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The way in which technologies support students with disability has been widely explored in recent times. Much of this research has focused on computer programs specifically designed to teach social and academic skills to students with disability. In the research reported in this paper we examined how students with disability could use technology designed for the general market. The impetus for the study was the principle of normalisation, which espouses that people with disability should have the opportunity to share in experiences of their same-aged peers. In previous research we demonstrated the benefits of using the commercially available hand-held games console Nintendo DS with Dr Kawashima's Brain Training program with students in mainstream classrooms. This finding led us to consider how this technology could be used to meet specific academic and social outcomes for students with disability in the same settings. We implemented a small-scale study in an Education Support Centre [1] as this setting provided us with the opportunity for a detailed examination of how students with disability might use this technology. We found that students with disability can benefit from using the Nintendo DS with Dr Kawashima's Brain Training program and have identified how they may use this type of technology in inclusive classrooms.

Introduction

Positive outcomes from a research project we conducted on the use of hand-held games consoles to enhance mental arithmetic learning for primary students in Western Australia, and an interest in engaging all students, led us to conduct the small-scale research project reported in this paper. In the previous research, the students' mental maths skills showed a statistically significant improvement (Main & O'Rourke, 2011; O'Rourke, Main & Ellis, 2013) which prompted us to wonder whether children with disability would benefit from using hand-held games consoles in the classroom. We decided to conduct a trial for students in a special education school, assuming that the teaching expertise, staffing levels, and the diversity of student ability would allow us to make detailed observations of how the students engaged with the hand-held games consoles, so we could identify what scaffolds were needed to support this engagement. Thus, the purpose of our research was to explore the ways and means for students with disability to benefit from using the same digital games as their peers.

We begin by discussing the literature on using digital games to meet learning objectives relevant to mathematics. The term 'digital game' refers to any game mediated by an electronic system including, but not limited to, personal computers, handheld gaming consoles and mobile phones. The concept of normalisation is included in this section because the opportunity for individuals with disability to have access to the same experiences as their peers without disability was a key driver behind the research. In the next section we describe the approach used to investigate the students' use of hand-held games consoles and report on the information collected from these observations. Our findings illustrate that students with disability can benefit from using the same digital games as their peers, albeit in different ways, with implications for mainstream teachers who have students with disability in their class.

Literature on the benefits of digital games-based learning

Digital game-based learning has been found to be popular with the current generation of students (Selwyn, Potter, & Cranmer, 2008), and has generally been well received as a learning tool by students in Australia (Beavis, Muspratt & Thompson, 2014). Oblinger (2006) asserted that digital games were engaging because they are immersive, involve social networks, require frequent decision-making, have clear goals, and change in response to the actions of individual players. Csikszentmihalyi (1991) found that the combination of anxiety, challenge, and reward in digital games could induce flow-type states that are associated with improved outcomes, through engagement and task commitment. In a European study involving 500 teachers, the researchers examined how these teachers used electronic games in the classroom and the outcomes for their students, identifying significant improvement in skills such as social, intellectual, spatio-temporal and concentration (Wastiau, Kearney & van den Berghe, 2009). In addition there was evidence from several of the case studies in their research that there were improvements in subject specific outcomes, such as story writing, maths automaticity and history.

Digital games-based learning for students with disability

Saridaki, Gouscos and Meimaris (2010) reported that digital games provided a less intimidating and more engaging learning medium for students with intellectual disabilities. They asserted that digital game-based learning met the needs of students in special education settings because it provided choice in experiential learning, and differentiation of the learning experience. Their study found that educators reported being impressed by the motivational aspect of digital games, with 70% of the almost 200 educators reporting that students exhibited an increased interest in learning, and 35% noting students' greater interest in the educational content (Saridaki et al., 2010, p. 345). Many of these educators also identified improved communication and cooperation as frequent outcomes of using digital games for learning.

The use of other forms of electronic games by students with disability has also led to positive outcomes. For example, Akhutnia et al. (2003) found that virtual environment based spatial training, in which students navigated mazes or manipulated objects, led to improvement in executive functions and verbal regulation of spatial functioning for students with complex motor disabilities. Tanaka et al. (2010) observed that a computerised program using interactive game modules improved the facial recognition skills of students with autism spectrum disorder. Games involving virtual reality have also been identified as effective in providing leisure opportunities for adolescents with physical and intellectual disabilities (Weiss, Bilalik & Kizony, 2003; Yalon-Chamovitz & Weiss, 2008).

Playing video games has also been linked to changes in systolic and diastolic blood pressure similar to changes emanating from normal physical activity (Rezaiyan, Mohammadi, & Fallah, 2007), which produced positive health benefits for individuals with limited movement. Rezaiyan et al. (2007) found that the attention skills of people with intellectual disability who played computer games were significantly greater than the matched control group. Furthermore, in a small-scale study involving adults with severe intellectual disabilities, Standen, Anderton, Karsandas, Battersby and Brown (2009) demonstrated that an adult's use of switch-controlled computer games that required a timed response resulted in a significant reduction in their choice reaction time (CRT) than the control group. In addition to improvements in developmental and social skills (Hansson & Wästerfors, 2015), computer and video based games have been found to be beneficial in preparing students with disability for the workforce (Shaffer, 2007; Stewart et al., 2013). Shaffer observed that computer and video based games, in which the individual enacted professional roles, provided career preparation experiences for young people with additional needs.

Many researchers have examined programs specifically designed for students with disability (Marco, Cerezo & Baldassarri, 2013; Saridaki et al., 2010), but it has been identified that few have explored how existing digital games can be used by students with diverse learning needs (Blum-Dimaya, Reeve & Reeve, 2010; Ke & Abras, 2013; Radovanovic, 2013). Therefore, despite the considerable interest in the use of digital games in education, there is room for further research on how game use may be implemented for students with special learning needs, including disability (Ke & Abras, 2013). Deater-Deckard, Chang and Evans (2013) asserted that there are differences in the level of individual engagement states, attention and memory for example, when using digital games and they identified this as an area for further research. For the research reported in this paper, we used hardware and software Nintendo DS and Dr Kawashima's Brain Training (DSs) designed for the mainstream market to explore how this type of technology could be used to support the learning of students with disability and how it influenced levels of engagement.

Mathematics anxiety and motivation

The DSs were used in this study because in previous research the DSs were found to make drill and practice type activities more appealing for primary students in Western Australian schools, resulting in significant improvement in the students' academic achievement and engagement in mental maths (Main & O'Rourke, 2011; O'Rourke et al., 2013). Mathematics was the focus of the previous research due to the researchers' interest in the impact of mathematics anxiety on students' performance and the assertion that this anxiety interferes with working memory and the initial learning of math skills (Cavanagh, 2007; Gargiulo & Metcalf, 2010). Whereas the previous research took place in a mainstream setting, it was reasonable to assume that students with disability could also experience maths anxiety. Because automaticity of basic maths skills has been found to support the completion of more complex mathematical computations (Ball et al., 2005; Woodward, 2006), anxiety that interferes with students' initial learning of maths skills is of significant concern. Traditional approaches to learning skills, such as times tables, involve routine overlearning (rote learning), which is supported by some (Whitehurst, 2003), criticised by others (Hiebert & Lefevre, 2009), and is not perceived as engaging enough by many classroom teachers (Clements & Sarama, 2009). Huang, Huang and Wu (2014) emphasised the importance of engaging learners in mathematics, suggesting that, "to help learners enjoy mathematics more, to avoid mathematics anxiety and to enhance their mathematics capabilities, it is necessary to studying (sic) it in a pleasant way." (p. 118). Deater-Deckard et al. (2013) asserted that, "children and adolescents are not optimally engaged during academic instruction in mathematics, [but] when playing well-designed educational games, most children become deeply involved and engaged" (p. 27). It is generally accepted that engagement is an important component of learning because learners who are engaged are more willing to attempt tasks that are in their zone of proximal development (Vygotsky, 1962), and are more likely to be optimistic about their ability to succeed and more willing to persist with difficult tasks (Rozendaal, Braat, & Wensveen, 2010).

Thus students' motivation is a component of engagement and needs to be aligned with a person's belief system, where there is an internal cause for actively participating in learning (Bandura, 2012; Ryan & Deci, 2000). Quite often students with disability are identified as having low motivation for learning, on the basis of the students' failure orientation and sense that academic outcomes are out of their control (Raymond, 2008). However, a scaffolded approach to learning and clear indicators of success allow students with additional needs to problem solve, focus on strategy, and ultimately self-manage their learning (Smith, Pollaway, Patton, & Dowdy, 2008) and these features can be found in digital games. In the spirit of normalisation and inclusive practice, we were interested in exploring whether and how using a digital game that has social currency might benefit students with disability.

Normalisation

The concept of normalisation, with its emphasis on social justice, is advocated as a guiding principle when structuring environments for people with disability (Culham & Nind, 2003). Normalisation is defined as the process whereby people with disability are provided with as near as possible the same opportunities and experiences as their peers without disability (Bank-Mikkelsen, 1969; Nirje, 1985; Wolfensberger, 2011). For students with disability this would include having the right, and being encouraged, to engage with the same games and technology as other students their age. Westling, Fox, and Carter (2015) argued the importance of teaching students with disability recreation skills that increase their likelihood of positive social interactions with their peers as being critical to a well-rounded curriculum.

In our previous research, we observed that students using DSs were more likely to ask their peers for help and to develop their own strategies, than students being taught by their classroom teacher (O'Rourke et al., 2013). The increased peer interaction and problem solving observed when students were using the DSs has obvious implications for social engagement. In addition to the social benefits of engaging with popular technology, the ability to differentiate the learning with digital games has also been identified (Wastiau et al., 2009).

Researchers have found that 'off the shelf' digital games can be used by students with disability (Blum-Dimaya et al., 2010; Weiss et al., 2003; Yalon-Chamovitz & Weiss, 2008) and we noted that the DS met a number of the criteria that Boone and Higgins (2007) developed regarding the use of educational software by students with disability. These criteria included; Repetition as an instructional strategy; software that adapts to student input and branches to appropriate instructional level with a variety of difficulty levels are available; directions provided on screen and instructions repeatable for students; feedback is positive, immediate, obvious, consistent, and relevant to action taken by students; software records student responses automatically; student progress records can be viewed; screen is uncluttered and design features are consistent and clear; and, minimal keyboarding skills are required.

It was also evident that the DSs allowed students to make choices and, therefore, individualise the experience to their own needs and interests (O'Rourke et al., 2013). The opportunity to make choices and have a sense of control over one's own environments is referred to as self-determination (Woolfolk, 2011), and this been associated with positive academic, social and quality of life outcomes (Wehmeyer et al., 2012). Ryan and Deci (2004) found that an individual's desire for autonomy was significant because it determined their behaviour more than extrinsic motivators. However, contrary to the principles of normalisation, individuals with disability are often not given the same opportunity as their peers when it comes to making choices in their lives (Antaki, Finlay, Walton, & Pate, 2008; Edwards, 2013; Wang & Dovidio, 2011).

Methodology

In setting out to explore the use of DSs for student with disability, we anticipated that there might be unexpected outcomes, that is, outcomes not directly related to the objectives of the games. Therefore, it was important to use a research methodology that was somewhat open-ended, allowing us to identify any improvements in other domains such as social skills, independence, decision-making, and problem solving. It was also important for us to consider any progress that students made during their learning with the DSs, not just the final results.

We elected to use a case study methodology, which focused on both the process and the product of this inquiry (Stake, 2005). Because the interactions within educational settings are complex and influenced by many factors, case studies have the potential for researcher to construct richness of detail and gain a depth of understanding (Merriam, 2002) that pure quantitative studies of teaching and learning environments often lack. The approach we used in this case study was to gather rich descriptive data that would enable the reader to 'see' what occurred when students used the DSs; in order for readers to 'learn' from the experience and apply this learning to their own context (Lincoln & Guba, 2002, p. 212).

Method

Our methodology was also necessarily participatory. For example, we held discussions with the participating teachers prior to starting the research to explain the purpose of the research; in particular, we wanted to convey that this was essentially an exploratory study to find out whether this form of digital games technology was conducive to support positive outcomes for students with disability. We also discussed with the teachers how the DSs game might be used with their students. The Nintendo DS console has dual screens and the player interacts with the software via microphone and a touch screen (Figure 1). The Dr Kawashima's Brain Training game involves several maths related computation games; focussed on speed and accuracy that students respond to by writing on the DS screen with a stylus. Teachers were given a Nintendo DS console with the Dr Kawashima's Brain Training game prior to commencement of the term so that they could familiarise themselves with the console and the game. Then a visit was made to each of the three classes using the hand-held games consoles prior to the intervention to explain the study to the students.

Figure 1: Hand-held games console Nintendo DS with Dr Kawashima's Brain Training

Procedure

The intervention took place over a 10-week period between August and November in 2012, as this is the standard length of a term in Western Australia. Students used the DS for approximately 20 minutes each day, depending on the student's engagement with the DS. The procedure for using the DSs varied depending on the objectives for each student, but all students followed the same initial steps of retrieving their allocated DS from where it was stored, turning it on, locating the stylus and proceeding to the x20 game, in which random single digit addition, subtraction and multiplication sums appeared on the screen.

Within the brain training software, students were given a time and game speed (for example, 'walking speed' or 'rocket speed' for completing the sequence in less than 10 seconds) on completion of a set. The teacher determined the level of prompting and scaffolding required for each student to complete this activity. After the students had completed the x20 session, they were free to choose from other Brain Training games on the DS.

Participants and measures

The participants in this study were 10 students, aged 6 to 10, in three classes at an Education Support Centre. This setting was selected for the study because the ratio of students to teacher was low, approximately 10 students to one teacher and four education assistants (EAs), enabling close observation of the students when they were using the DSs. A student's enrolment in an Education Support Centre at the time of the research was predicated on them having an IQ score of less than 70, significant impairments of conceptual, social or practical skills adaptive skills, and evidence of limited academic achievement in comparison to age expectations. Information about the specific disability criteria of each student was not requested for ethical reasons associated with principles of inclusive practice; however, students with severe motor functioning impairment were not included in the study because the technical expertise to support their interaction with the DS console was not available. Class One participants comprised of two Year 2 students and two Year 3 students. Class Two participants were one Year 4 and one Year 5 student. Class Three included one Year 4 and three Year 6 students.

The main methods of data collection for this research included interviews and a standardised assessment, which enabled us to replicate aspects of our previous study and make comparisons where appropriate. The Westwood One Minute Test of Basic Number Facts was used to measure numeracy skills before and after the students used the DSs. Westwood's One Minute Test of Basic Number Facts, developed in 1987, is a norm-referenced assessment consisting of four 33-item tests, one for each of the basic maths functions (+, - , x, and ÷). It has a test-retest reliability of .88 to .92 according to sub-test (Westwood, 2003). As the name suggests, students have one minute to complete the 33 questions for each function. Additional data were collected in the form of classroom observations, and checklists. These additional forms of data collection were vital in this study because they provided the opportunity to examine students' engagement with the DSs.

Pre-testing included reviewing the students' Individual Education Plans (IEPs) and incorporating relevant objectives into a checklist that could be monitored during the intervention period. A research assistant undertook observations of the students during weekly visits to the school, which included monitoring of the teachers' practices with the DSs. Teachers and education assistants (EAs) also made written observations of the students using the DSs and completed the checklists created from the IEPs. Because of the variability of the students' cognitive and communication skills, we did not include students' self-reports measures in the data collection process.

Data and discussion

Description of how each class used DSs

The students' complex needs influenced the way they could engage with the DSs; and their teachers used a variety of strategies and differentiated objectives for each student to meet his/her needs. All checklists included at least one objective related to mathematics, such as: recognising numbers, recognising maths symbols, matching maths symbols, verbalising correct answers, writing single and double digit numbers, using tools (calculator, manipulative, etc.) to solve maths problems, and solving single digit addition, subtraction and multiplication problems. Other objectives related to fine motor control, handwriting speed, self-regulation, organisation, independence, persistence, resilience, confidence, and 'getting along', depending on the needs of the child. Similarly, there were different levels of prompting required for students to use the DSs. These prompts included physical, verbal, visual and modelling. The staff in classes 1 and 3 also used concrete aids to support students' work on the DS, which included counters, rulers, number lines, and finger counting. The students in Class Two used calculators alongside the DS; they would read the problem on the DS, enter it into the calculator and then transpose the answer into the DS.

Findings from the data

We compared the pre-test and post-test results of the Westwood's One Minute Test of Basic Number Facts for students across the whole sample using a Wilcoxon Signed Ranks Test. There were overall improvements in student results, but subtraction was the only test to show statistically significant improvement, with a p value <.05 (see Table 1). The addition test results showed good improvement from the pre-test to post-test; however, there was no statistical significance.

Table 1: Summary of Wilcoxon Signed Ranks Test output

Westwood test	Mean		Median		Z score	P value
	Pre	Post	Pre	Post		
Addition	4.30	5.50	3.50	3.50	-1.132b	.258
Subtraction	2.10	5.40	2.00	5.50	-2.111b	.035
Multiplication	0.90	1.30	0.50	0.50	-.604b	.546
Division	0.70	1.00	0.00	0.00	-.431c	.666

b. Based on negative ranks
c. Based on positive ranks

We do not know why subtraction was the only math function to achieve statistical significance, but it is possible that addition and subtraction both improved more than the other math functions because they are easier functions to perform. However, the recorded classroom observations showed that students were very anxious when doing the standardised test and this is likely to have affected the quantitative results. The students were also anxious and distracted by the timer, and some students played with the timer or watched it during the test. These observations demonstrate the exigencies of recording accurate data on maths skills from a small sample of students with diverse and complex needs. Replicating the study on a larger sample, and over a longer period of time (so students could become more familiar with the test procedure) could shed light on patterns of difficulty experienced by the learners and may assist in determining the cause/s for the levels of improvement across the math functions.

The interview and observation data collected by the research assistant, teachers and EAs helped to depict the benefits of using the DSs in the special education context. The observations of four case study students are now presented to illustrate the change in these students' engagement with mathematics learning over the course of the intervention. Case study students A and B demonstrated progress in interaction and engagement as well as some progress in maths scores. Case study student C and D illustrated that, even with little or no improvement in math scores, they made gains in interaction and engagement.

Student A

Student A, diagnosed with learning difficulties and attention issues, was in Year 4 at the time of the research. He generally showed positive engagement with the DS and this increased over time as his persistence with challenging tasks improved. The Westwood test results for student A demonstrated a large improvement in his subtraction skills, but little or no improvements in other areas (Table 2). At the beginning of the intervention, student A was unable to do any mental math calculations correctly and appeared bored, but eventually he played the x20 game with some success. Student A was able to read the sums on the game quite easily, and when he understood the problem and entered the correct answer his motivation increased. However, student A had not yet learned to work independently. He needed to be consistently prompted by the EA to complete the sums in order to remain motivated. It also seemed that student A was motivated by getting the highest score possible in the game, which resulted in restarting the game if he felt he was not going to do well, rather than persisting and working out the correct answer to each sum.

A month after working on the DS, student A showed less interest in working independently on the x20 game. He was easily distracted, but still worked well when externally motivated to do so. Student A also showed reluctance to persist when the sums became challenging, instead he chose to reset the DS if the task became too hard to complete.

By the end of the intervention, student A showed signs of working independently and had increased his intrinsic motivation to complete tasks on the DS. Observations indicated that he was using a variety of strategies and tools to help him with his work on the DS, including rulers, number lines, and finger counting. He was more focussed on the sums and had taught himself to move onto the next question if he was unable to correctly answer a sum, as opposed to resetting the DS.

Table 2: Westwood scores for Student A

Westwood test	Pre-test	Post-test
Addition	16	18
Subtraction	0	9
Multiplication	0	0
Division	1	0

Student B

Student B, a Year 5 diagnosed with autism spectrum disorder and learning difficulties, willingly engaged with the DS from the outset. She appeared to make good progress in all of the maths skills in the Westwood test (Table 3). When the intervention commenced, verbal prompting was required to initiate her use of the DSs and to help her understand the tasks in the x20 game. The student was very preoccupied with writing neatly and correctly and this slowed her response rate.

By the mid-point of the intervention, student B was able to match, recognise and understand all maths symbols and recognise numbers. Her handwriting speed, another IEP objective, had increased when answering the maths sums using a stylus on the DS. However, she was reported to be easily distracted and would tend to restart the x20 if she answered an item incorrectly.

In weeks nine and ten, the final two weeks of the intervention, student B started the DS activities independently and used a calculator to confirm answers if she was unsure that she was answering correctly. The research assistant described her as being ‘focused and vigilant.’

Table 3: Westwood scores for Student B

Westwood test	Pre-test	Post-test
Addition	4	8
Subtraction	2	8
Multiplication	2	6
Division	0	8

Student C

The Westwood test results for student C, a Year 6 with learning difficulties and attention issues, indicated little or no improvements in maths skills (Table 4), but there was some indications that independence and use of support materials had improved. Initially, the EA reported that student C appeared to be slightly more capable than his peers when using the DS, but he still needed help.

By the middle of the intervention period, student C continued to struggle with addition, subtraction, multiplication and large numbers. People and objects around him occasionally distracted him, but he returned to work and persisted with the tasks even when he found them difficult.

In the final stages of the intervention, student C used a variety of tools effectively, including counters, number lines, and his fingers. He was still distracted occasionally and required verbal prompting or redirecting. He sought approval and would make eye contact with his teacher, which was one of his IEP objectives. He continued to struggle with multiplication and division, as was evidenced in his scores on the Westwood test.

Table 4: Westwood scores for Student C

Westwood Test	Pre-test	Post-test
Addition	5	1
Subtraction	2	5
Multiplication	0	2
Division	0	0

Student D

As with student C, student D's Westwood test results indicated that she made little or no improvements in maths skills (Table 5), but there were observed indicators that she became more independent and more effective in her use of support materials.

Initially student D, who had been diagnosed with learning difficulties, was able to name the mathematical symbols for addition, subtraction, multiplication and division, but sometimes confused the processes of addition and multiplication. She preferred the support of her peers, rather than that of the teachers, and was not able to work independently. She tended to guess the answers and required constant help and prompting to work out the correct answers. However, she would not ask for this help, and would give up when she found the task difficult.

As the intervention progressed, student D was able to use the DS independently but still had difficulty knowing the function required of all the mathematical symbols. She continued to require visual and physical prompts, but was more likely to ask for assistance from the teacher or EA before prompting was required.

At the end of the intervention, student D was able to use tools, such as counters, effectively and efficiently. She was also able to work independently, but occasionally used glancing eye contact to confirm that she was using the counters correctly. She followed her visual schedule and was enthusiastic when using the DS. She did, however, continue to confuse multiplication and division.

Table 5: Westwood scores for Student D

Westwood Test	Pre-test	Post-test
Addition	1	3
Subtraction	2	5
Multiplication	2	0
Division	1	0

Teachers' perception of the intervention

All the teachers reported that the use of the DS had been beneficial for their students, but expressed concerns about whether they were using the DSs correctly for the purposes of the research. One teacher reported to the researchers that; "I am fine with the objectives I have set for my students but am not sure I am doing it right for you."

The teacher in Class One noted that the students were able to use scaffolds more effectively to engage with and attempt the maths tasks as a result of the intervention. In Class Two the teacher asserted that students became more proficient in using the calculator, with higher accuracy and speed, as a result of using these in conjunction with the DSs. The teacher in Class Three reported that the students became more independent when using the DSs and, once they had finished playing the x20 games, would select other games based on their skills and interests; the students loved using the DSs and towards the end they didn't even need the EA's help - when they finished [the x20 game] they chose other games they liked.

Conclusion

This research was a sequel to a study we had conducted on the use of DSs in mainstream classrooms to improve the mental maths skills of the students. Because the original study had very positive outcomes for students (Main & O'Rourke, 2011; O'Rourke et al., 2013), we were optimistic that students with disability might also find success in using the DSs. Our follow-up research found that the students' were positively engaged with the technology, and that the teachers were able to use various strategies within their repertoire to support this engagement and facilitate the achievement of the students' learning objectives. Not all of the student's objectives were attained but fine-grained checklists, developed from the student's IEP, and observations enabled everyone to notice the incremental changes in the performance of these students with disability. The use of standardised tests provided some information about performance before and after the intervention; however, the use of observations and checklists enabled the researchers to track the changes and the context in which they took place. The observational focus on a broad range of skills, for example social, independence, and handwriting skills, provided rich data about whether there were benefits for the students in using the DSs.

There are obvious limitations in this study from an objectivist point of view, including the lack of generalisability due to the small sample size, the diversity of the participants, and the specialised educational setting. The teachers also reported that they would have liked more guidance about how to use the DSs with the specific students in their class; however, as a pilot study into the use of this technology for children with disability, there were palpable gains made for all parties. This study has yielded encouraging evidence that digital technology, even when not specifically designed for students with disability, can be used to achieve worthwhile outcomes. It also identified some of the ways in which teachers in mainstream classrooms might differentiate the use of technology for the students with disability in their class.

Our research leads us to make the following recommendations for using the DSs, in both special and inclusive mainstream classrooms. First, we advocate establishing a collaborative environment in which time is set-aside for teachers and teaching support staff who are using this technology to meet, share their approaches, and reflect on achievements and challenges. Second, when classroom teachers have limited experience in differentiating the curriculum they may require assistance to identify appropriate learning objectives for students with disability when using this technology. Third, students with disability may need more time to develop the skills necessary to engage with digital technology at a level that facilitates engagement with their peers. They may require more lead up time to develop the idea of game playing and also the fine motor/enhanced response time that are a feature of most games. Finally, the Westwood One Minute Test of Basic Number Facts was used in this research because it had been used in the previous studies, but curriculum–based assessment would be more appropriate in future studies to measure changes in students' performance. Curriculum-based assessments are developed to measure specific objectives set by the teacher, as part of the student's individual education program; for example, this type of assessment would be more likely to elicit information about the unique effects of the intervention on the students' skills than standardised assessments.

For the future, the following may prove fruitful: A larger group of participants, exploration of how to use the technology for students with severe physical disabilities, and more time to use the DSs and monitor the impact. Despite these limitations, the researchers feel that their impulse to fully support the principles of normalisation was rewarded. Students with disability should have the same opportunities to engage with digital technology as their peers without disability access. This study suggests that teachers can gain much from viewing learning as a process (journey), rather than a product (destination).

Endnote

[1] In Western Australian there are several placement options for parents of students with disability. Education Support Centres are on the grounds of a regular school but have their own principal. The criterion for enrolment generally includes evidence of a disability diagnosis and a mild to moderate level of intellectual disability.

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