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The Need for Inclusive Accessible Technologies for Students with Disabilities and Learning Difficulties

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Introduction

This chapter discusses the philosophy of how assistive technology for people with disabilities and other forms of learning difficulties can be more inclusive. It looks at an educational model for analysing technologies and argues the development of mobile learning has seen evolution of inclusive technology. It is the aim of this chapter to inform teachers and families of children with learning difficulties of approaches to integrating inclusive technologies in their children's education, to help adults who have disabilities and other learning difficulties choose the best forms of technology for particular situations and also to contribute to a debate amongst educators and technologists as to the most effective future development of inclusive, assistive technologies.

This chapter is necessary in a book that reviews the future directions of education as many new technologies are being introduced into schools and colleges in wealthy countries, yet relatively little is known about their application in teaching and learning of students with difficulties in the school environment. For instance in the United Arab Emirates, Dubai's schools and government higher education institutions have introduced mobile tablet computers for all of its early years teachers in an initiative designed to make learning more independent and flexible¹, yet few studies of this initiative have been conducted either before or after implementation with students with disabilities. This is a pity as technology in many instances has been found to help in situations seen in many Emirati schools. For example, a recent study has found that icon-based interfaces such as those found in tablet computers can be helpful to students who speak English as a second language². Furthermore, in many countries laws have enshrined a right to inclusion in education and similar cultural activities for students with disabilities, such as the 2010 Equalities

¹ McGinley, S. (2012) Sheikh Mohammed Unveiled iPad College Scheme. *Arabian Business*, Monday, 24 September 2012, Downloaded from <http://www.arabianbusiness.com/sheikh-mohammed-unveiled-ipad-college-scheme-474030.html>

² Meurant, R.C. (2010) The iPad and EFL Digital Literacy. *Communications in Computer and Information Science*, 123, 224-234.

Act in the UK and Americans With Disabilities Act 2008 Amendments in the US. Technology is a valuable tool in this process.

The chapter is broken into four sections: The first section examines the study of educational technology, the integration of learning theories and modes of teaching with technology and how technology has been integrated into education through a model of Substitution, Augmentation Modification and Redefinition (SAMR). The second section describes what disability is, how accessible technology can support students with disabilities and learning difficulties, and how these technologies have changed the way we teach students and the institutions they learn in. The third section argues for a redefinition of accessible technology and presents mobile learning as a case study of an inclusive form of educational technology. The fourth section draws conclusions.

The foundations of educational technology as a subject of study

The subject of educational technology is designed as a “study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources” (P.24).³ The first studies of technology in formal learning started in Ancient Greece as early as 500 BC⁴, however an understanding of the importance of technology in school education has only recently been realized. It took many years for comprehensive histories to be written on this topic, particularly those relating to electronic media in schools⁵. This is unfortunate as we now realize that technology often plays an important role in the delivery and assessment of teaching and learning, and has been involved in the understanding of learning processes from the earliest psychological and classroom experiments. For example, the earliest behavioral experiments devised to mimic learning, such as those of Ivan Pavlov⁶, used devices such as bells and metronomes to provide stimuli. Similarly, Pavlov’s contemporary Edward Thorndike⁷ designed a technological innovation, the puzzle box to mimic a complex

³ Richey, R.C. (2008). Reflections on the 2008 AECT Definitions of the Field. *Tech. Trends*. 52/1/24-25

⁴ Saettler, P. (1968). *A History of Instructional Technology*. New York: McGraw-Hill.

⁵ See for example, Reiser, R. A., & Dempsey, J. V. (2011). *Trends and issues in instructional design and technology*. London: Pearson., Anglin, G. J. (1995). *Instructional technology: Past, present, and future*. Englewood, CO: Libraries Unlimited., and Reiser, R. A. (2001). *A history of instructional design and technology: Part I: A history of instructional media. Educational technology research and development*, 49/1/53-64.

⁶ Pavlov, I. P. (1927). *Conditioned reflexes*. Mineola, NY: Dover Publications.

⁷ Thorndike, E. L. (1898). *Animal intelligence: An experimental study of the associative processes in animals. Psychological Monographs: General and Applied*, 2/4/i-109.

form of learning behavior. Later Buhurus F. Skinner⁸ designed similar cages with levers to deliver punishment and rewards, and Martin Seligman⁹, through instruments of punishment, incorporated technologies as a medium of learning in order to measure learned helplessness. In his most popular work, *Beyond Freedom and Dignity*¹⁰, Skinner took this notion of educational technology further still by suggesting that students could do away with traditional lessons and teachers, and instead learn in their own time through devices meant to provide positive and negative stimuli depending on whether students learnt a given piece of knowledge in a correct or incorrect way. Even modern studies of cognition refer to technologies, with Howard Gardener's¹¹ literature in particular referencing musical, artistic and physical technologies in the development and application of multiple intelligences. Yet despite the necessity of technologies to the development and application of all these learning theories, the *nature* and *role* of the technology that has been studied has too often been considered to be superfluous to the act of learning by school teachers in all but *high-tech* subjects.

Educational technology has, however, been established in other institutions for some time. In some universities in particular this attitude was different. Fifty years ago, for instance, educators in higher education started to realize that not only scientifically measurable behavior but the environment of education could be equally important to teaching and learning, and thus educational technology became of considerable value to new universities and colleges. In 1966 the British Prime Minister Harold Wilson described the need to keep up with what he called "the white heat of technology" through the delivery of lifelong learning for workers in Britain, in order to update their skills¹². As it was impossible for these workers to attend universities full time, open and distance learning was developed and the Open University was created to train people in their own homes through communication technologies such as television, telephone and radio. This was learning that had previously been delivered through more traditional routes of correspondence through paper files and weekend lectures in local colleges¹³. Consequently, the Open University developed considerable expertise through its Institute for Educational Technology in delivering learning and assessment materials via increasingly sophisticated and

⁸ Skinner, B. F. (1972). *Beyond freedom and dignity*. New York: Bantam Books.

⁹ Seligman, M. E. (1975). *Helplessness: On depression, development, and death*. New York: Henry Holt & Co.

¹⁰ Skinner Op. Cit.

¹¹ See for example, Gardner, H. (1985). *Frames of mind: The theory of multiple intelligences*. New York: Basic books.

¹² Edgerton, D. (1996). The 'White Heat' revisited: the British government and technology in the 1960 s. *Twentieth Century British History*, 7/1/ 53-82.

¹³ Nasseh, B. (1997). A brief history of distance education. *Adult Education in the News*.

digitized technologies, including the earliest versions of the World Wide Web and social networking. Now Open University courses can be studied and research studies conducted entirely through web based technologies such as Second Life, the fantasized, virtual world in which human beings are represented through their own avatars, and can live life without gravity or geographical boundaries¹⁴.

Despite this lack of balance in considering educational technology in schools and no unified theory of implementing and developing educational technology, a number of separate phases of the history of educational and learning technologies developed over the course of the 20th Century, and still continue to develop separately at the beginning of the 21st Century¹⁵. What is perhaps most important to identify in this chapter are that there are two particular phases that have transformed our use of technology in mainstream schools since the introduction of electronic technology into schools: the personal computer phase and the mobile computing phase. The personal computer phase itself has two separate eras. The first era is the introduction of general computing technology in the 1960s, that is computing technology that did not take-up a whole room, which although it did not change mainstream teaching at the time it did introduce school students to the use of technologies in an educational environment. The second era came to bear in the 1990s and involved the use of computing technology in non-technical subjects and environments. This began with the introduction of teachers' computers, projectors and interactive computer-driven whiteboards – otherwise known as smart-boards. Shortly after this phase students started to use computers for non-technical as well as high-tech subjects. With this second phase came a sea-change in teaching and learning, and an acceptance of digital technologies in lesson planning, curriculum development and assessments in education. This second era subsequently gave rise to new models of educational technology, models that included not just identifying technologies as they were in previous eras but classifying these educational technologies according to their pedagogical designs and needs.

One such model is the SAMR model of classifying the use of technology¹⁶. This model categorizes the application of technology in lessons as either Transformative - i.e. one that transforms the subject of education and delivers a brand new topic to the curriculum - or

¹⁴ See for example a research project conducted on death in virtual worlds,

<http://r3beccaf.wordpress.com/2013/09/09/death-in-virtual-worlds/>

¹⁵ Reiser Op. Cit.

¹⁶ Chell, G., & Dowling, S. (2013). Substitution to redefinition: The challenges of using technology. In Dowling, S., Gunn, C., Raven, J. and Hayhoe, S. (Eds.). eLearning in action: Redefining learning . Abu Dhabi. HCT Press.

Enhancement - i.e. the use of technology to enhance the teaching of traditional subjects and vocational skills during lesson periods. To enhance education through technology, teaching types are split into two further groups: the Substitution and Augmentation of mechanical tasks into digital tasks. For example, instead of teaching students to type, as was required by many secretarial colleges and jobs in the past, digital technology has substituted the word processor for this older technology, and required the teaching of a relatively similar set of skills in the same lessons. The introduction of digital technology has also led to the augmentation of tools that were once mechanical, such as the shredding or filing of documents, to digital equivalents, such as the use of electronic waste bins and folders on modern operating systems' desktops. Similarly, to use technology as an Enhancement in education, teaching is split into two further groups: the Modification and Redefinition of mechanical tasks into new digital ones. For example, word processors have not only substituted and augmented functions, they also have brand new tools that modify mechanical, physical ways of working to cognitive digital processes. Examples of these processes include the ability to save different versions of files, to email directly from a document, and to change a paper based document into a webpage. Similarly, tasks once taught through the use of old fashioned technologies such as keyboards have been completely redefined, and are now possible through digital input devices, such as voice inputs, or swiping and tapping touch screens; this requires a whole new skill set to be learnt by the students and trainees of the 21st century. This change in pedagogy is illustrated in Table 1.

Table 1: An illustration of the SAMR model of technology driven education

Transformation		
Redefinition	Technology allowing for the transition of training in new tasks through AT/IT	Teaching students how to use their tablet computers, their operating systems, etc.
Modification	Technology allows for significant redesign of tasks	The inclusion of email functions within word processors, the integration of mail merge or hyper text editing within word processors

Augmentation	Technology substitutes as a direct tool, with functional improvements	Cut and paste functions, waste bin functions, spell checking functions, grammar checking functions within word-processing
Substitution	Technology acts as a direct tool substitute, with no functional change	The use of a word processor instead of a typewriter, or hot metal publishing processes.
Enhancement		

This raises two questions in relation to technology and disability: 1) How has technology changed the life and education of students with disabilities and learning difficulties? 2) Can the SAMR model of describing technologically enhanced teaching and learning be applied to the teaching of these students? To address these questions, it is first required to look at what disabilities and learning difficulties in an educational context are.

Disability, learning difficulties and accessible technology

The word disability and the phrase learning difficulty have come to mean many things, although they were not used in education until the latter half of the 20th century¹⁷. The modern origins of these concepts date back to eighteenth century Europe when people who could not work or learn in the few schools available for able bodied students were increasingly marginalized by urbanization and resorted to begging in city streets, particularly those of port cities. Although there were able bodied beggars at the time, people with physical impairments were said to be resorting to begging in increasing numbers¹⁸. Indeed, people with what are now called disabilities were seen to be particularly successful as beggars or seen as a class apart deserving of charity, as Christian ethics determined that they needed assistance. However, this also stereotyped all people with disabilities as lazy and immoral, particularly as many of the causes of disabilities and learning difficulties were linked with diseases that were caused by immorality or prevalent amongst the “lower classes”, who were themselves often considered to be mentally subnormal. As a consequence, a number of Christian institutions were founded in France, then Britain and

¹⁷ Hayhoe, S. (2008a). *God, money & politics: English attitudes to blindness and touch, from enlightenment to integration*. Charlotte, North Carolina: Information Age Publishing.

¹⁸ (Hayhoe, 2008a), *Ibid*.

then the rest of continental Europe to institutionalize people with different forms of disability. These institutions were designed to educate people with disabilities and either provide an intellectual “enlightenment” or to learn a trade that would discourage them from begging. Although initially developed for adults these institutions also later adapted to cater for children, and took on a more formal educative role in the process.¹⁹

Although people with different conditions, such as blindness, deafness and mental illness, were kept in separate institutions from the eighteenth century to the first half of the twentieth century, there was a tacit understanding that people with impairments, particularly physical impairments, had similar social struggles. This was recognised in many countries throughout Europe and from the nineteenth century North America too, with many countries passing laws for students with disabilities and appointing departments and experts to develop education for such students. Perhaps the most respected of these experts was the educational psychologist Lev Vygotsky who was appointed the director for students with “defects” in the former USSR. In this respect Vygotsky²⁰ was the first theorist to acknowledge that social factors were at least as important as physical, sensory and learning impairments in education. As he stated on this matter:

Every physical defect, be it blindness or deafness, alters the child’s attitude towards the universe and, primarily towards its fellow beings. Let us take, for instance, the geometrical place of a human being in the social sphere, his part and his fate as partaker of life and all functions of social existence, and we shall all come to the conclusion that everything is to be entirely altered on the case of the human being with any defect. Any physical defect provokes a social sprain, with unavoidable consequences. (pp. 19-20)²¹

Developing in concert with this evolving notion of disability was the development of inclusion into education and other social and cultural institutions for people with impairments. This was followed by the notion of a combination of cognitive, developmental, emotional and social impairments, such as dyslexia and behavioural problems that could lead to learning difficulties. In more recent years, as equality and greater opportunities for people with disabilities has become the theme of politics in Westernized countries, a debate on the equality of disabled people has also become a theme for national governments and quasi international governments

¹⁹ Hayhoe, S. (2011). How do we define ability? Keynote presentation to the National Association of Disability Practitioners Annual Conference and AGM, Warwickshire, UK, on the 27th June 2011.

²⁰ Vygotsky, L. S. (1994). Principles of the social education of deaf and dumb children in Russia. In R. Van der Veer, & J. Valsiner (Eds.), *The Vygotsky reader* (pp. 19–26). Oxford, U.K.: Blackwell Publishers.

²¹ Vygotsky, *Ibid.*

and NGOs, such as the World Health Organisation (WHO) and the United Nations (UN). Consequently, these institutions have devised a series of definitions of disability that have increasingly incorporated the notion that social and cultural factors disabled people more than bodily or physical factors. This is particularly reflected in the UN's last definition of disability, which includes the notion of learning difficulty:

The term persons with disabilities is used to apply to all persons with disabilities including those who have long-term physical, mental, intellectual or sensory impairments which, in interaction with various attitudinal and environmental barriers, hinders their full and effective participation in society on an equal basis with others... Disability resides in the society not in the person. (Online)²²

The technologies developed to assist inclusion of people with disabilities and learning difficulties in education have become known as assistive technologies and are broadly defined as “any item, piece of equipment, or system, whether acquired commercially, modified, or customized, that is commonly used to increase, maintain, or improve functional capabilities of individuals with disabilities.” (P. 80504)²³ Historically, as soon as institutions for people with disabilities developed, technologies and adapted teaching methodologies evolved, articles were written and associations of teachers and innovators were incorporated to cultivate new pedagogies and technologies to overcome their impairments. For example, special schools and institutions have become expert at teaching advances such as Braille – developed by a former student at the Paris institute for the blind, following on from touch languages developed from the 18th Century²⁴ – magnifying lenses and devices to assist mobility such as crutches, white canes and later wheel chairs. With the advent of electronic audio devices also came the development of technologies such as hearing aids and amplifiers for deaf people, and radio transmissions for people who were blind or visually impaired. Later, digital technologies have also provided further help in making literature and knowledge available. Software in particular has helped to overcome barriers to learning through, for instance, audio descriptions of books and art works, enlargement or recolouring of text on screen, and the representation of sound as text²⁵.

²² United Nations. (Downloaded). Enable: Rights and dignity of persons with disability. Downloaded from <http://www.un.org/disabilities/> on the 1st July 2012.

²³ Architectural and Transportation Barriers Compliance Board. (2000). Electronic and Information Technology Accessibility Standards (36 CFR Part 1194). Federal Register, 65, 246, 80500-80528.

²⁴ (Hayhoe, 2008a), Op. Cit.

²⁵ Sultan, N. & Hayhoe, S. (2013) Assistive technologies for students with special needs at the Higher Colleges of Technology, UAE. In S. Dowling, C. Gunn, J. Raven, and S. Hayhoe (Eds.). eLearning in action: Redefining learning. Abu Dhabi. HCT Press.

In keeping with an SAMR model of classifying technology in education, training strategies have been developed to incorporate the use of these devices to Enhance learning. Substitution allows mainstream teaching to take place with technologies that can blend in with the pedagogy of the lesson. For example, students who have reading difficulties can record the teacher in class to play the lesson back through MP3 devices in lieu of note-taking, or can use enlarged or coloured type on computer screens to substitute for traditional reading materials²⁶. Augmentation skills are taught through the use of software such as JAWS, Ruby on Rails, or other screen-readers that augment voices for blind computer users, or devices to augment voices for people with incapacitated facial muscles²⁷. In addition to these enhancing technologies, there are more radical Transformations of syllabi through assistive technologies. For example, software and hardware has Redefined how students are taught to read and produce writing through devices such as the Perkin's Braille in schools for the blind. This tradition has continued with more contemporary technologies such as Braille readers to assist with tactile literacy for people who are blind²⁸. Similarly, devices have been developed that can Modify the way that traditional skills in special schools are taught. For example, students with restricted movement in their limbs are taught mobility skills through virtual reality devices rather than traditional and potentially more dangerous equipment²⁹. All of these categories are illustrated in Table 2.

Table 2: An illustration of the SAMR model of assistive technology driven education

Transformation

²⁶ Meurant, R.C. (2010) The iPad and EFL Digital Literacy. Communications in Computer and Information Science, 123, 224-234., Department of Education and Training. (2011). iPad Trial: Is the iPad Suitable as a Learning Tool in Schools? Queensland, Australia: Government of Queensland.

²⁷ Hawking, S. (2013) The computer. Downloaded from <http://www.hawking.org.uk/the-computer.html> on the 29th September 2013.

²⁸ Wong, M.E. & Tan, S. S. K. (2012) Teaching the Benefits of Smart Phone Technology to Blind Consumers: Exploring the Potential of the iPhone. Journal of Visual Impairment and Blindness, 106, 10, Downloaded from <http://www.afb.org/afbpres/pubjvib.asp?DocID=jvib0610toc>. Hayhoe, S. (2012). Using an iPad with a Blind Student: A Case Study at Sharjah Women's College, In Dowling S. et. al. (Eds.). eLearning In Action: Opening Up Learning. Abu Dhabi: HCT Press.

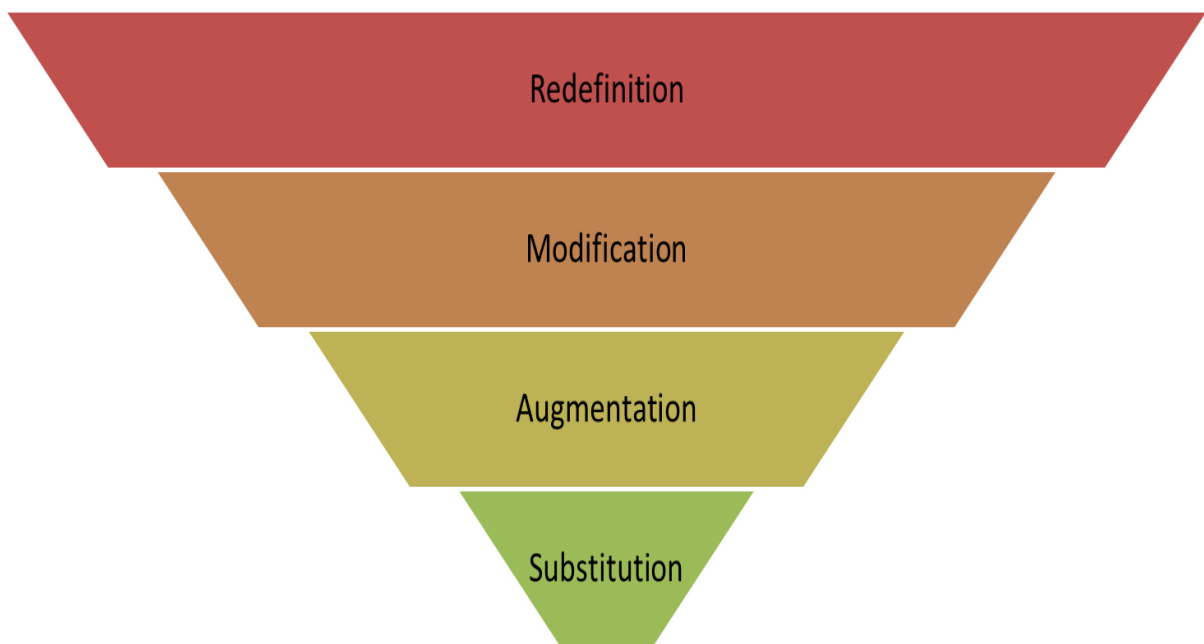
²⁹ RivaetaL, G. (1998). Uses of virtual reality in clinical training: Developing the spatial skills of children with mobility impairments. Virtual Environments in Clinical Psychology and Neuroscience: Methods and Techniques in Advanced Patient Therapist Interaction, 58, 219.

Redefinition	Technology allowing for the training of new skills through	Customised technology that allows students to write or read using alternative technologies, such as the Perkins Braille.
Modification	Technology allows for significant redesign of tasks	Customised technology that allows teachers and students mobility, writing facilities, reading facilities, hearing facilities
Augmentation	Technology substitutes as a direct tool, with functional improvements	Accessible settings, such as voice recognition
Substitution	Technology acts as a direct tool substitute, with no functional change	Tablet computers, smart phones, mp3 players and multimedia devices with differing inputs and outputs
Enhancement		

However, there is a problem with the idea of traditional assistive technology as it has been applied in educational contexts – and arguably in other social settings too. In itself assistive technology too often separates students with disabilities from those without disabilities, and provides a reason not to include disabled students in mainstream lessons, curricula and schools – in many cases assistive technologies, and the skills needed by teachers to use and teach with them, require that they are installed in special schools, leaving no social inclusion at all in the lives of disabled students. Furthermore, many schools, teachers, students and families have found that there are many economic problems with affording traditional assistive technologies, as their specialist nature and the fact that they are developed and manufactured in small numbers make them more expensive than mainstream, mass produced technologies. In addition, although the name assistive technology is designed to signify the assistance of technology in lessons, this emphasis on difference often means that students with disabilities and learning difficulties are more often separated and taught skills necessary to use assistive technologies or modify existing tasks that separate students included in mainstream tasks than use technologies to support

mainstream classes³⁰. In relation to the SAMR model, what is often observable of many applications of assistive technologies in education is that they too often focus on Transformative education rather than provide an Enhancement to mainstream teaching and learning. This emphasis can be illustrated as an inverted pyramid, in which most teaching with assistive technologies occurs in the top half of the pyramid. This is illustrated graphically in figure 1.

Figure 1: An illustration of the SAMR model of assistive technology, showing the traditional balance of teaching with assistive devices



Redefining assistive technology as inclusive technology

It can thus be argued that traditional assistive technologies are some of the last cultural and social barriers to the full educational inclusion of students with disabilities and learning difficulties. This is a problem of assistive engineering and design as these disciplines are too often developed and written about by able bodied people trying to imagine what it is like to have a disability.

Moreover, engineers and designers more often than not fall prey to the academic, social and cultural stereotypes that their imagination engenders. As a result, traditional assistive technologies often encompass highly immobile, awkward and physically restrictive devices which are bound to single classrooms and adapted environments. In addition, many assistive devices are also restricted to separate, special schools designed only for people with disabilities because,

³⁰ Clarkson, J., Langdon, P., & Robinson, P. (Eds.). (2006). *Designing Accessible Technology*. London: Springer.

as has already been stated in this chapter, they are also too expensive and uneconomical to install and maintain in mainstream schools and colleges.

There are also socially and culturally negative aspects of traditional assistive technologies that affect the self-esteem of students who have to use them. In particular, it has been observed that traditional assistive devices often identify a person as having a special need, which can stigmatize students with disabilities and learning difficulties among their able bodied peers³¹. Academia itself also does not help in the *process* of developing methods to include students through assistive technology, as the largest body of literature targeting the use of assistive technologies in education focuses on the mechanical and electronic properties of hardware and software, rather than thinking about the aesthetics of their design, or the cultural and social acceptance of such devices in mainstream settings. Moreover, despite the development of new forms of mainstream educational technology through innovations such as m-learning, there is little research on the use of this new technology with assistive devices, even though many modern mobile technologies now have assistive functions. This provides a problem in educational research, and highlights the need for a re-philosophical evaluation of the pedagogy that accompanies assistive technologies. This re-evaluation can be summarized through the following two questions: (1) what is inclusion in assistive technology? (2) how can such technologies be inclusive?

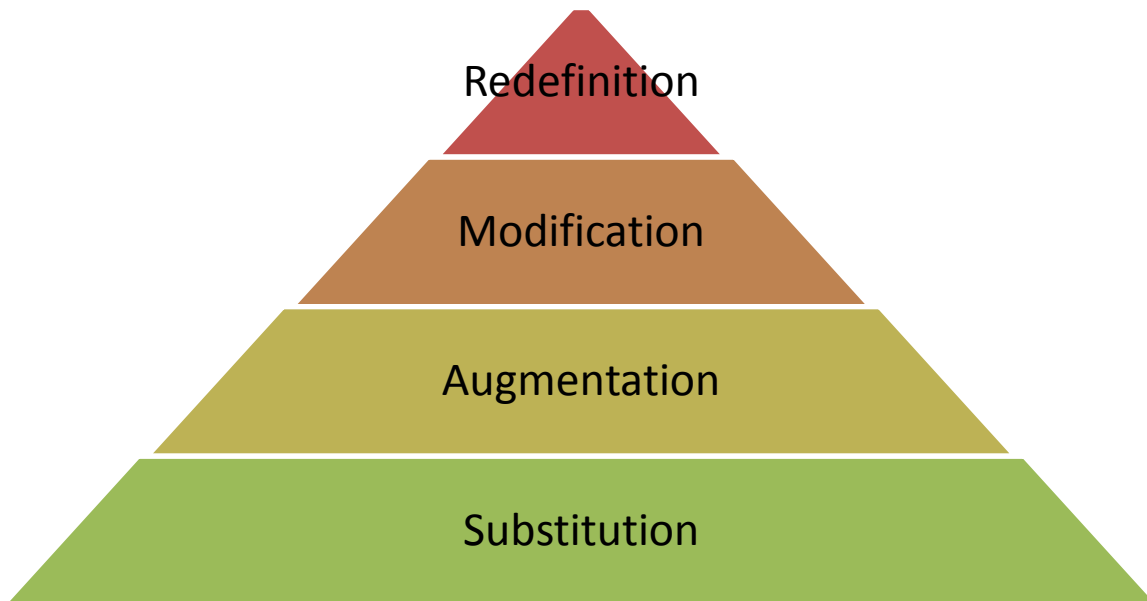
In answer to the first question, it is argued³² that inclusive technology is “mainstream technology that can be used with either no or minimal adaption by a person with a disability as an accessible technology. It is also seen as technology that provides social inclusion, such as communication and interaction, for people with disabilities.” (Online). Thus, in order for technology and the design of technology for people with disabilities and learning difficulties to be wholly useful it needs to be driven by a mainstream social and cultural form in concert with the notion that students should not have a separate form of education. This brings the study of assistive technology in line with the educational philosophy of inclusion in education, one that states that all students should have social and cultural equality with each-other in all forms of teaching and learning.

³¹ Hayhoe, S. (in press). An enquiry into passive and active exclusion from sensory aesthetics in museums and on the Web: Two case studies of final year students at California School for the Blind studying art works. *British Journal of Visual Impairment*.

³² Hayhoe, S. (2013). A review of the literature on the use of the iPad as an assistive device for students with disabilities – with reference to the Gulf. Paper delivered at the Global Education Forum, World Trade Centre, Dubai, UAE, March 2013.

In answer to the second question, it is argued that the existing understanding of what an assistive technology is needs to be reshaped, and the terminology used to describe such technologies and their accompanying pedagogies in mainstream environments needs to be redefined. The first method by which this can be done is to rename assistive technology in education, inclusive educational technology. This will help to shift the focus away from the design and engineering of such devices as an engineered assistance to people who are disabled or who have learning difficulties, and move it towards the inclusiveness of the education that they support, and the social and cultural inclusion issues that they address. The second part of this process is to redefine the process of engineering design itself, in order to make it fit for purpose for people with disabilities and learning difficulties; i.e. to not make the design and engineering process about perceived practical measures as defined by academics or engineers, and to make it customer led, focusing solely on the individuals for whom the technology is created. This can be achieved by training and encouraging people with disabilities and learning difficulties to create their own technologies, or at the very least by including people with disabilities in the design process, and not just as end user testers. Furthermore, it is necessary that assistive technology should not signify inferiority, particularly in matters of intelligence. It must instead be emphasized that students with disabilities and learning difficulties still have human capital that is valuable to their societies. If this is achieved, then we can invert the SAMR model's pyramid to show Redefinition of tasks as being the least important purpose of technologies in the education of students with disabilities and learning difficulties, and Substitution as being the most important role for these technologies. This is illustrated graphically in figure 2.

Figure 2: An illustration of the SAMR model of assistive technology, showing of teaching through technology that is truly inclusive



For some engineers and designers, this process has already begun. As previously stated, mobile learning (m-learning) is a pedagogy employed in education with mobile devices, such as tablets, MP3 players and recorders, and mobile telephones – the latter is most often through smartphones. This means that many aspects of education are controlled outside of the traditional classroom and either resources become highly accessible in all learning environments – not just in the library – or that the classroom itself is less important to teaching and learning, allowing learning to happen in multiple locations at any time³³. This form of learning lends itself to the education and training of students with disabilities and learning difficulties, as they can record mainstream classes, access extra data that they may need in mainstream classes, and even have access to specialist media such as Braille through the Web. Apple devices in particular have been found to be noteworthy inclusive devices for use in m-learning as they are designed for multiple communication channels, multi-media and quick access to apps. In addition, Apple has made a full commitment to accessibility in its mainstream devices. In its tablet devices, such as the iPad, iPhone or iPod, rather than engineering features for perceived individual problems of disability, features for use in special education are broken into the following four categories³⁴:

- Literacy and learning
- Vision
- Hearing

³³ Ally, M. (Ed.). (2009). *Mobile learning: Transforming the delivery of education and training*. Athabasca, Canada: Athabasca University Press.

³⁴ Apple. (2013). *Accessibility – Resources*. Downloaded from <http://www.apple.com/accessibility/resources/> on the 12/2/2013.

- Physical and motor skills

For Apple, tablets in particular have a number of inclusive features which are fitted as standard, such as voice functions to identify objects for people who are blind or have reading problems, text on screen for people with hearing impairments, software and apps for reading to help students with learning disabilities, a zoom facility for users with low vision, and a function for changing colour to photo-negative – a function that can help people with low vision and also people with dyslexia and dyscalculia. However, as has also been noted about this device, some elements still need improving. The cost of the iPad in comparison to other mainstream tablets, for instance, is relatively much higher. In addition, the amount of processing time is greater when using inclusive features, and it takes a large amount of time to setup the settings – which are described in a user manual that is inaccessible to many people who are blind, or who have many learning difficulties or visual impairments. Thus it is too early to say whether it significantly improves the prospects of students with disabilities and learning difficulties.

Conclusion

Assistive technology has helped many people, and has largely been perceived to be a force for good for students with disabilities and learning difficulties for over 200 years. However, unlike other aspects of education it has failed to evolve to include all students in mainstream education. This is because the focus of the engineering and design of assistive learning technologies is largely on their technical capacities and perceived functions, rather than their form or their ability to include people with disabilities in all mainstream social and cultural settings. Unfortunately, such design problems are often the result of a lack of understanding by the designers and engineers, who often over-intellectualise the problems of disability. The application of the SAMR model of learning with technology applied to assistive technology illustrates this point well. Thus what is needed, if we are to make technologies fully inclusive, is to consult and include users of assistive technology at every stage of the design process – not just the testing process - and in the long term train people with disabilities and learning difficulties to engineer technologies that best serve their own purposes. More importantly, we must restate the aims and title of assistive technology as inclusive technology in education; technology that integrates students and others with disabilities and learning difficulties in all aspects of life. Although this process has started with mobile technologies and learning, there is still a long way to go.