching (support and cooperation of professional colleagues within and beyond the school);
- Co-operative learning (peer mentoring and flexible pupil grouping);
- Collaborative problem solving (focus on addressing behaviour issues);
- Heterogeneous grouping (but more differentiated when required to meet diversity of need);
- Effective teaching (high expectations and individualised learning plans, with systematic monitoring, assessment, planning and evaluation of learners work);
- Home Area system (with fixed learning areas supported by a team of teachers);
- Alternative ways of learning (learning to learn and problem solving).

Examples of both collaborative teaching and co-operative learning to support inclusive education facilitated through ICT are provided in a handbook on using digital technologies to promote inclusive practices in education (Walker and Logan, 2009). These include the use of video and digital cameras, school radio stations. Collaborative problem solving can foster both academic and key skills, including: working as a team player, active listening, assertion, managing conflict through group resolution, critical thinking – forming a fluid argument, negotiating and fostering mutually respectful relationships. It can be argued that many of these strategies can be facilitated and enhanced through the use of ICT, and that at scale, technology greatly increases the opportunity and capacity for these outcomes (Groff, 2013).

The majority of teachers realise they have a significant role to play to promote and realise inclusion, but many indicate that they need specific information and guidance on how to choose and use ICT to achieve that aim (Benigno et al., 2007).



Loveless (2009) in her review of literature on pedagogy and ICT observes that things have moved on from Shulman's (1987) characteristics of teacher knowledge, and proposes that it now 'incorporate[s] understandings of the construction of knowledge through distributed cognition, design, interaction, integration, context, complexity, dialogue, conversation, concepts and relationships' (p. 7). ICT as well as being a valuable tool for instruction (Kennisnet, 2011), is also ideal to support constructivist, knowledge construction, teaching and learning approaches that can help to deliver these new understandings of pedagogy.

Becta, in a research informed publication that matched ICT competencies to national professional standards for teachers, highlighted what this means for a teacher demonstrating effective practice with ICT (Becta, 2010b) in terms of skills and practice, knowledge and understanding, and values and attributes. This resource provided teachers with an easy way of evaluating their practice and planning development activities and included the prompt for teachers to consider whether they provide adaptive solutions for learners with special needs have appropriate specialist knowledge of ICT and manages learners' use of technology appropriately to promote engagement and learning.

A publication that focused specifically on special needs and inclusive ICT approaches based on this self-assessment approach was also produced (Becta, 2010c). This checklist approach, along with school improvement tools such as the ICT Self Review Framework (Naace, 2012) are examples of nationally developed resources to help schools reflect on how they integrate technology into all aspects of running a school. The Self-Review Framework, which provides schools with a means of assessing and accrediting their whole school use of ICT, has inclusion and diversity considerations integrated into the framework and examples.

To ensure that young people with additional learning needs are included within the teaching and learning environment with appropriate access to, or use of, mainstream technologies, adaptations are necessary or the provision of personal assistive technologies are required. Beningo et al. (2007) found that teachers need support in identifying and evaluating software and hardware suitable to meet this need. Advice for teachers on assessing the quality and appropriateness of digital learning resources has been developed and often include principles of accessibility and inclusion (Becta, 2007a). This guidance included a core principle that digital learning resources should, in most circumstances, support inclusive practices in their design and in the supporting materials they offer practitioners and learners. It suggested that teachers can do this by offering the flexibility to adapt resources to different learning preferences, or by suggesting alternative ways of addressing the intended learning objectives, where the digital learning resources are limited in relevance.

In addition, a core design principle of accessibility should be followed; accessible design of digital learning resources concerns ensuring that no user, practitioner or learner is unreasonably prevented from benefiting from a resource simply because of their access requirements or preferences. The report acknowledged that there is still debate around the best approaches to accessibility, but core aspects that all designers must address are that:

- accessibility issues must be considered from the earliest point of the development process;
- accessibility is not simply a technical issue and all aspects of design must be considered, for example the user interface and the layout of information and support materials;



- resources must offer relevant information on the accessibility features that are included and/or relevant technical specifications (Becta, 2007a).

Heemskerk et al. (2005) reviewed the literature to identify to what extent the characteristics of educational ICT tools enhance or inhibit learning for different groups of learners. This was carried out to test the assumption, validated by previous researchers, which found that the design of software can have built in assumptions, for example of typical users' attitudes or interests. Where learners are not able to identify with the supposed user, this may inhibit their learning. Ultimately, this can result in differences in participation, attitudes and learning outcomes in both ICT itself and subjects in which ICT is used as an educational tool.

Heemskerk and colleagues acknowledge the inherent difficulties of trying to design software to meet the potential interests, gender specific, cultural, social and other aspects, but argue that teachers (maybe working with learners themselves) should be aware of these and where possible provide a mix of materials across the teaching and learning offered by the institution. The authors go on to argue that the multisensory, non-linear and contextual aspects of educational software or digital learning materials mean that a critical consideration of its content and how it is used is needed. The research highlights some important issues regarding independent use of ICT materials and the need for educators to consider ICT materials in possibly a more critical way than other teaching and learning resources (such as books for example).

Online communities and Web 2.0 technologies can encourage and support communicative, collaborative and community building, for example through social software which can be used to foster a learner voice culture, a more personalised approach to learning, and improved knowledge-sharing with others (Walker and Logan, 2009). Crook et al. (2008), who examined the impact, barriers and issues of implementing Web 2.0 technologies in secondary schools, noted that practitioners found it engaged many learners who were tentative contributors in class or who had special needs, and supported learners' natural curiosity by enabling expression through different media and a sense of audience, providing access to further resources and the ability to gain confidence and skill in speaking and presenting.

Walker and Logan (2009) cite an English teacher who found that learners who would not sit down and put pen to paper in their exercise book will, after midnight, put postings on a forum. ICT can essentially appeal to different learners' different learning styles. Other teachers commented that homework had been improved, that the internet introduced greater variety and removed some laborious aspects with technology generally seen to be valuable for learners with poor literacy skills.

Dudzinskienė et al. (2010) propose innovative inclusive teaching and learning methods using ICT for primary school teachers, highlighting the need for sharing between colleagues, individualisation of learning, the encouragement of learner collaboration, and family involvement. Čedavičienė and colleagues (2012), also writing about innovative teaching methods and ICT developed in Lithuania, encourage schools teachers to recognise that learning is a personal and unique process. They propose a six stage implementation process for innovative teaching methods with ICT emphasising the importance of working in a collaborative environment. The recommended stages for innovative teaching methods and ICT implementation are:

- precise definition of the desired innovations;
- formation of the innovation implementation team;



- team activity co-ordination and organisation;
- innovation implementation strategic planning;
- reflection on and evaluation of the achieved results;
- teacher motivation and in-service teacher training

3.4 Teachers' competences in using ICT to support learning

In the Netherlands, an annual survey reports on the use and benefits of ICT in Dutch schools in primary, secondary and vocational education and training. The 2011 report (Kennisnet, 2011) highlights a national model to both track progress as well as support schools in improving practice. The report highlights recent research findings that support the view that for improvements to be made, they need to be driven by human factors – namely *vision* and *expertise* – supported by the technological factors of digital learning materials and ICT infrastructure. An approach to co-ordination that puts technological factors before pedagogy has only a limited chance of success. Four crucial human factors, identified by researchers as success factors, are:

- The ICT (facilities) match the teacher's views on education. The alignment of an ICT application with pedagogic principles increases the likelihood of it being used;
- The teacher is familiar with ICT and is capable of using it. Without this the use will be ineffective, but to have an impact usage needs to then be integrated into the subject or pedagogic approach of the teacher;
- The teacher is convinced of the added value of ICT. Extending this it is highlighted that a teacher's professional development should lead to an understanding of which ICT related pedagogic strategies lead to improved learner performance, and
- There is leadership that allows teachers to be involved in innovation. Research indicates this can motivate and allow a shared vision to be developed not only with trend-setters but also other teachers who are less convinced.

A report on teacher education for inclusion across Europe (European Agency for Development in Special Needs Education, 2011b) summarised the key competencies that the majority of countries identified as most relevant to inclusive practice and it is encouraging to see the degree of alignment with the OECD report cited above and the UNESCO *ICT Competency framework*. Many of these are not surprisingly attitudinal, and include:

- *Reflection on their own learning, seeking out information to overcome challenges and support innovative practice;*
- *Attending to the well-being of learners, taking responsibility for meeting all learning and support needs and ensuring a positive ethos and good relationships;*
- *Collaborating with others (professionals, parents) to assess and plan an engaging curriculum to meet the diverse needs of learners, attending to issues of equality and human rights;*
- *Using a variety of 'inclusive' teaching methods and group and independent work appropriate for the aims of learning, the learners' age, and their abilities/stage of development and evaluating learning and the effectiveness of methods used;*
- *Addressing language learning in multi-lingual contexts and valuing cultural diversity as a resource (p. 51).*



The importance of teamwork, with collaboration of professionals from initial assessment of assistive technology for learning for an individual, through implementation, follow up, feedback and re-evaluation is highlighted (Mavrou, 2011b). Mavrou also notes that training and support, consistency of approaches between different disciplines, and access to relevant assistive technology in the home are importance policy and practice issues.

Experts from education, industry, government and other stakeholders in the use of accessible ICTs (UNESCO, 2012b) recommended teachers and schools should:

- Make maximum use of the access features built into current technology, such as the operating system or productivity tool accessibility checking options;
- Assess learning and ICT access preferences at an early stage and enable learners to select their own personal preferences for their computer and store them, including assistive technology options (either on the network, on pen drives or remotely);
- Create an inclusive and positive attitude towards the use of technology for learning, where accessible ICT is viewed as a positive and equitable support for all not just those with disabilities.

3.5 Summary

It is widely recognised that good quality teaching is essential to the education of all young people. It is also recognised that technology has an important role to play in the education of learners with special educational needs. The research, however, highlights the significant challenge of bringing all these aspects together – inclusive education that meets the needs of all learners, including those with special educational needs, combined with effective exploitation of ICT to achieve that aim.

There is evidence that a pro-inclusive education approach is sustained in the classroom following initial teacher education that includes that element. However, there is limited information exploring how this is translated into practice in terms of the use ICT.

Although there is growing research evidence of what works in terms of teaching and learning strategies, there appears to be a limited number of studies that focus directly on how these strategies can be enhanced through the use of ICT. Likewise, there continues to be a challenge around finding meaningful indicators of the impact of ICT on learning, beyond that of motivation, increased engagement and improved behaviour.

As a number of researchers point out, in the majority of cases there is no need for separate pedagogies for learners with special educational needs, but rather the application of the appropriate mix of existing tried and tested approaches, utilising a wide range of tools and techniques (including ICT) to maximise learning experiences.

Online communities of practice and networking are widely available across Europe, and viewed as a valuable means of real support, but are still seen as new with only a minority of teachers taking advantage of these opportunities.

The challenge for education systems appears to be how to ensure this can be supported – beginning during the initial education of teachers and ensuring appropriate CPD is available throughout their career.



4. MULTI-STAKEHOLDER RESEARCH AND DEVELOPMENT INTO ICT

Innovation in technology for inclusion concerns the development of new tools, and also new ways of using ICT, may come from researchers, developers or professional educators. The literature points increasingly to the recognition that it is essential to involve users in the design and implementation of inclusive educational technologies, and it is important for the different stakeholders, designers, people with disabilities and the educational staff who work with them need to network and share information (Abbott et al., 2011; European Agency for Development in Special Needs Education and UNESCO IITE, 2011; Wright et al., 2011).

4.1 Design for All

The Design for All (DfA) approach is increasingly promoted as a means of accommodating individual differences. Design for All is used to describe a design philosophy targeting the use of products, services and systems by as many people as possible without the need for adaptation. Design for All is design for human diversity, social inclusion and equality (EIDD Stockholm Declaration, 2004: <http://www.designforalleurope.org/Design-for-All/EIDD-Documents/Stockholm-Declaration/>).

The concept encourages manufacturers and providers of services to produce new technologies which can be accessed by nearly all potential users without modification. The approach recognises that where this is not possible, the product or services should be easily adapted to meet different needs, or use standardised interfaces so that assistive technologies will work with them. However, there is a need for independent longitudinal research that focuses more on the impact of the use of assistive technologies on learning outcomes rather than adoption rates and design (Abbott et al., with Salminen, 2008).

The Global Assistive Technology Encyclopedia initiative (<http://abilitynet.wetpaint.com/>), which provided a collaborative environment for assistive technology professionals, was also found to be effective in enhancing knowledge about Design for All principles. This assistive technology resource was established to promote knowledge exchange in this subject domain and involved mainly professionals, developers, vendors as well as people with disabilities. The platform provides an easy way of providing up to date information, advice and views on emerging products as well as over 500 videos, at the time of writing, which provide examples of use by practitioners (Redecker, 2009).

Rather than requiring special accommodations, increasingly people with and without disabilities are taking advantage of access features built into mainstream technology and systems (Abbott et al., 2011). Some technologies with such access features have been used for some considerable time, but there has often been little or no research into their effectiveness (Abbott et al. cite voice output communication aids and speech recognition software as examples here). However, they point out that users are starting to be asked what they want from products, particularly in the area of augmentative and additional communication (AAC), rather than development just focussing upon professional input.

Abbott et al. (2011) acknowledge that there has been a shift since Salminen (2008), albeit restricted, in terms of the scope/definition of the research, literature review of European research literature on assistive technologies for children with disabilities, which at the time highlighted a dearth of findings. Definitions of assistive technologies, as highlighted earlier, continue to be debated, however, it is clear from recent reviews that there has now been wider research in more wide ranging areas. Much is in line with the UN Declaration on the Rights of Persons with Disabilities focus on *inclusive* rather than *special* education, and



there has been some shift in focus of research to issues of rights and entitlements to inclusive education and appropriate support. Abbott acknowledges that there is still a relatively small number of research papers and projects, but goes on to highlight 5 key themes (Abbott et al., 2011):

- increased user involvement, using participant design approaches;
- the mainstreaming of mobile devices with the development of assistive technologies that work with these being built into their design rather than added afterwards;
- assistive technologies usage increasingly visible and used by many people, including those without disabilities, such as speech (voice recognition to create text or to search, and speech synthesis as well as symbol support for text);
- wider interaction and collaboration afforded by technology between people with and without disabilities due to the increasing diversity of mainstream multimodal literacy;
- development of new technologies and interfaces, such as eye gaze and neural control of devices, games interfaces that exploit motion sensing technologies, and robotics.

A related concept to Design for All is Universal Design for Learning (see CAST <http://www.cast.org/udl/index.html>). This is based on research from learning science and provides an educational framework to guide the design and development of flexible learning environments. The principles are widely recognised with guidelines (CAST, 2012) on using ICTs translated into several languages. The three main principles, each with accompanying guidelines, are:

Principle 1: Provide multiple means of representation – with guidelines to provide options for perception; language, mathematical expressions, and symbols; and comprehension;

Principle 2: Provide multiple means of action and expression – with guidelines to provide options for physical action; expression and communication; and executive functions;

Principle 3: Provide multiple means of engagement – with guidelines for recruiting interest; sustaining effort and persistence; and self-regulation.

Reid et al. (2013) contend that the use of Universal Design for Learning and individualisation of learning tools, such as mobile technology, can support the integration of interventions that support learners with dyslexia into the curriculum. The use of apps and mobile technologies allow for easier delivery of tried and tested accommodations and encourage more independence and confidence in learning.

McKnight and Davies (2012) note that there are many sets of guidelines for educators on how to present materials for learners with special needs in an accessible way, the majority of which follow standard usability guidelines. They argue that there is a benefit for these separate guidelines as it brings the guidelines and underlying research to an audience that may be unfamiliar with them, may reveal differences for particular groups of users, and can help designers prioritise requirements for specific groups.

4.2 Involving users in the design of technology for learning

The need for more participant research design approaches that involve other key stakeholders can have a significant impact on the effectiveness and impact of assistive



technologies such as teachers, carers, therapists and other learning support professionals is highlighted by researchers (Abbott et al., 2011; Wright et al., 2011).

An example of a multi-disciplinary approach to participatory design to include learners with complex needs and promote inclusive practice can be found in the work of Keay-Bright (2007) whose research focuses on games and exploratory play for early years and early development, and in particular the use of touch based technologies such as the interactive whiteboard and tablet computers. This research highlights the importance of involving end-users, in this case children with autistic spectrum disorders (ASD), and argues the importance of participatory design process and the design of play to provide a resource that meet the needs of all involved. The challenge for designers includes firstly the idiosyncratic behaviours of the young people who, she reports, take ownership of the play environment the software and interactive whiteboards offers, and secondly, how this ownership can be built into the design process. The research highlights the benefits of this type of interface on enhancing the learning of young people with ASD (Keay-Bright, 2007).

There are growing numbers of research projects that involve users with learning difficulties in both the design and evaluation of new technologies for education, for example between developers and educationalists to develop software and virtual learning environments for young adults with cognitive and physical disabilities (Maquire et al., 2006). Mazzone and colleagues (2011) highlight the multimedia advocacy approach which adopts a participative approach to the design of websites particularly designed for adults with learning difficulties. They believe their approach has relevance for Design for All and recommend that contact with the users has to be supported by a psycho-educational professional; features that could be considered usable according to commonly applied principles need to be adjusted and tested in each specific context of use; that the Web Accessibility Initiative Guidelines (W3C, <http://www.w3.org/WAI/>) and personalization standards implementation is essential to achieving the necessary flexibility and adaptability; users' engagement is important to increase users' motivation in completing the task and their familiarisation and satisfaction with using the product, and the system's adaptability and flexibility is crucial as the specific user requirements are changeable and very dependent both on unpredictable external and internal factors – more than with most users.

In additional to web accessibility guidelines, advice and guidance for developers of digital content for e-learning have been produced and include accessibility and inclusion features as well as other technical, usability and curriculum relevant criteria (Becta, 2007b).

One challenge highlighted in the Agency report into the use of ICT and SEN in 2001 (European Agency for Development in Special Needs Education, 2001), still seems relevant today, as does the possible means of addressing it. There continues to be a dearth of commercially available materials for young people with learning difficulties that provide age appropriate content (matching literacy level, cognitive ability and life experience) that support the development of daily living skills or life skills (Røddevand and Hellman, 2011). Their research identified eight areas where Instrumental Activities of Daily Living training are required and the lack of products appropriate to the needs of these young people. They found that most commercial products were aimed at beginner's level and material targeted at their age group containing more complex language and with less motivating elements. This raises the issues of universal design of educational products, user involvement in the design and of teachers having time or expertise to provide personalised multimedia materials.



McKnight and Davies (2012) highlight some of the practical and ethical issues in involving users with special educational needs in research. They cite the research of Davis et al. (2010) into interactive software use by young people with autism, which indicates that for some groups of learners, user centred or participatory design may not be appropriate. There is also the real challenge of ensuring informed and valid consent to be involved in research, particularly with young people with complex special educational needs (McKnight and Davies, 2012; Lewis and Porter, 2007).

Andreou and Mavrou (2012) in their qualitative research into the design and development of instructional materials in the subject of Greek Language applied the principles of Universal Design for Learning. They found students' use of symbols to facilitate written instruction enabled them to undertake work that would otherwise not have been possible and to complete it faster. User involvement also led to increased use of coloured worksheets as students found them more motivating, highlighting the importance of designing learning resources in response to learners' requirements. The move from textbook to the use in schools of new media and digital tools for trans-media storytelling also offers opportunities for participatory design and inclusive personalised learning paths (Limone, 2012).

Luckin et al. (2012) highlight the disconnection between industry, research and practice and the need for these to work together to test ideas and evaluate potential innovations before they go to market. Such an approach would develop an evidence base that is consistent and can be applied to practice. Some researchers and advocacy groups recommend including learners in all aspects of the design, development, implementation and marketing of technologies in order to develop technology that is both accessible and responsive, and an accessible and inclusive approach should also be applied to specialised technologies (Foley and Ferri, 2012). A notable example of this is the recommendations by One Voice for Accessible ICT on producing accessible apps (<http://www.onevoiceict.org/node/86>).

4.3 Universally accessible technology

Some researchers – such as Foley and Ferri (2012) – suggest that currently technology is designed in a way that is deeply embedded in social, economic and cultural practice. These have an impact on the whole process of design, marketing and implementation of technology. Foley and Ferri argue for the need for all technology to be accessible and inclusive with a shift from the current focus on assistive technology, which they argue creates subtle forms of exclusion. They highlight many AT devices are not used due to their often unattractive or stigmatising design.

Hodkinson (2011) found in his study of electronic media in primary schools that the representation of disability is limited, with images being infrequent and where they were presented often showing or described in terms of a medical deficit.

Foley and Ferri (2012) argue that technology is designed in ways that reflect taken for granted ideas about what constitutes normal. They cite examples of exclusive practice, such as formal mechanistic processes around assistive technology provision in schools that matches technology to a student's impairment. They found more subtle examples, for example the way in which search engines may display results when a term related to a physical or sensory impairment is entered: the results typically focusing on rehabilitation or remediation, while other terms relating to race or sexuality provided a wider variety of results, often relating to social interaction (rather than medical ones). They highlight online learning environments as an example of a teaching and learning technology not typically



designed with people who have a disability in mind, and the subsequent need to provide accommodations is costly and time consuming.

Developers and providers of AT should also consider the impact on learner's self-identity when designing and recommending provision, as even small design errors or incompatible technologies and the use of assistive ICT may result in a focus on the impairment and reinforce negative stereotypes of disability (Söderström, 2013).

The inflexibility and high cost of many dedicated assistive technology devices compared to the relative affordability of mass market products such as the iPad, and the fact that investing in a dedicated device often commits the user to a technology that has been 'designed with very particular ideas about who disabled users are and what they want in a device' is highlighted in research (Foley and Ferri, 2012, p. 7).

Foley and Ferri (2012) state that assistive technology too often follows a reactive model rather than building in access from the beginning, noting that with the rapid pace of development of technology it is difficult for accessible standards to remain current. This is not to say that some products do not cross over between mainstream and disability specific solutions, and in some cases there are good examples of products that were designed specifically for people with disabilities in mind that provide a better experience for all users. These include predictive spellchecking software, computer touch-screens, synthetic speech and graphic symbols. The authors argue the need for accessible and inclusive technology which builds in accessibility from the start, includes disabled people in all aspects of the process from design to marketing of products with the aim of creating accessible and responsive products, by '... creating multiple points of access for users. This approach would consider the needs of those with cognitive, sensory and physical disabilities as important sources of diversity and complexity necessary to inform the design of technology to increase accessibility and usability for all users' (p. 8). They go on to suggest this approach could also be extended to the design of specialised technology, which would also be more acceptable to the user and is designed with social inclusion in mind.

4.4 Summary

Much of the research literature highlights the need for more multi-stakeholder approaches research into the design of assistive and accessible technologies. This section has highlighted, however, the intrinsic challenges this presents, ranging from the practical and ethical issues of participatory research design methodologies that involve learners with special educational needs, to the moral issues when using an intervention with one group of learners and not another.

There are signs of increased interaction between different disciplines in research that focuses on specific disabilities such as autism spectrum disorders, but there is still a lack of longitudinal studies on the effectiveness and impact of technology on learning.

In terms of multi-stakeholder involvement in providing accessible information, there seems to have been only slow progress in the adoption of standards and good practice at all levels. Although some governments are taking the lead in producing accessible websites, and in some countries procurement regulations encourage companies to provide products and services with built in accessibility, this does not necessarily translate to providers of education at all levels.

There continues to be a need for on-going education on all fronts for all the different professional that support the education of learners with special educational needs, in the



design of inclusive education, pedagogy, accessible learning resources and information. Input from a wider range of professionals, for example in the creative design field would help to make assistive technologies more socially acceptable to people with disabilities. Research into social media for learners with disabilities and ways of ensuring they are safe within the digital space is also required in order for them to exploit the benefits both educationally and socially of this important part of young people's lives. If every teacher is truly to become a teacher of all children, then education is the key for all teachers and all those that work with them and provide services to schools and their learners.

There are some indications that users with special needs are being involved in the design of assistive technologies, but these may be adults rather than school age learners. Examples of higher education research institutions involving young people exist, for example with learners who have ASD, but these may well be the exception rather than the norm. Some researchers have highlighted the challenge of involving younger learners, both practically and ethically. Research generally suggests this is needed both in the design of mainstream technologies to ensure they are accessible and in the development of specialist technologies to ensure they meet learners' needs from an overall inclusive perspective – socially and educationally.

The topic of the social construction of technology and the inherent value systems of the designers highlights the scale of the challenge in developing inclusive technologies, both for learning and in society as a whole. Although there has been significant progress in the area of making the built environment such as schools that are more accessible to people with disabilities, researchers have highlighted the subtle discrimination and exclusive nature of some technologies. These include search engines, software (content as well as functionality) and learning platforms, and it was only relatively recently that interactive whiteboards became height adjustable. Research also highlights instances of processes and systems of assessment that suggest a mechanistic – rather than holistic – approach to the assessment of learners for assistive technology.



5. MONITORING THE USE OF ICT FOR INCLUSION

As is clear from the previous sections the use ICT for inclusion is a complex field and involves many actors, disciplines and policy areas. The need for this to be considered a 'trans-sectoral' field is acknowledged, as is the need to develop cross-sectoral policies based on the diverse sources of information generated. It is also noted that the use of an agreed common shared language, particularly for the use of ICT in the education of people with disabilities, would be advantageous to monitoring of usage at a national level (European Agency for Development in Special Needs Education and UNESCO IITE, 2011).

There are some data sources referred to in previous sections of this review (OECD, 2011) that provide an indication of inclusive education measures, and individual countries have reported on the use of ICT to support learners with special educational needs in annual surveys, for example in England, Becta's Harnessing Technology survey (2010a).

The Agency highlighted the challenge of developing indicators for inclusive education and proposes in their recent report (European Agency for Development in Special Needs Education, 2011a) a set of indicators that could be used for analysis of comparative data that focuses on participation of different groups of learners. In 2012 the Agency published a report (European Agency for Development in Special Needs Education, 2011e) which indicated that this was feasible and proposed a short, medium and long term strategy which initially would use existing data measures, and over time would lead to a shared and agreed framework. They identify four key issues and corresponding indicators:

- Receptiveness to diversity, as evidenced via admission data;
- Quality of learning, as evidenced via data on assessment;
- Quality of support, as evidenced via data on planning; and
- Teacher effectiveness, as evidenced via data on teaching.

Ideally the longer-term approach would take note of the impact that ICT has in achieving these outcomes as well as facilitating the collection of data at school and national level.

Across the literature reviewed, there is little evidence of monitoring of the use of ICT for inclusion. In some cases efforts have been made to identify sub-sets or qualitative indicators have been used. For example in the Harnessing Technology survey, referenced above, teachers were asked if they had ready access to assistive technologies when they were required to support learners cognitive, sensory or physical needs, and established a helpful baseline figure around perceived availability. In some cases accurate figures on the level of need of some groups of learners is still unknown.

This was the case in the United Kingdom for those with a need for communication aids, where Communication Matters researched the number of people who have the need for technology (and other forms of support) as an aid to communication (Communication Matters, 2013). Supported by funding from the Education Department in England, they established for the first time a baseline figure as a percentage of the population. This included estimates of the level of unmet need for aided communication devices (see <http://www.communicationmatters.org.uk/dfc-aac-project>). As a new model of provision is being introduced it was important to have reliable data on the level of need in order to provide responsive services. The intention is to repeat the exercise in ten years' time to measure progress.



Longer term it may be that technology developments will drive a change in collection and sharing of data on the use of ICT for inclusion, although initially this may only be at a school or local level. Schools make use of Management Information Systems to record, monitor progress and report on learners, and a recent survey by one provider in the UK indicated that 83% were using such systems to record and track pupil assessment data. (<http://www.capita-sims.co.uk/survey-reveals-almost-half-schools-will-increase-ict-expenditure-year>). Trade Associations and social enterprises also undertake research on the expenditure and use of technology in schools (see for example BESA, <http://www.besa.org.uk/research>, although these are often designed to inform the industry).

The *Horizon Report* (New Media Consortium, 2013) suggests that learning analytics is a technology that is within 2 to 3 years of large-scale adoption within education. As they state in their report, the idea of this technology is to use data and analyses to adapt instruction to individual learners' needs in real time. Not only can this help to make online learning adaptive, but could also be used to aggregate information on effective interventions and the impact on cohorts of students.

There is, however, little research available on inclusion indicators and the use of data to indicate how practice – particularly in using ICT – has influenced inclusive outcomes. Data on the number of pupils with special educational needs is collected across Europe (European Agency for Development in Special Needs Education, 2012a), but there is no systematic recording of provision, such as in relation to assistive technologies, across all countries.

Some countries collect data from schools and other educational institutions relating to learner achievement, qualifications, behaviour and attendance, and relate this to a range of characteristics, such as type of school attended, socio-economic background and ethnicity. However, there are few examples of research into the systematic monitoring or measurement of the impact of the use of ICT for inclusion beyond the examples cited (e.g. Becta, 2010a). However there are many countries and international organisations that provide practice examples and case studies of the use of ICT to meet a range of individual needs (UNESCO IITE, 2011).

Lindsay et al. (2011) reporting on a government led national whole school professional development programme focusing on inclusive education, provided some measure of the impact it had. Between two thirds and three quarters of teachers judged that the IDP materials (<http://www.idponline.org.uk/>) had improved their knowledge, understanding and confidence to teach learners with dyslexia, speech language and communication needs, autistic spectrum disorders and behaviour, emotional and social disabilities. Unfortunately the analysis did not examine the impact the programme had on the use of ICT for inclusion, although this was covered to a certain extent in the training and the materials.

5.1 Summary

There are a range of agencies in Europe that collect data on the use of ICT for education. Eurydice (http://eacea.ec.europa.eu/education/eurydice/index_en.php) provides the *Key Data* series which is an annual report on education in Europe. They published *Learning and Innovation through ICT at school in Europe* (European Commission, 2011) and also thematic reports on a range of topics. The European Schoolnet (<http://www.eun.org/>) is a network of 30 European Ministries of Education which helps schools to make effective use of educational technologies, equipping both teachers and pupils with the skills to achieve in the knowledge society. European Schoolnet provides both Ministries and schools with:



information and services relating to the innovative use of educational technology; outreach campaigns on specific educational topics such as maths, science and technology; and research activities. As well as the survey mentioned below, they publish an annual *ICT in Education* report provided by 28 member Ministries, and from 2013 these highlight both access of SEN students to digital learning resources and service and ICT for inclusion in the context of teacher education for inclusion (http://insight.eun.org/ww/en/pub/insight/policy/policies/2009_country_reports.htm). The *Survey of Schools: ICT in Education - Benchmarking Access, Use and Attitudes to Technology in Europe's Schools* (European Commission, 2013) report details the finding from the largest scale survey of students' experience of ICT in schools. Some of these include information beyond the technology and look at other factors such as competences and attitudes, but few have so far focused on ICT for inclusion.

There is generally very little evidence of monitoring the use of ICT for inclusion available in the reviewed literature. Although most countries collect significant amounts of data on learners' characteristics, progress and achievements, location (including the type of institution where they receive education) and a range of other indicators, this is typically used to assess the effectiveness of the school in terms of the quality of management and teaching and learning and make comparisons with other similar institutions.

At international and national level surveys and data collection systems that detail the use of ICT in education have increasingly focused on not just the number of computers available and access to the internet, but also how they are being deployed, teacher CPD and digital competencies. However, few include either quantitative or qualitative indicators relating to the inclusive use of ICT.

Overall, there is little evidence of progress is in the monitoring of use of inclusive technologies. Although data is collected on the number of and nature of the establishments that learners with special needs attend, and there have been surveys of the quantity of ICT in schools as well as use and attitudes to its usage, there have been no systematic recording of the use of ICT for inclusion. This is clearly a major challenge, as recording of assistive technologies alone, in the same way as recording the number of computers in the past, would be not an indicator of use or impact. However, without even this baseline information it is difficult to have a clear picture of provision within education systems. To have real value, measurement and monitoring would need to be more subtle and nuanced to elicit a true understanding of the range of technologies being used to support learners with special educational needs in an inclusive way, and data on accessible technologies as well as assistive devices, along with how they are being used, would need to be captured and then revisited over time to measure progress and impact.



CONCLUDING COMMENTS

The complementary policy review, *Information and Communication Technology for Inclusion: International Policy Review* (2013), provides a context for much of the practice undertaken across the EU, and also more widely across the world. Since the last project on this theme, managed by the European Agency for Development in Special Needs Education (1999-2001), there have been significant developments in both technologies used in mainstream and special education schools, and in the wider commercial/domestic sector, which have had a significant impact on wider technology adoption.

In the area of specialist assistive technologies for learning there has also been a growth in the number available with innovation as well as many products becoming more widely used. The growth of touch-screen technologies and online social networks have been sudden and to a large extent unpredicted. The impact of both these areas is still to be properly analysed and evaluated by research.

As the policy review reveals, there has also been a significant change in government, societies, and in particular parents/carers and expectations of the type of education their children should receive. They expect more choice in the type of school provided, mainstream or specialist, with an increasing expectation these will be in mainstream settings, and that technology will be provided to meet their child's special educational needs or disabilities to ensure their inclusion within the school.

This review has identified a relatively small number of research papers that focused specifically on the use and impact of ICT for inclusion in the context of education. There is, however, considerable research on some aspects of inclusion, for example e-inclusion, and also the need for accessible information technology and resources. A few reports looked beyond the use of ICT and how it can provide physical access, to learning through assistive technology and the development of accessible technologies.

There is a significant volume of research and reports that focus on the education of learners with special educational needs and disabilities, and approaches to inclusive education, and also much published generally on the use of ICT in education; with some that bridge both areas of research.

This literature review highlights the following:

- Knowledge and awareness of products in an area of rapid development in technology is a challenge for educators and others who work with young people and those providing on-going professional development. The absence of a common language across disciplines and countries is also a complicating factor.
- There is a need to incorporate a practical understanding of the ways in which both assistive and enabling technologies can be mainstreamed and form a core element of inclusive teaching practice.
- Some researchers have highlighted the value of understanding basic access features and configurations built into operating systems, and other utilities in commonly used software, such as predictive spellcheckers in word processors.
- Official statistics indicate that although in many of the EC countries the ratio of computers to learners is high, there are indications that where this is not the case there are still significant barriers to ICT becoming integrated into practice, inclusive or otherwise.



- Generally, information on monitoring the use of ICT for inclusion is scarce and where available, the impact of ICT upon inclusion has to be inferred rather than it being explicitly stated.
- There is some research into the impact within an education context of mainstream commercial mobile devices such as touch-screen tablets, already showing a positive impact, and highlighting the potential to have a transformative effect in the classroom with indications that schools are investing in these, both in mainstream and special school settings.
- Although research has repeatedly highlighted the social, economic and learning benefits of internet enabled computer access in the home, there is still a digital divide with some young people (at best) having shared or public access.
- There has been considerable Europe-wide research into e-safety and some on vulnerable learners, but almost none on those who have special educational needs and disabilities.
- there is considerable research into universal design principles, some of which are related to education, in particular to standards and protocols, and some evidence of increased involvement of users in the design and implementation process.
- With access features increasing built into mainstream commercial products such as mobile phones and tablets, it could be argued that for many young people with special educational needs there is an opportunity to discover and personalise the device at home to support informal learning, homework, etc. The challenge to schools and the education system is how to integrate this into their systems and approaches.
- Many of the devices that are provided with built in accessibility features are produced in the USA, driven to a large extent by the legislation (Section 508 of the Rehabilitation Act as amended by the Workforce Investment Act of 1998, <http://www.section508.gov/>) around the procurement of accessible goods and services. This has had a global impact as many of these devices are either sold abroad or imported into the US and therefore need to be compliant with accessibility legislation. In Europe the European Commission is developing a requirement for the public procurement of accessible information and communication technologies products and services within Europe (Mandate M376). These will identify a set of functional accessibility requirements for public procurement, and develop an online toolkit through which public procurers can access these requirements in a structured way as part of the normal procurement process (<http://www.mandate376.eu/>).

Overall the research paints a picture of continuing development in the availability of technology in schools and society as a whole, with the potential for this to have a significant impact on education and inclusive practice. There is widespread evidence of teacher education embracing inclusive pedagogy; however, there appears to be a number of barriers to the use of ICT being used to support this practice. These include teachers' understanding and competence in using assistive ICT and new technologies generally. Online networks of peer support show potential for support teachers' on-going professional development but are yet to be adopted or widely used by teachers across Europe.

Even widely adopted technologies such as interactive whiteboards and learning platforms have yet to provide an inclusive experience for many learners, with these often used in a didactic rather than for collaborative or interactive learning. Learning materials are often not accessible and traditional assistive technologies sometimes viewed by the learners themselves as socially isolating and reflecting a negative image of themselves among their



peers. There is also evidence of learners rejecting these in favour of less accessible but socially acceptable technologies, both in school and at home. Technologies such as mobile phones are increasingly an intrinsic part of the lives of learners with special educational needs. Often they are not allowed to use these in schools and have limited access to shared devices, which do not necessarily provide the accessible features they are used to at home or on their mobile, or the immediacy of internet access they expect outside of school. There are also economic pressures that are continuing to restrict access for learners to assistive technologies, assessments, and services that provide training and support.

Looking forward, the rapid adoption by institutions of mobile devices, especially tablets with built in accessibility features, along with low cost assistive technology apps, is opening up many new opportunities for inclusive teaching and learning. There are emerging indications that teachers are more comfortable with these devices and willing to take a more experimental approach to using low cost apps, as well as being more willingness to learn from the learners themselves.

Across Europe as well as at the global level there is an on-going need to identify centres of excellence in the use of ICT for inclusion and for practical ways to be developed for the sharing knowledge on how this has been achieved. Research into inclusive practice supported by ICT is needed, as is baseline data gathering and on-going monitoring of ICT for inclusion.



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