The Use of Technology to Support the Learning of Children with Down Syndrome in Saudi Arabia

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Abstract

The research employed a survey questionnaire to explore the type of technological tools available in schools for children with Down syndrome (DS) in Saudi Arabia, perceptions of teachers toward the benefits of technology-assisted learning for DS students, the skills that children with DS need to use technology, the challenges of using technology for children with DS, and what can be done to improve the use of technology for children with DS. The data from the 20 teachers in two schools were analysed using qualitative data analysis procedures, which yielded several themes.

The findings show that the sampled schools have different types of technologies but computers, iPads and projectors are the most commonly used devices, although there are other devices such as DVD players, mobile phones, and loudspeakers among others. Many teachers understand the benefits of using technology to support children with DS and their views are supported by studies conducted in the past on the same area as presented in extant literature. The key challenges to using technology as identified by the teachers include lack of resources such as computers, lack of software designed in Arabic, and lack of training for teachers to enable them to support children with DS. Recommendations are discussed.

Keywords: *Saudi Arabia and students with disabilities; technology and special education; children with Down Syndrome*

1. Introduction

Students with Down Syndrome (DS) and other disabilities have been disadvantaged for a long time in terms of access to the school curriculum due to the limitations of traditional teaching methods. Typically, educators have used a range of teaching methods and strategies such as pacing, task analysis, and repetition to support the learning of children with DS. While these methods have worked for some students, some students fail to achieve optimally in school and teachers have been challenged to provide more creative ways of supporting students including the use of technology. The recent advances in technology have resulted in the availability of a range of devices in classrooms as learning tools and teachers now have options. However, the uptake of these technologies varies from country to country and school to school, due to national policies, and teachers' knowledge, skills and attitudes. This study was conducted to determine the extent of use or technology to support the learning needs of children with DS in the Kingdom of Saudi Arabia (KSA).

1.1 Problem of the Study

Although the use of computer-assisted technology to support the learning of students with special needs including those with DS has grown exponentially in the last two decades (Klein, Cook & Richardson-Gibbs, 2001, pp. 26–27; Black & Wood, 2003a), some developing countries are yet to embrace technology use for students with special learning needs.

The KSA Ministry of Education has put in place policies and resources to support the education of children with special needs. However, Al rubiyea (2010) reports that there is a lack of comprehensive information that focuses on the needs and rights of children with special needs in KSA, including the use of technology. While numerous studies about the use of technology to assist children with DS have been conducted in countries such as the US, there is limited

information about the state of technology use to support children with this condition in KSA.

1.2 Aim of the Study

This research was conducted to determine the extent of use of technology to support the learning needs of DS children in KSA. The research was necessitated by the gap in information about the use of technology to assist learners with DS in KSA. It was therefore aimed at sealing this gap by investigating the situation in two schools in KSA which offer education to children with DS.

1.3 Research Questions

1.   What types of technological tools are there in schools for children with DS in KSA?

2.   What do teachers think are the benefits of technology-assisted learning for DS students?

3.   What skills do DS students need to use technology?

4.   What are the challenges of using technology for children with DS in KSA?

5.   What can be done to improve the use of technology for DS students in KSA?

This study is important because it will provide information about the various types of technologies being used in schools and the teachers' preparedness to use them. This knowledge is important for stakeholders in the education sector in KSA in improving the methods and facilities for teaching DS children. The findings can also be used as a basis for conducting similar studies in different schools to determine the extent of use of technology for children with DS in KSA.

2. Literature Review

2.1 Downs Syndrome and Its Effects on Children's Learning

DS is defined as a generic disorder which is caused by chromosomal abnormalities. The condition is manifested when a person has an extra chromosome (Al Shamsi, Talhami & Shaalan, 2006, p. 146). Children with DS have a number of physical and cognitive characteristics, which need to be given serious consideration when it comes to their education. DS children may have a below average length and weight at birth, broad hands with diminutive fingers, a small mouth, a short neck, a small nose with a flat nasal bridge and flattened facial features, eyes that slant upwards and outward (almond shaped eyes), and a tongue that tends to protrude out of the mouth among other features (Klein et al., 2001, p. 25; Fegan, 2011, p. 160). They are also likely to have other health problems such as chronic mouth breathing, frequent upper respiratory infections, and heart malformations (Klein et al. 2001, p. 25).

As a result of the aforementioned challenges, DS children have several learning and interaction problems including poor balance, perceptual difficulties, hearing loss and poor vision (Fegan, 2011, p. 160). Additionally, such children are usually characterised by generally poor communication abilities, a reasonably unintelligible speech and phonological problems (Feng, Lazar, Kumin & Ozok, 2008).

Children with DS experience difficulties in areas such as motor development, obtaining grammar skills, speech clarity and the ability to use expressive language, which are associated with cognitive deficits (Down Syndrome Education International (DSEI), 2013). Specifically, this is because the motor skills in children with DS develop much slower compared to non-DS children. Consequently, children with DS do not explore and learn about their environment at the same pace as non-DS children. This means that although children with DS are able to achieve many of the same developmental milestones that other children without the condition do, they usually attain these milestones at a slower pace. Additionally, their rate of response is oftentimes rather sluggish, and they may often require many repetitions in order to master a given task (Klein et al. 2001, p. 25). Further, most DS children never grasp truly complex syntactic constructions that involve elements such as embedding and related language areas (Tomasello, 2006). Although research on the causes of such challenges has not yet produced conclusive results, it is apparent that the main problem that DS children face is a cognitive one (Tomasello, 2006, p. 291), which affects their learning in school and demands that schools use a range of strategies and resources to support their learning.

2.2 Strategies to Help DS Children in Their Learning

Some of the strategies that can be used to help DS children in learning include pacing, task analysis, repetition, and the use of computer-assisted technology (Klein et al. 2001, pp. 26–27; Black & Wood, 2003a). Pacing entails both the rate of speaking and making movements – that is how fast the teacher speaks or performs a given activity or task and how long the instructor waits for the learner to respond or to finish a task (Klein et al. 2001, p. 26). It involves the teacher

slowing down the pace of activities in the classroom to suit the needs of children with learning difficulties (Klein et al., 2001, p. 26; Buckley & Le Prèvost, 2002).

Closely related to pacing is task analysis, which involves breaking tasks into small steps and helping the child to learn one step at a time (Klein et al. 2001, p. 26). According to Hodapp and Dykens (2006), task analysis has enabled many people with mental retardation to work successfully in supported work environments (p. 487).

Turning to repetition, Klein et al. (2001, p. 27) opine that repetition is one of the most effective and simple methods of supporting children with cognitive disabilities. They argue that by simply repeating important words or movements an extra time or more, a teacher can significantly increase a child's opportunity to learn. Mahoney and Perales (2008) also assert that children with DS must experience significantly more repetitions in order for them to learn the same amount of information as those children whose cognitive processes are not compromised.

The other approach that can be used to improve information reception for DS children is the use computer-assisted technologies. Computer-assisted learning provides benefits for children with DS such as self-paced learning, visual presentation, motivating graphics and sounds, instantaneous feedback as well as the opportunity to be in control of their own learning (Black & Wood, 2003a).

Various authors (Buckley, 2000; Black & Wood, 2003a; Black &Wood, 2003b) have argued that computer-assisted learning provides particular benefits for DS children, as well as for people with learning disabilities in general. The authors however note that direct research evidence in this area is limited. That aside, Buckley (2000, p. 10) has the view that the research that is available, as well as the practical experience that has been gained, seem to corroborate the perception that children with DS can benefit from computer-assisted learning.

Discussions by Buckley (2000), Black and Wood (2003a) and Black and Wood (2003b) suggest the following benefits of computer-assisted learning for people with DS. First is that computer-assisted learning improves motivation through the use of pictures, animation and sounds – all of which can promote interest. Secondly, computer-assisted learning builds self-confidence by helping children with DS understand that they can have an impact on their surroundings. This is facilitated through the use of 'cause and effect' software, which enables learners to have a sense of control over what they are doing, and from here they can start to use familiar programs unaided (Black & Wood, 2003a). This can eventually contribute to independent learning. Computer-assisted learning also offers learners a multi-sensory experience since computers provide both visual and auditory input as stated above. Black and Wood (2003a) argue that DS children are visual learners who learn best when content is relayed to them visually and find learning from listening more difficult. As such, computer technology is particularly well-suited for children with DS. Discussing the same point, Buckley (2000, p. 10) notes that the emphasis on the visual presentation of information in computer-assisted lessons is also likely to help individuals with DS overcome language processing limitations.

Self-paced learning is also highlighted as a key benefit of computer-assisted learning as the child is able to proceed at his or her own desired pace. The computer can be programmed to 'wait' for learners such that it only prompts them to proceed with the lesson after they have had time to fully process the information and develop their response (Black & Wood, 2003a). Another benefit is that computer technology provides an opportunity for errorless learning (Buckley, 2000, p. 10). Computer programs can be configured in such that a way that the child is supported so as to attain repeated success. The child is helped at each stage as necessary, before they make an error, and this allows the child to learn a series of steps to attain success each time (Black & Wood, 2003a). As well, the use of computer technology ensures that children receive immediate feedback. Additionally, unlike human beings (in this case teachers), computers never get frustrated or impatient due to repeated errors, and the feedback is non-judgemental and non-threatening. Further benefits of using computer technologies to support the learning of children with DS include the points that such technologies provide children with the much needed opportunity of doing practice to grasp new skills and that various programs can be differentiated to meet the varied needs of different children. Computer programs provide as many opportunities as are necessary to repeat the same target in exactly the same way. Also, both software and hardware can be customised and modified to meet the needs of children with different individual needs (Black & Wood, 2003a).

2.3 The Situation in KSA and Other Arab Countries

KSA has strived to ensure that the rights of people with disability as regards access to education are protected. This is embodied in various legislations passed to guide practices. In 1987, KSA passed the disability legislation (LD), which contains significant provisions that guarantee people with disabilities rights equal to those of other people in the society (Alquraini, 2010). There is also the disability code that was passed in 2000. This code is a pledge by the KSA government that people with disability have equal access to free and proper educational, medical, social, psychological and rehabilitation services through public institutions (Alquraini, 2010).

Further, there are special arrangements for the education of people with disabilities in that the government strives to ensure that special education services provide "high-quality education services in the least restrictive environment" (Alquraini, 2010, p. 141). In addition, students with mild and moderate disabilities receive their education in typical classrooms with support from special education services like source rooms. Students with severe disabilities receive their education in separate institutions. The downside of this approach however is that students with severe disabilities are often educated in segregated environments that do not enable them to interact with other colleagues who do not have disability where they could improve their communication, social and academic skills (Alquraini, 2010, p. 141).

From the discussion above, it is apparent that there are some challenges in the education system in KSA. A research conducted by Al rubiyea (2010) indicated that KSA is still in the process of modernising its institutions to deal with the challenges posed by changes in the national and international systems. Al rubiyea (2010) concluded that there is lack of comprehensive information that pays attention to the needs and rights of children with special needs in the country. Further, parents of children with special needs in KSA are under stress because of a lack of proper guidelines and policies for such children. In particular, Al rubiyea (2010) pointed out that meeting the needs of children with special needs in the kingdom is still in the infancy stage, implying that there is a dearth of facilities to cater for the needs of children with special needs like those with DS. The research by Al rubiyea (2010) also identified social barriers as one of the key obstacles to the education of children with special needs in KSA. Social barriers are also a major challenge to helping DS children in other countries such as the UAE.

In KSA, according to Rana, Fakrudeen, Miraz, Yousef and Torqi (2011), there are 1237 institutes and programmes which have integrated the use of Information and Communication Technology (ICT) in offering special education for people with learning disabilities (p. 535). This number is however not broken down to indicate the exact figure of schools that are using ICT in teaching children with learning disabilities as it includes all learning institutions. The figure provided by Rana et al. (2011) also does not specify the types of technologies being used by the various institutions for individuals with learning disabilities and the types of learning disabilities being dealt with. Therefore, it is not possible to deduce from this literature the number of schools that provide education to DS children which have adopted the use of various technologies. Generally, other sources of literature (such as HLMDD, 2013) have revealed that lack of ICT accessibility, lack of resources and lack of skills are the major challenges that hinder the use of technology in learning institutions. This implies that even if there are schools to cater for the needs of children with DS, they may not be adequately equipped with modern technologies to help these children in learning.

2.4 Technologies Used to Support Learning and the Potential Challenges

An assistive technology is defined as any item, gadget or product system, whether produced commercially, customised or modified, that is used to enhance, sustain or improve the functional capabilities of individuals with disabilities (Ryba, Curzon & Selby, 2005). There are different types of assistive technologies. They include switches, direct selection devices, scanning devices, alternative keyboards, alternatives to a mouse, speech-to-text and text-to-speech devices, multimedia devices and other specialised conversion devices (Ryba et al., 2005; James, 2003, p. 227).

Switch interfaces provide a channel through which people with learning disabilities can engage various devices and thus control the events in their environments (Ryba et al., 2005). Direct selection devices are equipment whereby the user activates a switch and something happens instantaneously (this is usually referred to as cause and effect or stimulus and response) (Ryba et al., 2005).

Scanning devices represent a more sophisticated form of interaction with a computer. There are specialised scanning computer programs used to present a series of choices referred to as scanning array. Different alternatives can be identified by sound, for instance through a beep, by framing or by highlighting. The user of the device then activates the switch after identifying the required choice (Ryba et al., 2005).

Alternative keyboards are meant for learners who need specially designed keyboard layouts that can accommodate particular cognitive or physical challenges (Ryba et al., 2005). Alternatives to a computer mouse are available because using the ordinary mouse is cognitively challenging (Ryba et al., 2005). Also available are speech recognition devices, which are used in converting spoken words or sentences to text (Al Shamsi et al., 2006, p. 148).

Multimedia devices are defined as gadgets that offer any combination of text, graphic, animation, video and sound that are delivered by a computer system. Such devices thus allow users or viewers of a project to control when and where these elements are delivered. Multimedia applications enable learners to explore the media content by themselves, at their own speed, and to anticipate non-threatening guidance from the computer program (James, 2003, pp. 227-228).

There also are other types of specialised conversion devices such as the Mountbatten Brailler™, which makes any typed text to be printed rapidly, spoken or embossed in Braille. There are also other devices which convert text to

refreshable Braille. Other devices can also convert Braille to speech using a system such as the Braille Lite™, which has a number of applications such as a word processor, a database, a calculator, and a diary (Ryba et al., 2005).

Hasselbring and Glaser (2000) also argue that technologies such as the Internet can be used by learners to communicate and network, hence being able to expand their learning environment beyond the walls of the classroom. The authors also suggest that technologies like the Internet facilitate the students' capacity to make personal connections with others and offer opportunities to pay attention to writing skills within a perspective that they value, devoid of the fear of being stigmatised (p. 108).

It is important to note that each of the abovementioned technologies is used for different purposes (memory training, reading and writing training, physical and spatial training, etc). For example, Microsoft (2012) documents a case study of how a gaming system is used in Bogota, Colombia to enrich learning for children with DS at the Down Syndrome Corporation. The aim of using the system is to go beyond the traditional presentation tools and visual aids since it enables learners with DS to engage more with technology, do some physical exercise and to grasp a wider array of concepts. The results of using this technology have been impressive because two years since its inception, teachers recorded some progress in the students' behavioural and cognitive areas (Microsoft, 2012)

Other tools like tablets and/or desktop computers or laptops can also be used to enhance students' learning as is evident through the case highlighted by Layton (2011) in North Carolina, the US. iPads and iPods are also on record for playing a vital role as a technology tool for children with DS (Lester, 2012). In reference to the iPad, Layton (2011) notes that at first, "Most children...are quite taken by the technology. They focus more, interact more, interact with it easily, and verbally interact with the appropriate apps" (para. 1). In the larger US, a study conducted by Hasselbring and Glaser (2000) suggested that the use of computer technology among students with learning needs studying in integrated classrooms can help them keep up with their non-disabled peers. Where students have severe learning disabilities as would happen with extreme cases of DS, Hasselbring and Glaser (2000), found out that special technological interventions developed specifically for purposes of aiding children had a positive impact on learning outcomes.

It is also evident from literature that for assistive technologies to successfully enhance learning for children with DS and other special needs, the technologies ought to match with the needs and abilities of individual children (Herrera, Bruno, González, Moreno & Sanabria, 2011). This is particularly important because children and adults with DS vary greatly in their achievements and interest in different types of skills (Herrera et al., 2011).

Herrera et al.'s (2011) study was aimed at determining the level of addition and subtraction skill progression in students with DS compared to those without the disability. The researchers interviewed students with DS aged 12-31 years by asking them questions that required conceptual and procedural knowledge of subtraction and addition. Based on their findings, Herrera et al. (2011) concluded that students with DS could be provided with instructional programmes that focus on understanding algorithms before using them as this has been shown to result into increases in both procedural and conceptual knowledge in non-DS students. Such knowledge is critical in the design and use of technology for DS children.

Bennett, Holmes and Buckley (2013) used computerised memory training on children with DS in the US, and noted that the training had a positive effect on the children in that they showed improvements on "visuospatial short-term memory tasks" (p. 179). The aim of the research, which involved 21 children aged 7-12 years, was to assess the impact of a computerised visuospatial memory training intervention on the behavioural skills and memory of DS children.

Bennett et al.'s (2013) findings above are supported by numerous other studies (Conners, Rosenquist & Taylor, 2001; Nadkarni, Sumi & Ashok, 2012). These authors argue that rehearsal training can improve the working memory in individuals with DS. The research by Conners et al. (2001) was aimed at resolving various issues: (1) whether the auditory working memory of children with DS can be improved reliably, (2) whether the improvement can be maintained over the long term, and (3) whether the improvements can match up to more rigorous comparisons. The research involved children with DS aged 6-14 years. In their findings and conclusions, Conners et al. (2001) confirmed previous research findings that indicated that rehearsal training can enhance the working memory in individuals with DS. The use of technology can enhance working memory training.

On the other hand, the research by Nadkarni et al. (2012), which was conducted in the UAE, was aimed at understanding the correlation between visual-spatial abilities and eye-hand coordination based on the re-training strategy. The research involved three children with DS aged between nine and 11 years. The authors concluded that there was a significant improvement in the eye-hand coordination and the visual-spatial capabilities of children who participated in the rigorous therapy programme.

Despite the potential use of technology to support learning, this review shows that there are challenges for both teachers and students. Thus knowledge of how DS children can use different technologies and how this can benefit them and the related challenges is also critical in determining how various technologies can be used in different areas. Feng, Lazar, Kumin and Ozok (2010) conducted a study to determine the extent of computer usage by children with DS. By using an online questionnaire survey on 600 parents of children with DS, Feng et al. (2010) gathered information on the challenges experienced by children with DS when using computers. Cognitive limitations were identified as hindrances to effective use of computers by DS children. These include general cognitive difficulties, difficulties caused by frustration, and language difficulties. Other challenges that were identified include societal difficulties and the age of computer users (Feng et al., 2010).

As already mentioned, there is not much literature about the use of technology for children with DS in KSA and other Arab countries and it is perhaps indicative of the lack of, or limited use of technology to support such students.   The negative attitudes towards persons with disability as shown in studies (Al-Kindi, Al-Juhaishi & Saffar, 2012; Gaad, 2006) might impact   on the willingness to adapt teaching methods   because such societal difficulties impact how DS children can use technology in their learning both in school and at home (Feng et al. (2010).

3. Methodology

In this research, the interpretivist paradigm was used. Interpretivism makes use of qualitative methodology, which pays more attention to words and meanings than quantitative methodology. The interpretivist approach was preferred because of the nature of the problem to be investigated, required respondents to express themselves from their own perspective as opposed to relying on the researcher's knowledge in the area as would be the case using a hypothesis. This approach is based on the notion of qualitative research, which is that "qualitative research is a multi-method in focus, involving and interpretive, naturalistic approach to its subject matter" (Denzin & Lincoln, 1994, cited by Klenke, 2008, p. 7). This implies that qualitative researchers study occurrences in their usual settings and attempt to understand or interpret issues in terms of the meanings that people convey (Klenke, 2008).

In addition, interpretivist research recognises that there may be many explanations for certain actions (Mukherji & Albon, 2010), which is not the case with positivist methodology. Since DS affects children differently and the use of technology could affect them differently, it was important to study the issue of technology use by DS children in a naturalistic manner that allowed respondents to discuss the subject matter from their own understanding of the phenomenon.

Another point is that instead of applying random sampling as is the norm in quantitative research, qualitative research makes use of theoretical or purposive sampling. Therefore, in this study, two schools were purposely selected because as schools built for children with DS, they could provide a detailed account of the phenomenon being investigated and the participants (in this case teachers who have experience in that context) could report their experiences.

3.1 Participants, Sample and Sampling Procedures

The participants were 20 teachers of children with DS in two special schools for children with DS. The researchers purposefully selected two schools which offer education to children with special needs and which use different types of technologies to assist these children in learning. The researchers visited the two selected schools and requested for permission from the schools' principals to conduct the research with teachers dealing with DS children as the participants. Ten teachers were selected from each school for the study; hence 20 teachers participated in the study.

3.2 Instruments

The research made use of a qualitative survey questionnaire with open-ended questions, which is typically used in exploratory or qualitative research (Johnson & Christensen, 2012, p. 1700). This allowed the respondents to provide their own answers to the questions. The questionnaire was developed by the researchers and focused on questions around what technology is used in teaching, the benefits of the technology, the effectiveness of the use of technology, the challenges of using technology and what can be done to improve the use of technology.

3.3 Data Collection

Before data collection, ethics approval was sought from the UNE Ethics Committee. Once the ethics committee approval was obtained, we contacted the two schools which specially teach children with DS in Riyadh. The schools were The Voice of Down Syndrome Society and Down Syndrome Charitable Association (DSCA). On two different days, one of the researchers visited each school to seek the principals' approval for data collection. During each visit, the principals were provided with translated copies of Information Sheet for Participants, Consent Forms and

Questionnaire Schedules. Upon the school principals' approval for the research to proceed, the researchers were given an appointment to have a meeting with the participants from each school (ten participants from each school). Questionnaires were distributed to participants during the meetings and each participant was required to answer the questions and return to the researchers. Some of the completed questionnaires were collected on the day and others were collected some days later.

3.4 Data Analysis

The data from the questionnaires were analysed according to the existing questions, which served as pre-determined themes and sub-themes. The answers to each question from all of the 20 participants were summarised so that the researcher could make sense of what the teachers thought about the question, and by doing so obtained comprehensive information, which is presented in the results section.

4. Results and Discussion

4.1 What Types of Technological Tools are there in Schools for Children with DS in Saudi Arabia?

The responses to this question show that the two schools in the study use technologies to support the learning processes of children with DS. Computers are the most widely used device, as indicated by the 10 participants who mentioned computers. Other devices that are used in the schools include iPads, projectors, and to a lesser extent, television sets since only one teacher mentioned the use of television as a teaching aid. These findings corroborate views in existing literature which point to the use of different computer-assisted technologies as aids to support the learning of children with DS (Black & Wood, 2003a). Although the findings do not express the extent to which the various computer-assisted technologies are used in different schools, it can be said that the schools which use computers to support learning for children with DS aim to capitalise on the technologies' benefits such as self-paced learning, better visual presentation, motivating graphics and sounds, instantaneous feedback from the devices among others as noted by Black and Wood (2003a).

In regard to the types of technologies that the participants had used, a large number of the teachers said that they had used iPad (an example of tablet computers) while others mentioned simpler and cheaper devices such as mobile phones and DVD players. The use of tablet computers to help children with DS has been highlighted in literature (Layton, 2011). In particular, Layton discusses how such gadgets, including desktop computers and laptops, have been used to enhance learning for children with DS in North Carolina, US.

Furthermore, authors such as Lester (2012) have pointed to the use of iPads and iPods to assist children with DS. A recent systematic review of literature into the use of iPad and iPod devices within the wider field of intellectual disability supports the view that these tools can be used to enhance educational skills among other areas (Moni & Jobling, 2014, p. 230). The use of iPods can be linked to the use of DVD players since iPods play music and video just as DVD players. iPods can be said to be more sophisticated since they can be embedded with new apps designed specifically to meet the learning needs of children with DS.

Generally, it can be said that some of the technologies used by teachers to help children with DS are limited in terms of how their features can meet the multiple needs of such children. However, since some teachers said that they were using mobile phones, it can be assumed that these were smartphones, with the ability to support new apps designed for helping children with DS. De Krassel (2007) argues that today's children like surrounding themselves with technology devices, and there is no doubt therefore that mobile phones, especially smartphones, can be used to support the learning needs of children with DS through features such as games, music players and cameras which are usually embedded in such devices.

Other technologies that some of the teachers said they had used are loudspeakers and projectors. Use of hearing speakers to help children with DS who have mild hearing loss has been found to increase their ability to distinguish different sounds (Goldin-Meadow, 2009, p. 275). Use of projectors is also mentioned as a way of enhancing the learning experience for children with learning disorders like DS (Berry, 2004, p. 406).

4.2 What Do Teachers Think Are the Benefits of Technology-Assisted Learning for DS Students?

    i.   From your practical experience, how can technology-assisted learning support or enhance learning for children with Down syndrome?

The responses to this question demonstrate teachers' understanding of how technology-assisted learning supports or enhances learning for children with DS. It can be noted that while some of the teachers (seven) understand the benefits of using technology to assist children with DS, others are not aware while others did not answer the question due to

undisclosed reasons. The lack of awareness by some teachers regarding the benefits of technologies for children with DS is in contrast to results from elsewhere, where Microsoft (2012) for instance noted teachers reported impressive results from learners after using assistive technologies for a period of over two years. Overall however, the fact that more teachers were aware of the benefits of technology indicates that a good number of teachers in KSA are more likely to be informed about the positive impact of using technology to teach disabled learners.

The reasons why the teachers who were of the view that technology-assisted learning could enhance learning for children for with DS were varied. While some teachers focused on how technology-assisted learning could encourage learners' participation in various activities through programs containing voice and pictures, thereby enhancing their ability to learn, others believed that different technologies enabled teachers to display lesson contents more easily. The view that teachers' use of technology can encourage learner participation can be linked to the literature by Black and Wood (2003a) which discusses the various ways in which technology motivates children with DS to learn. Additionally, the view that teachers can also benefit from the use of technology is supported in literature by Bourdess (2001), who notes for instance that such technologies take some of the additional responsibility of attending to the learners' needs off the classroom teacher.

> *ii.   What is the most significant contribution of technology aids in the teaching/training children with DS?*

Responses to this question show that many of the teachers are aware of the benefits of technology in supporting the mental and physical aspects of children with DS, which is important for improving their learning. This suggests that many teachers are cognisant of the mental and physical challenges that children with DS face in regard to the learning in class. Such challenges are associated with the children's slow attainment of developmental milestones as discussed by Klein et al. (2001).

Being aware of such challenges can help teachers to prepare themselves in terms of how to deal with such children and to select the types of technologies that can be used to help children with DS. For instance, some of the respondents suggested that using technology to assist children with DS in areas such as reading stimulated their involvement in reading. Others noted that technology enhanced mental improvement and growth in the communication abilities of children with DS. As it was discussed in the literature review, the mental factors that affect children with DS are auditory short-term memory and differentiation of sounds (Al Shamsi et al., 2006, p. 147). Because of the problem of short-term memory, children with DS are not able to process and memorise learning instructions (Feng et al., 2008; DSEI, 2013). It is therefore likely that when the participants indicated that technology helps enhance mental improvement and growth in communication abilities, they meant that different technologies offer some solutions to some of the problems faced by DS children as highlighted above.

Also highlighted in the response to the research question is the point that some teachers noted that technology allowed them to present their lessons to children with less effort, thus positively influencing learning for such children. This finding is in agreement with the finding in the first part of the second research question in which some respondents indicated that technology can also benefit teachers – a view that is also supported by Bourdess (2001) as discussed above. Even though one participant did not provide a response to this question, it is evident from the other responses that many teachers are aware of the 'most significant contribution of technology aids in the teaching/training of children with DS'.

> *iii.   As a teacher, what difference do you think technology makes when it is used among children with DS?*

The research participants perceive the use of technology for teaching children with DS differently. Whereas one teacher was of the view that using technology presents an opportunity for teachers to use new teaching methods and approaches, another one indicated that children who used different technologies showed improvements in comprehension. Yet others believed that the use of technology generally motivated children with DS to learn. These findings show the link between technology use and both teacher and learner motivation as discussed in literature (Black & Wood, 2003a; Down Syndrome Victoria, 2009).

It is also worthwhile to look at the responses in terms of what teachers think about how DS children can use various technologies. As indicated by one of the participants in the research, the way in which any technology makes a difference to children with DS depends on the physical and mental conditions of the learners and the ability of the users to utilise the particular technology. This means that since DS affects different children differently, the affected children are likely to use various technologies differently. More importantly, teachers of DS children not only need a positive attitude to inclusion but also require specialist training and resources to help such children in accordance with their different needs (Down Syndrome Victoria, 2009).

Finally, there was one teacher who noted that it was not possible to single out any difference brought by the use of technology when teaching DS children. This view cannot be dismissed, as it represents the views of teachers who may not have noted any changes either because the technologies that they are using are not well suited for the learners or because the learners have challenges that cannot be simply dealt with through the use of technology alone. As already mentioned, a positive attitude to inclusion towards children with DS is also necessary as a way of helping such children. Further, one teacher did not offer a response, and the reason for such action could as well be explained using the same argument.

iv.   How do you gauge the success of technologies which are in use at your school? (Comment on their effectiveness and efficiency in meeting the learning needs of individual students)

Responses indicate how teachers of children with DS can determine the success of technology use in their schools. The assessments are based on the ability of the children to use the technology, the ease by which these technologies can be used, and the ability of the technology to meet the learning needs of DS children. Other teachers indicated that the level of technology use by children was 'good to moderate' while others said that the situation was 'not bad'. At the same time, another participant indicated that technology use was less than satisfactory. The different opinions given by the research participants arguably show the lack of precise information about use and success of technology adoption for children with disabilities, particularly DS in KSA as pointed out by Al rubiyea (2010).

4.3 What Skills Do DS Students Need to Use Technology?

Responses here show the areas in which emphasis needs to be laid when training DS children to use different technologies. Some of the teachers indicated that DS children need to have a reasonable level of intellectual ability and the ability to coordinate motor and visual skills. Others mentioned coordination skills in order for children with DS to use devices such as computer keyboards or mice effectively while others highlighted the need for flexibility when dealing with such children. This confirms that DS children need support from teachers and others even when they are using various technologies. For instance, it has been shown that children with DS can become competent mouse and keyboard users while their specific motor skills for handwriting are still being developed (Down Syndrome Victoria, 2009), but again, there is need for support to enhance the development of these motor skills.

4.4 What Are the Challenges of Using Technology for Children with DS in Saudi Arabia?

The major obstacles as identified by the respondents include lack of material capabilities, lack of willingness among teachers, the mental and physical problems that children with DS face, and lack of computer programs written in Arabic. These challenges can be grouped as those affecting the children themselves due to their physical and mental conditions, those associated with teachers, and those that exist as a result of lack of adequate resources or inadequacies in the technologies that are available. The challenges that affect children with DS were discussed in the literature review section, with citations from Klein et al. (2001), Al Shamsi et al. (2006) and Fegan (2011) among others. Challenges associated with teachers (e.g. negative attitudes towards the children) can be regarded as social barriers and were discussed in the literature review with supporting information from Al rubiyea (2010), where it was noted that such barriers hinder the education of children with special needs in KSA. For instance, even if a technology exists for children with DS but teachers do not offer the required support to such children, the technology will not be helpful at all. Other challenges are due to lack of resources such as computers and the limited nature of the technologies that are available. Such problems were clearly cited by one teacher who said that lack of adequate computers made it difficult for schools to adopt the use of technology to help DS children.

4.5 What Can be Done to Improve the Use of Technology for DS Students in Saudi Arabia?

i.   What are the most important methods and devices that you suggest to use among children with DS in Saudi Arabian schools?

Computers were identified as the most important devices for teaching children with DS followed by iPads. Generally, all kinds of computers such as desktops, laptops and tablets are preferred as technological devices because of their ability to be used with new hardware devices and software. For instance, some of these devices can also be used with projectors, which the research participants identified as the third most important device. Other devices include modelling methods, smart boards, data show projectors and other visual aids.

ii.   What advice would you give your school administrators to encourage the effective use of technology among children with DS?

Some of the ideas that were suggested by participants include implementing technology in schools to motivate teachers to use it for the benefit of DS children, provision of enough computers, offering high quality training courses and

creating enough material sources. Although these views are varied, there is a general indication that there are inadequate resources in schools to support learning technologies for DS children. These include shortages in actual equipment like computers and inadequate training for teachers. This point of view is supported in literature by Almalki, Finger and Zagami (2013), who note that the barriers that limit implementation of technology in learning institutions in KSA include classroom inaccessibility to ICT tools and Internet, inadequate time to develop courses, and unproductive training (p. 49). Lack of proper training could also be one of the reasons why some teachers called for 'open communication between the schools and members of staff'. The same could be attributed to the teachers who either objected to the use of technology or wanted the time spent on using technology to be reduced. The same point can also be said of the teacher who did not provide an answer to this question.

> iii.   *What are some of the key areas you would recommend to address in order to enhance the learning environment for children with DS?*

The teachers suggested the implementation of teaching for DS children in an entertaining way. This view is based on the point that making learning more entertaining can enhance motivation among DS children. It is supported by the research in which it was found out that most young people use computers for learning and entertainment (Feng et al. 2008, cited by Feng et al., 2010). Further, some of the respondents suggested that educational tools such as multimedia (e.g. voice and picture), visual aids, games and others should be used. More importantly, some teachers suggested that there is need for support through training courses for teachers and parents and general understanding of the needs of DS children. Arguably, if such issues are addressed, they will help tackle the social barriers to the education of DS children.

> iv.   *In addition to a deep IT knowledge, what do you think a teacher needs to be professional among children with DS?*

The teachers identified the need for self-development in using technology through attending training courses. They also highlighted the need to understand each child's mental capabilities first so as to develop a proper method to meet their needs. The implication of this is could be that many teachers in KSA are not adequately trained to meet the needs of DS children, whether using technology or other methods of teaching as noted by Almalki et al. (2013).

5. Conclusion

The research employed a survey questionnaire with questions about the type of technological tools available in schools for children with DS in KSA, perceptions of teachers toward the benefits of technology-assisted learning for DS students, the skills that children with DS need to use technology, the challenges of using technology for DS children, and what can be done to improve the use of technology for such children. The findings show that the sampled schools have different types of technologies but computers, iPads and projectors are the most commonly used devices. Other technologies are DVD players, mobile phones and loudspeakers among others. Many teachers understand the benefits of using technology to support DS children and their views are supported by studies conducted in the past on the same area as presented in extant literature. The key challenges to using technology as identified by the participants include lack of resources such as computers, lack of computer programs written in Arabic, and lack of proper training for teachers to enable them to handle children with DS in a better way. The teachers therefore recommended the use of technology in a more entertaining way to motivate DS children as well as incorporation of more educational tools such as multimedia to meet the target. More importantly, the teachers called for more training to enable them handle children better not only through the use of technology but also through inclusion, which is essential for a more effective use of technology. The main limitations of this study are that the two schools that were sampled for the research may not be adequately representative of the situation in the larger KSA. Since the research only targeted schools located in Riyadh, the results may not be representative of the larger KSA. Therefore, future research should focus on evidence from integrated schools and schools in the entire country.

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