INFORMATION AND COMMUNICATION TECHNOLOGY FOR INCLUSION

A review of the literature

(Draft)

European Agency for Development in Special Needs Education

CONTENTS

INTRODUCTION

This literature review is one of the information collection activities within the Agency ICT for Inclusion project (http://www.european-agency.org/agency-projects/ict4i). The main focus of the project is upon country policy and practice for 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 peers for the largest part of the school day.

The project activities provide an update to the *Information Communication Technology in Special Needs Education* project that ran from 1999 – 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://iite.unesco.org/).

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 will be touched upon in this review.

Within the context of preparing this review, the topic of inclusion has been one of considerable debate as has the definition. One definition is "Promoting inclusive learning is a process of increasing the presence, participation and achievement of all learners in their educational settings" (Hick et al, 2005). The Teacher Education for Inclusion project (European Agency for Development in Special Needs Education, 2011b) used the UNESCO definition which states that inclusive education is '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' (UNESCO, 2008 p3). Another report from the European Agency for Development in Special Needs Education (2011a) highlights the need for the development of indicators for inclusive education, recognising that there is often overlap of terminology in this area, with a strong focus on meeting the needs of young people with special educational needs in many countries. The use of ICT for the inclusion of young people with special educational needs (SEN) is widely recognised as good practice, not only for those young people who are identified as such, but for other young people with additional needs. Although there are different interpretations of the term 'special educational needs', most teachers across Europe have a shared understanding of what the term encompasses. Similarly there are national nuances in definitions of disability, recognising the medical and social models that have been refined over time. For this report, the terminology used within terms of the United Nations Convention on the Rights of Persons with Disabilities (UN CRPD, 2006) was adopted:

"Persons with disabilities include 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 p5).

This current review gathers research findings together under the five headings identified in the publication ICTs in Education for People with Disabilities (European Agency for Development in Special Needs Education and UNESCO IITE, 2011):

- ICT should be considered as a key tool for promoting equity in educational opportunities;

- Access to appropriate ICTs should be considered an entitlement;

- Training of educational staff in the use of general and specialist ICT must be considered a priority area;

- The promotion of ICT research and development requires a multi-stakeholder approach;

- Data collection and monitoring in the use of ICT in inclusion should be considered an area requiring attention at all levels of educational provision.

Each of these topics is used as the focus for the subsequent chapters:

- Promoting equity in educational opportunities

- Access as an entitlement

- Training of educational staff in general and specialist ICT

- Multi-stakeholder research and development into ICT

- Monitoring the use of ICT for inclusion

This draft only focuses on research that has been published in English and is being circulated to illustrate some of the themes and trends emerging from the literature. The intention is that the draft will encourage countries to provide abstracts of relevant literature that is published in the countries language. The final version will be then developed with the additional country inputs.

METHODOLOGY

The methodology for this literature review was to systematically search the 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 thesis, where relevant, have also been taken into consideration. Material was organised into the themes, outlined in the introduction, providing the section headings.

The initial search terms used included: ICT for inclusion, accessibility, assistive technology, ICT in education, inclusive education, ICT and special educational needs/disabilities. This was widen to include specific areas of need and broaden 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 that rapid changes in both technology and resulting practice approaches more recent research, from 2008 onwards, was given precedent. The focus was on ICT for children and young people with special educational needs and disabilities, with particular attention to factors influencing classroom practices.

CONTEXT

The complementary policy review, Information and Communication Technology for Inclusion: International Policy Review (in development), 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, in 2000, 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, 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.

PROMOTING EQUITY IN EDUCATIONAL OPPORTUNITIES

The use of ICT is widely recognised as an everyday part of many people's lives, and has an impact on many aspects of society, including education, training and employment, the economic prosperity of individuals and countries, as well as media and 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 international policy review 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.

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

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 is a key exclusion factor (EC, 2008). The report from the EC 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 the 98 million at risk of poverty, including the 10 million working poor; and the 15 million foreign-born residents" (p10)

It is not possible in this review to include all the research that focuses on all areas of inclusion, however it would be remiss not to acknowledge the importance, and often overlapping nature of these, and the potential ways in which technology can help to provide support. These overlaps will be referenced throughout the report where possible. At the core of inclusion is the freedom to participate equally in society.

E-Learning and Inclusive practice

D'Alessio and colleagues (2010) identify the progress across Europe in moving to inclusive education for all, but also record 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 (citing both Armstrong, 2008 and Soriano el al, 2009). 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 disadvantages 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 inequality and ensure environmental sustainability and global partnership." (D'Alessio et al, 2010 p116). 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 the model of inclusive education adopted across Europe.

It is interesting to note that the areas highlighted by D'Alessio et al, in the context of achieving inclusive education for all, are mirrored by others when referring to the transformational potential of ICT for schools in terms of curriculum, assessment, pedagogue an organisation. 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 value 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 this process is also likely to be subject to the same caveats about wholesale adoption of models.

The European Agency for Development in Special Needs Education 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 they published a report (European Agency for Development in Special Needs Education, 2012a) 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 to 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.

The Organisation for Economic Co-operation and Development (OECD, 2011) report on (socially) inclusive schools uses a measure of vertical and horizontal inclusion, recognising that those with greater levels of inclusion have better overall outcomes and less inequality. Where school systems or schools tend to separate learners by levels of performance this is referred to as vertical segregation. Horizontal integration is used to refer to systems whereby children from different socio-economic backgrounds tend to be in different schools (regardless of ability or performance). In the report they use OECD PISA data (for 2009) for the proportion of variance in reading performance within schools as an indicator – with low variance an indication of high vertical inclusion. The proportion of variance in socio-economic background within schools is used as an indicator of horizontal inclusion (as this can clearly be seen within major cities where families live in poor or wealthy areas). They note that inclusive policies can aid horizontal inclusion but that there is often a political challenge to increasing vertical inclusion, although equity and equality can be increased through putting more resource into those schools with more children from disadvantaged backgrounds.

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" (EC, 2008, p5). The report by the EC goes onto highlight the importance of digital literacy which in turn leads to digital competence. This it defines 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". 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." (EC, 2008, p8).

The report highlights the challenge for ICT of Innovation in 3 areas, for 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 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 less so in its use for knowledge construction.

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." (EC, 2008, p11). In the context of technological innovation, digital content is highlighted in this report, as is networking, mobile technologies, and opportunities afforded by convergence of digital media (digital broadcast media, interoperability) and gaming, simulations and immersive environment potentially offering new learning tool – from pre-school to specialised professional training. Intellectual property rights and the role of the commercial sector are recognised as is the value of open educational resources. The changing nature of educational institutions with a move towards learning centres, the role of universities as learning service providers, companies as learning organisations is highlighted as is the need for more collaboration.

ICT can be used as a tool for personalising learning and for promoting equity in education and most countries in Europe encourage this (European Commission, 2011). Previous reports highlight the role of ICT in helping students with special educational needs gain greater autonomy and enabling children to keep in contact with their classroom. The authors also note that by allowing users to learn at their own pace, ICT can also encourage less able students and enhance their self-esteem. Although there are different priorities across the EC member countries many, but not all, focus on ICT in mainstream education to address the needs of students with SEN as well as socially disadvantaged young people. Examples of practice in the use of special techniques and equipment are detailed in a joint report by UNESCO Institute for Information Technologies in Education, and the European Agency for Development in Special Needs Education (2011), but it is noted that this does not necessarily imply separated or segregated provision, rather they show how ICT can be integral in supporting learning in a variety of ways within inclusive settings. The report goes on to remind the reader that ICT use for inclusion should be viewed as a means rather than an end in itself, and one that can increase effective access and participation

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 2006-9 (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 made 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 natural 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 as well as using simpler and clearer language and terms (i.e. learning in a digital networked society rather than 'e-learning'). There is also a problem that exists in the language of assistive technology for people with disabilities. The 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.

Assistive Technologies

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

Definitions of assistive technology

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) agrees that a wider definition allows for a more flexible and inclusive approach and goes on to propose the term e-Inclusion and 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, namely technology to train and rehearse; technology to assist learning and technology to enable learning. The British Assistive Technology Association (BATA), a social enterprise that focuses on assistive technology 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" (BATA, 2011).

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.

Assistive technology is defined (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 (p87).

Innovative use of assistive technologies

Abbott and colleagues (Abbott et al 2011) in their recent review of the literature of AT highlight that innovation takes place in all stages of technology development and that there is software and hardware that supports the learning of young people, particularly those with special educational needs or disabilities in the areas proposed in Abbott's earlier

research. Software that helps to *train or practise* (commonly called 'drill and practice' software), is still important for supporting overlearning and repetition of basic concepts in a more imaginative way than pen and paper. Software designed to *assist learning* is primarily but not solely 'technology for access'. This type of software is important, particularly for those with sensory or cognitive disabilities. The technologies which Abbott et al consider most enabling are those which support communication for cannot do so without the use of technology, and can 'enable learning'. An earlier literature review into AT for education in Europe is cited, (Salminen 2008, which covered 2000-2005), which found little evidence of research relating to children and also a dearth of longitudinal studies.

Other definitions help to make it clearer what enabling or assistive ICT's 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. It can be used as a tool in many areas, as a means for: teaching, studying, communication and aiding therapy and diagnosis of need (Molnár et al, 2008). Winter and O'Raw (2010) identify the following features of ICT that support learners with SEN in accessing the curriculum and to support 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 student. This type of software can also to provide feedback to the teacher on students time on tasks etc.

- Planning tools: visual organising or mapping tools to support the structuring of information, for example when planning an essay

Symbol supported learning approaches have moved from being recognised as a tool for remediation to that of supporting inclusive learning with multidisciplinary collaboration (teaching, speech and language, and occupational therapist) to create resources (Abbott et al, 2011).

The development of Web 2.0 technologies and the adoption of virtual learning environments (VLEs) in a growing number of European countries is 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 which can support learners with specific needs, and also provide a richer learning experience for all. However courseware 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 available.

Assistive technology and an indicator of developments

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), 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 and promote digital accessibility and assistive technologies. They developed an ICT Accessibility Self-Assessment Framework and Digital Accessibility Inclusion Index which is used to measure the progress of countries who 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 programs 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 program. However they go on to note that many innovations conceived by universities do not result in viable commercial products, and recommend more effective relationships between academia and industry.

The increasing proliferation of mobile devices that connect to the internet and the development of apps are already having an impact on education. The value of mobile technologies for education has already been mentioned and is highlighted by others (Passey, 2010). Currently there is little published research into the educational value and impact of tablets and apps although a number of reports have highlighted the inclusive potential of this technology. 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 crowdsourcing. 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 proposes seven principles, based on inclusive design, for developers to follow in order to create accessible apps. 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. The research was commissioned by OneVoice for Accessible ICT, which is an example of different sectors working together to help organisations embed the use of accessible information and communication technologies, as a fundamental part of their diversity and inclusion values and culture [http://www.onevoiceict.org/home].

Emerging technologies

The term 'emerging technologies' is widely used but a clear definition is difficult to locate. 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' (p3-5).

The benefits of emerging technologies

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. Over the past 5-10 years (as is highlighted in various parts of this report) technologies that were previously used in higher education, business or the home have been adopted by schools. Examples of these include interactive whiteboards, virtual learning environments and portable computers. Researchers and others continue to predict which technologies will be adopted by education, identify trends and suggest how this will impact on teaching and learning and on education systems. The Horizon report (The New Media Consortium, 2012) predicts that the emerging technologies which are likely to have a large impact on teaching, learning, research, or creative expression within education around the globe are:

- in the short term (1 year or less) mobiles and apps, and tablet computing,

- in the medium (2-3 years) game-based learning and personal learning environments, and

- in the longer term (4-5 years) augmented reality and natural user interfaces.

The same report, published in the US, also highlights the key trends and challenges, based on research, debate, published resources and practice, which an expert board predicts provides the context for the use of these technologies. A report from GMSA and McKinsey (GMSA and McKinsey and Company, 2012) also 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" (p4). The report also highlights the impact mobile technology is already having in improving oracy in pre-school children. The benefits of the mobile phone for education are recognised in a recent UNESCO policy briefing (UNESCO IITE, 2010).

The educational and social benefits of some of emerging technology are being investigated and researched and the implications for inclusion, particularly of those learners with disabilities, being highlighted (Koumpis and Crehan, 2012). The report by e-accessibility 2020 highlights for example the wider benefits of smartphones for people who are blind or deaf, and that the development of innovative new applications - for mainstream or groups of people with specific needs - can be done 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 may be 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, and content developers. An additional challenge is that significant

volumes of shared user generated content is not made by professionals but he 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.

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, of which one 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, m-learning and the development of accessible Open Educational Resources.

The challenges of emerging technologies

Newly qualified teachers have been found 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. As has been mentioned elsewhere 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) and others. This is especially true for assessment for learning, recording and reporting, parent portals, collaborative learning spaces and where other interactive features are integrated into the VLE.

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. Balankstat et al (2006) in their review of ICT impact in schools in Europe highlights evidence of the impact ICT can have on motivation, and engaging low achievers, differentiation and behaviour.

Research in Finland (Karna-Lin et al, 2007) highlighted 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 students 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.

The work of Levinson (2010) which focused on changing the understanding and approach to reading and writing, not just of several schools but a whole municipality in Denmark, is 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 teacher's perceptions and views were a significant factor influencing a young person's attitudes about themselves and what they were able to achieve. She cites Holmgaard, who believes adults' reactions are central to children's self-esteem and influence whether they think they have a disability or are in a difficult situation. The assumption that modification of context and practice may remove barriers and allow the person in difficulties to participate on equal terms, and be included, in the normal class was central to the philosophy of the research project. Taking this perspective allowed for the acceptance that to read or write may mean using text to speech or speech to text technology. Using these tools students were was able to participate with peers, although not necessarily at the same level.

Benigno et al (2007) highlights that new technology 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 that 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 of social computing in education 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 pedagogic approach implements (Redecker 2009 p88). He cites a project involving students at the Spanish Open University, which although only having 400 out of 4000 disabled students at the University involved was successful in providing new learning opportunities, improving their 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 the 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, p26 - citing DfE impact analysis report, 2010)

Inclusion is also about equal opportunity and access and in terms of ICT this includes access to leisure as well as learning. The use of game technology by young people and adults has increased exponentially over the last 3-5 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, Douche et al (2010) found that the use of games on handheld devices such as the Sony PlayStation Portable (PSP), and Nintendo DS, and also using the Nintendo Wii that there were positive outcomes for the use of 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.

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 (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 (SCOPE, 2008).

As has been mentioned previously 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. New methods of interacting with technology, by body gesture, touch, eye movement and even directly via the brain and nervous system are providing new opportunities, as well as potentially barriers, for interaction, communication and learning.

ACCESS AS AN ENTITLEMENT

In order for technology to support inclusion it needs to be available when it is needed and be fit for purpose in meeting an 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).

Appropriate technology for learning

The International Policy Review that complements this review outlines the policy expectations, including enacting legislation that protects the rights of people with disabilities. The Convention on the Rights of People 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 a legal one where compliance is built into national legislation and associated advice and guidance on how to achieve it. Translating this into practice is clearly a challenge and some of these are detailed below and in subsequent sections of this report.

Many young people with physical disabilities use assistive technologies regularly in their everyday activities, supporting and enhancing their communication, and providing a means to engage in social interaction, entertainment as well as learning. Young people with physical disabilities need AT to be integrated into educational practice and to experience immediate benefits which do not affect their social participation in every day school activity (Lindstrom, 2011). Young people with physical disabilities 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.

There is a major challenge of gaining formal recognition for achievements, in a climate of educational standards, and organisational issues in moving from a transmission model of education to a collaborative learning teaching and learning environment (Redecker 2009, p89). Power relationships and dynamics of staff in an educational establishment, for example between ICT and not-ICT literate professionals is an example of institutional barriers that can exist. For successful adoption of ICT by organisations generally there is a need for professional and senior management adoption and support (Redecker, 2009 p89, Comber et al, 2006). It follows that for inclusive ICT practice to be successful this also needs to come from school leaders and be supported through structures and practices throughout the institution. The Achievement for All project 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).

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, 2008). 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. There have been efforts across Europe, and wider, to reduce the digital divide, of which some have taken an inclusive approach.

Research commissioned by Becta (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 varying skills at identifying and matching needs with solutions. It highlighted how varying timeframes for assessment can prevent a child from accessing appropriate assistive technologies, which can impact on the inclusion of that child, and that reassessments do not follow a standard process; leading to children not being reassessed often enough and consequently using old technology that may no longer match their needs. 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, causing the schools workforce struggling to keep up with the advances. The report highlighted that there is no consistent approach for inclusion training and knowledge sharing for schools, leading to a varied experience for children.

The need for more training, both initial and on-going 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 AAC services and technology for young people (in England the legal responsibility of the health service, but with very few specialist commissioners even aware of this fact), 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 worrying high number indicated that they did not know if they did or not (Becta, 2010).

The WSIS (2010) report on an expert forum of multiple stakeholders, expressed the view that there is a global crisis with the continued development of inaccessible ICT and prices increasing along with decreasing availability. They noted that "technologies are still not available for each disability and for each person with disabilities" (p51). The report goes on to recommended – "Emerging cloud-based infrastructures and the ability to personalize applications and content should be used to enable digital inclusion and address barriers of physical, sensory and cognitive access to online systems."(p51)

Access to information and learning content

 "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 p7). This recent report examined why it is that although policies and legislation is in place 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.

Making teaching materials (in particular traditional text books) available to text disabled pupils 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, p6.) 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. They authors recommend that text book 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.

The 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 students' needs. A 'team effort' is required which involves students, 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, 2012).

Although access to technology, for example for communication or to access information, is a legal entitlement under human rights legislation, that does not necessarily mean it is provided, as research from charities and advocacy groups often demonstrate. For example a report by SCOPE, a charity which campaigns for the rights of people with disabilities, identified the barriers to the provision of AAC as including a lack of training and development needs of professionals, or cross-sectoral policies that join up, fragmented and inconsistent coverage of services, and especially the lack of funding for equipment, support and services. (Bush et al, 2008).

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 are vulnerable and the growing issue of bullying of these young people in social networks and stress the need for research and advice to teacher and pupils 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 one country (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 'cyberbullying'.

Although national strategies, advice and guidance and schemes have been developed in many countries across Europe, both for teachers to help them educate children and their parents, and for the children themselves, see for example the EC Safer Internet Programme, specific research and advice relating to children with disabilities is lacking (UKCCIS, 2012). Cyberbullying 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 indicators of a high risk for cyberbullying (Cross et al, 2012). Young people with higher levels of support need or from disadvantaged backgrounds were found to be more likely to be subjected to persistent and sustained cyberbullying. The EU Kids Online Survey (Livingstone et al, 2011a and 2011b) identified that children of parents who were less educated or did not use the Internet were a significant group that experienced higher risk and were more upset by disturbing online material. An example of where the digital divide has a compound effect. There was also some indication that recent immigrants were more at risk of racist or nationalistic cyberbullying. The groups most vulnerable were also those most likely to find it difficult to access help in the form of support, guidance or resources.

Carrick-Davies (2011) researched young people excluded from mainstream schools and which 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 essential to them and they often rely on these to give them identity, connection and a sense of community. He recommends that e-safety is embedded into the wider teaching of emotional, social and digital literacies in all schools from an early age.

A report which reported on the discussions of an expert group seminar on e-safety and vulnerable children 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. In this seminar, we have gained good evidence that children's vulnerabilities online may be related to the nature of the online services they use, the contacts they make, the content that they view, their own risky behaviours and the commercialism they encounter. However, we still lack a thorough understanding of when, why and how children become vulnerable. In addition, though it is apparent that certain groups of children identified as vulnerable offline will be vulnerable online, this isn't always the case. From the evidence shared at the seminar it would seem that the stage of development of children and young people is also a significant factor pertaining to vulnerability online – especially children entering the pubescent stage of their development." (UKCCIS, 2012). They also noted that there is very little published research on e-safety for children with special educational needs and called for this to be urgently addressed.

TRAINING OF EDUCATIONAL STAFF IN 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.

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 EC 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.

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 pupil 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. In line with Benigno (2007) and others an awareness of the barriers that some ICTs created was found to be limited.

Starcic (2009) reports on the use of a virtual learning environment (SEVERI) developed originally for students with special educational needs in Slovenian schools but later localised for six other European countries. This award winning 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 students in an educational technology curriculum as a means of developing an enquiry based planning and incorporating innovative use of ICT into their lessons and to develop their competencies for professional development Although noting that research indicates that inclusive practice and ICT skills are a recognised area of weakness by many teachers he found that this approach, which focused on autonomy, inquiry, creativity and innovation was successful.

Lack of training for professionals working with young people who need 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 their 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 concern about teacher training is not new. Nearly 10 years ago 'eLearning: Designing Tomorrow's Education' (2003), a European Commission 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 results suggest that educational innovation involving the use of ICT should not be considered only as a matter of access to technology or only as a matter of implementation. The use of technology in classrooms is found to be socially contextualised, interacting with the institutional and organisational cultures of schools and reflecting elements of the prevailing social relations in and around the context of use. 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." (p9).

Initial teacher training

It has been argued 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 competencies include these comments.

A Scottish University which adopted a 'learning without limits' element, investigated 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 author suggest there is a need for inclusion specialists to support the process in much the same way as special needs coordinators are required (Beacham and Rouse, 2012).

Research indicates 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. A post graduate 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).

Teachers' positive attitudes towards inclusion depend strongly on their education, experience with learners having special educational needs and the availability of support (Benigno el at, 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, 2012).

Continuing professional development

Governments are in an ideal position to promote national level training which can influence attitudes and practice to inclusive education. Lindsay et al, (2011) recently evaluated a number of overlapping national level, English government initiatives that run from 2008-11 designed to provide high quality initial teacher training. The Special Educational Needs and DisabilitiesTraining 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. Dissemination was observed to be essential to the success of the IDP and involved national, regional and local leadership and coordination with a central agency (National Strategies) at the centre and nominated coordinators within each local authority. Training materials themselves were provided in an e-learning format, both online and via a DVD and incorporated advice on the use of ICT to support young people with a range of learning needs.

A number of factors were identified as important, including developing the programme as a SEN and school improvement issues, thus reducing the likelihood of it being solely about pupils 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.

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. The teaching skills of the future will include the ability to develop innovative ways of using technology to enhance the learning environment, and to encourage technology literacy, knowledge deepening and knowledge creation. Teacher professional learning will be a crucial component of this educational improvement" (p8).

The Standards set out six components and three increasing levels of competency and detail 18 study modules with curricular goals and the skills that teacher 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 student 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." (p73).

Classroom practice

D'Alessio et al (2010) citing Meijer (2003) identifies key factors in transforming classroom practive to support inclusion. It can be argued that these strategies, listed below, can all be facilitated and enhanced through the use of ICT:

- 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).

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 (Shulman, 1987) characteristics of teacher knowledge, and proposes that it now "incorporate understandings of the construction of knowledge through distributed cognition, design, interaction, integration, context, complexity, dialogue, conversation, concepts and relationships" (p7). ICT as well as being a valuable tool for instruction (Kennisnet, 2011 http://downloads.kennisnet.nl/algemeen/Vier-in-balans-monitor-2011-Engelse-versie-internet.pdf) 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 [http://webarchive.nationalarchives.gov.uk/20101102103654/publications.becta.org.uk/display.cfm?resID=41521]. This resource provided teachers with an easy way of evaluating their practice and planning development activities. A publication that focused specifically on special needs and inclusive ICT approaches based on this self-assessment approach was also produced (Becta, 2010c). This simple 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 appropriate access to, or use of, mainstream technologies, adaptations where necessary, or the provision of personal assistive technologies are required. Research indicates that teachers need support in identifying and evaluating software and hardware suitable to meet this need.

In Italy ICT educational software developers are required by law to declare the accessibility of their products detailing not only legal compliance but also usability by people with disabilities through the Essediquadro online database [http://sd2.itd.cnr.it/foreign.php]. The AEsseDI project provided an online platform for sharing good practice through the collaborative construction, sharing and re-use of inclusive pedagogical plans (Benigno el at, 2007). 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, 2007).

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 students. This was carried out to test the assumption, validated by previous researchers, that the design of software can have built in assumptions, for example of typical users attitudes or interests.. Where students 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 means 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).

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 coordination 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 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 this 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 pupil performance, and

- There is leadership, which can get teachers involved in innovations. Research indicates this can motivate and allow a shared vision not only of trendsetters but also the majority who are less convinced.

Schleicher's report indicates that in the 18 OECD counties 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 students 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.

A report on teacher education for inclusion across Europe (EADSNE, 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." (p51)

It is interesting however to note that neither this report or the accompanying international literature and policy reviews make more than passing reference to the use of ICT in inclusive education.

Experts from education, industry, government and other stakeholders in the use of accessible ICTs 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 students learning and ICT access preferences at an early stage and enable students 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. (UNESCO, 2012)

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 and can involve both high tech and low tech applications. The literature points increasingly to the recognition that it is essential to involve users in the design and implementation of inclusive educational technologies and the need for networking and sharing of the different stakeholders, designers, people with disabilities and the educational staff who work with them (European Agency for Development in Special Needs Education and UNESCO IITE, 2011, Abbott el al, 2011, Wright et al, 2011).

Design for All and for learning

The Design for All approach is increasingly promoted as a means of accommodating individual differences. Rather than making accommodations increasingly people with and without disabilities are taking advantage of access features built into systems (Abbott et al 2011). For example some technologies have been used for some considerable time but there has often been little or no research into their effectiveness, citing (VOCAs), and speech recognition software as examples. However Abbott et al (2011) 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 just professional input.

Abbott et al (2011) acknowledges 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, and in line with the UN Declaration on the Right of People with Disabilities focus on inclusion rather than 'special' education there has been some shift in focus of research to these issues. Abbott acknowledges that this is still a relatively small number of research papers and projects but goes onto highlight 5 key themes (Abbott et al, 2011, p13):

- increased user involvement, using participant design approaches;

- the mainstreaming of mobile devices with the development of assistive technologies that work with these being built in to 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 literacies;

- development of new technologies and interfaces, such as eye gaze and neural control of devices, games interfaces that exploit motion sensing technologies, and robotics.

There is agreement by Abbott with Salminen (2007) however on the 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.

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. The AT wiki was established to promote knowledge exchange in this subject domain and involved mainly professionals,

developers, vendors as well as people with disabilities. The platform provided 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, that quickly provide examples of use by practitioners (Redecker, 2009).

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 interesting 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 Wendy Keay-Bright from Cardiff School of Art and Design. Her 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. Keay-Bright's research highlights the importance of involving end-users, in this case children with autistic spectrum disorders (ASD), and argues that the importance of participatory design process and the design of play (in this case for children with autism is essential 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 are involving users with learning difficulties in both the design and evaluation of new technologies for education, for example between developers and educationalist 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 of the Rix Centre at the University of East London and their 'Inclusive New Media Design' which adopted a participative approach to the design of websites particularly designed for adults with LD. They believe their approach has relevance for design for all and recommend that:

- "The 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;

- The WAI Guidelines (W3C-WAI, 1999 & W3C-WAI, 2008) 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

- 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" (p 9).

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).

Beyond design for all – from assistive to accessible technology?

Some researchers (Foley and Ferri, 2012) suggest that currently technology is designed in a way that reflects notions of normal and a process is deeply embedded in social, economic and cultural practice and these have an impact on the whole process of design, marketing and implementation of technology. They argue for the need for all technology to be accessible and inclusive with a shift to this rather than the current focus on assistive technology which they content creates subtle forms of exclusion. It highlights the high levels of abandonment or discontinuation of use of assistive technologies and the often unattractive or stigmatising design of such devices. More subtle examples are given, for example the way in which search engines may display results when a term related to a physical or sensory impairment is entered. They found that the results were typically websites that focus on rehab or remediation, which the use of terms for other groups, such as those relating to race or sexuality provide a wider variety of results, often relating to social interaction (rather than medical ones). The example of online learning environments is highlighted as an example of a teaching and learning technology is not typically designed with people who have a disability in mind. The subsequent need to provide accommodations is highlighted as costly and time consuming.

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 p7).

Söderström and Ytterhus (2010) state that assistive technology too often follows a reactive model rather than building in access from the beginning and go on to state 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 no 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. 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." (p8). 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.

The potential of new technology developments as a means of overcoming current barriers to learning encountered by learners needs to be monitored and exploited. Current trends worth monitoring include mobile learning, cloud-based solutions and the use of game technologies for learning (UNESCO, 2012). It is interesting to note that there is currently research taking place on the use of mobile phones to support the social communication and life skills of young people with autism (WLGA, 2012).

MONITORING OF 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, as would be 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 counties have reported on the use of ICT to support learners with special educational needs in annual surveys, for example Becta's Harnessing Technology survey (2010).

Evaluation of national inclusive learning projects

In UK (England), the Achievement for All (AfA) pilot, 2009-2011, involved over 450 schools (primary, secondary, special and a small number of pupil referral units, i.e. schools for excluded pupils) and investigated three elements considered essential for learners with special educational needs to fulfil their potential:

- assessment, tracking and intervention – where young people's progress was tracked, learning targets set and interventions implemented to support progress in learning;

- structured conversations with parents to build parental engagements and confidence; and

- wider outcomes including, improved attendance or behaviour, reduced bullying and the development of positive relationships and participation.

The evaluation of the AfA pilot (Humphreys 2011) found that pupils made significantly greater progress (compared with the national average) in English and Maths; significant increase in positive relationships and behaviour with reduced incidences of bullying and related improvement in attendance. Importantly teachers were found to have an increased awareness of SEN and inclusion issues with a greater emphasis on understanding and addressing the wider needs of pupils. The structured conversations with parents was felt to have changed the teacher's expectations of young people with SEN and along with associated CPD resulted in personalised teaching and learning approaches. "Successful schools 'made the most of the data'; that is, they used it at a variety of levels and for a variety of purposes. The use of data within school through effective assessment, tracking and monitoring enabled them to evaluate interventions and make decisions about which to continue funding. Data led professional conversations between members of the senior leadership teams and class teachers in schools ensured that children who were not making expected progress were identified and appropriate classroom support given." (Humphreys, 2011 p14).

Technology was used for tracking pupil progress and highlighting gaps. Consequently in some cases teachers could have target sheets to hand which could be used to guide daily provision. It was also used to identify support and resource needs. Case studies highlighted the value of sharing these targets online with staff and parents – with target, progress data along with guidance on what was needed for progress to be achieved. The importance of parents in promoting positive outcomes for learners with SEN, in line with other research findings, was highlighted as absolutely central and has an impact on

academic as well as non-academic outcomes. This highlights the importance of education at home as well as school and the importance of the relationship between both (Humphreys, 2011).

There is however little research available on inclusion indicators and the use of data to indicate how practice had influenced inclusive outcomes. Many countries collect data on the young people by categories of special educational need or disabilities, as well as statistics on the outcomes for various groups and settings (EC, 2010).

Lindsay et al (2011) reporting on a government lead national whole school professional development programme focusing on Inclusive education, provided some measure of the impact it had. Special educational needs coordinators (SENCOs), who are responsible for coordinating help for children with special educational needs, reported that the IDP continuing professional development, had promoted discussion of pupils' teaching and learning needs (96% SENCOs), improved teachers' knowledge (94%), improved teachers' empathy with pupils' having barriers to learning (90%), and benefited the learning of targeted pupils (89%). Between two thirds and three quarters of teachers judged that the IDP materials had improved their knowledge, understanding and confidence to teach pupils 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 extend in the training and the materials.

Many countries capture data from schools and other educational institutions relating to pupil achievement and qualifications and behaviour and attendance, and relate this to a range of characteristics, such as type of school, socio-economic background, type of school attended 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. 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 (UNECO IITE, 2011).

DISCUSSION AND ISSUES FOR CONSIDERATION

The review identified a relatively small number of research papers that focused 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 and resources. A few reports looked beyond the use of ICT and how it can provide physical access, to learning through assistive technology, and examined the ways in which scaffolding can be provided, both in terms of over-learning and practice software, and in assisting learning through communication and interaction.

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. For example research by Abbott et al (2011) summarises some of the more recent findings in the use of technology for enabling learning, focusing on the new forms of access and control, such as eye-gaze and neural control, and games based immersive experience for people with autism. However the review also highlighted the dearth of in-depth research into this area, of longitudinal or pedagogically informed classroom practice.

The review has so far highlighted that:

- 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 researcher 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 pupils 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;

- there is little research into the impact of mainstream commercial mobile devices, such as touch screen tablets, within an education context, although there are 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 needs and disabilities;

- there is considerable research into universal design principles, some of which are related to education, in particular to standards and protocols, as well as some evidence of increased involvement of users in the design and implementation process.

The one area where research was scarce is that on the development and monitoring of the use of ICT for inclusion and these are touched upon only by a couple of reports and even in those cases the impact had to be inferred rather than being explicitly stated.

This draft publication is a review of the research, primarily in the public domain, and published in English. In order to ensure it is truly representative of the situation across Europe the integration of further research findings, published in other languages is essential. Contributions from Representative Board members, in the form of English language abstracts of research will be integrated into the final review.

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