An Investigation into the Effects of iPad/Tablet Device Use in Special Needs Education and in Particular in the Case of a Student with Williams Syndrome

A Case Study Approach

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Submitted to the University of Limerick, October 2013
Declaration

I hereby declare that this is entirely my own work and that it has not been submitted for the award of any degree at any university.

Signature: _________________

Date: _________________
Abstract

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Williams Syndrome is a rare neurodevelopmental genetic disorder that is associated with a particular uneven cognitive profile. The student with Williams Syndrome at the centre of this investigation is six years old and attends senior infants in a primary mainstream school setting in the west of Ireland. In common with other children with Williams Syndrome, the student experiences difficulty with number concepts and gross and fine motor skills, including handwriting. Difficulties in concentration and distractibility posed a major barrier to learning for the student.

In 2010, the first commercially successful tablet product known as the Apple iPad was released. It was reported at the time that there was a rapid uptake of the iPad in the area of education. The iPad has been identified as defining a new genre of mobile technological device. Other brands of tablet computers soon followed the release of the iPad. However, the iPad has remained the tablet of choice in many schools. The main aim of this study was to investigate the effects of iPad use on students with special needs and in particular in the case of a student with Williams Syndrome.

Initially, a profile of the participants in the study was established to assist in the identification and selection of appropriate iPad applications for the period of study. Over a period of nine weeks, the student was observed using an Apple iPad device on a daily basis. In addition, an online questionnaire was distributed to teachers of students with Special Educational Needs (SEN) using iPads or other tablet computers. A combination of qualitative and quantitative methods such as observations, interviews, and both formal and informal tests were used to collect findings from the case study research.

The study investigated the effects of iPad use on the special needs student in the areas of academic achievement, behaviour, concentration, motivation and communication. Results reveal an increase in achievement levels in the areas of reading and handwriting as a result of iPad use. The iPad use had little or no effect on the case study student’s numeracy skills, though other SEN teachers surveyed thought that iPad use had an effect on improving numeracy skills. Following use of the Guided Access features of the iPad, the student’s concentration levels increased considerably. Findings also suggest that iPad use leads to increased levels of motivation. However, the impact of iPad use on communication skills is more ambiguous.

This study confirms that the iPad is a valuable educational tool to be considered in personalising learning situations, particularly such as those found in special needs education.
Acknowledgements

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## List of Abbreviations

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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>1:1</td>
<td>One student to one iPad/tablet device</td>
</tr>
<tr>
<td>ABA</td>
<td>Applied Behavioural Analysis</td>
</tr>
<tr>
<td>ABLLS-R</td>
<td>Assessment of Basic Language and Learning Skills –Revised</td>
</tr>
<tr>
<td>ADHD</td>
<td>Attention Deficit Hyperactivity Disorder</td>
</tr>
<tr>
<td>ADD</td>
<td>Attention Deficit Disorder</td>
</tr>
<tr>
<td>App</td>
<td>iTunes Software or Application</td>
</tr>
<tr>
<td>ASD</td>
<td>Autistic Spectrum Disorder</td>
</tr>
<tr>
<td>DES</td>
<td>Department of Education and Skills</td>
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<tr>
<td>DS</td>
<td>Down Syndrome</td>
</tr>
<tr>
<td>EPSEN</td>
<td>Education for Persons with Special Educational Needs</td>
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<tr>
<td>HCI</td>
<td>Human Computer Interaction</td>
</tr>
<tr>
<td>HSE</td>
<td>Health Service Executive</td>
</tr>
<tr>
<td>IEP</td>
<td>Individual Education Plan</td>
</tr>
<tr>
<td>NCCA</td>
<td>National Council for Curriculum and Assessment</td>
</tr>
<tr>
<td>NCSE</td>
<td>National Council for Special Education</td>
</tr>
<tr>
<td>NEPS</td>
<td>National Educational Psychological Service</td>
</tr>
<tr>
<td>NSW</td>
<td>New South Wales</td>
</tr>
<tr>
<td>OS</td>
<td>Operating System</td>
</tr>
<tr>
<td>PECS</td>
<td>Picture Exchange Communication System</td>
</tr>
<tr>
<td>SEN</td>
<td>Special Educational Needs</td>
</tr>
<tr>
<td>SENO</td>
<td>Special Educational Needs Organiser</td>
</tr>
<tr>
<td>SERC</td>
<td>Special Education Review Committee</td>
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<tr>
<td>SESS</td>
<td>Special Education Support Service</td>
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<tr>
<td>SNA</td>
<td>Special Needs Assistant</td>
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<tr>
<td>TEACCH</td>
<td>Treatment and Education of Autistic and Communication related handicapped Children</td>
</tr>
<tr>
<td>WPPSI-III</td>
<td>Wechsler Preschool and Primary Scale of Intelligence</td>
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Chapter One  Introduction

1.1 Introduction

Teachers strive to create positive learning environments for their students, and are continuously seeking techniques and methods to motivate students to learn (Carlson and White 1998). Modern day mobile technologies such as iPad/tablet devices and smartphones enable increased variety of learning opportunities for children.

An appropriate digital environment provides a vehicle that can take a child further than he or she might travel unassisted. Responsible and well-considered design and content choices in keeping with a child’s developmental needs provide the basis of positive digital environments for children.

(Cooper 2005, p.299)

Special Needs Education provides for a diverse range of needs. Modern day technologies offer potential for personalisation of educational experiences to cater for the range of strengths and weaknesses present in the case of Special Needs Education.

1.2 Statement of Topic

Rapid uptake of iPads in schools in both Ireland and globally has been observed in the three years since the iPad was first released. This study attempts to investigate the effects of iPad/tablet use in the case of Special Needs Education and in particular in the case of a student with Williams Syndrome. Williams Syndrome is a rare neurodevelopmental genetic disorder that affects the student cognitively, socially and behaviourally. The high visual tactile nature of the iPad/tablet device was identified as an appropriate means to engage and support a student with Williams Syndrome in meaningful learning opportunities.

It is important to note that this study has an emphasis on the use of iPad devices in schools. Whilst the author of the report initially intended to evaluate the effects of a variety of tablet devices available on the market, it quickly became apparent that the
Apple iPad was the main tablet device used in educational settings. In addition, all recent research and international studies address the Apple iPad device.

1.3 Research Questions

The main aim of this study is to investigate the effects of iPad/tablet device use by students with special educational needs, and in particular in the case of a student with Williams Syndrome. The study will address the following research questions;

1. What evidence is there of improvement in student academic achievement that can be attributed to the use of iPads/tablets?
2. What effect does iPad/tablet use have on a student’s behaviour?
3. What capacity does the iPad/tablet have to enhance the concentration levels of special needs students?
4. To what extent does iPad/tablet use affect motivation levels in a student with special educational needs?
5. Do students with special needs have better communication skills as a result of iPad use?

1.4 Relevance

Following release of the iPad in 2010, three million devices were sold in the first eighty days. It was reported at the time that there was an “unanticipated” response from the autistic community (Herbert 2010). An internationally recognised Horizon report (2012) highlighted tablet computers such as the iPad as one of the top trends for technology adoption for schools in 2013.

1.5 Significance

This research is important because of the great investment being made in the adoption of iPad/tablet devices without the support of solid evidence that would prove or
otherwise the benefits of tablet technology. Educators are keen to learn if and how iPad/tablet technology can assist as a learning tool to enhance teaching methodologies and thus maximise learning opportunities. Whilst a few international reports and studies exist in relation to the impact of iPad/tablets in schools, there is even less evidence available regarding the effect of iPad/tablet use in Special Needs Education. This study attempts to address this deficit.

1.6 Research Background

The author of this study is a senior infant primary mainstream class teacher. It became apparent that a six year old student with Williams Syndrome needed help in accessing the curriculum in an alternative way to other students in the class. The student has been assessed as having a mild general learning disability, difficulties in attention span, poor co-ordination and delayed communication skills. In common with other children with Williams Syndrome, the student experiences difficulty with number concepts and gross and fine motor skills, including handwriting. Difficulties in concentration and distractibility posed a major barrier to learning for the student. Typical of children with Williams Syndrome the student in the study displayed strengths in musical ability and rote learning and responded best to visual stimuli in the classroom. Williams Syndrome children respond best when verbal information and visual information are presented simultaneously (Rossi et al. 2012). The aim of the study is to investigate the suitability of the iPad as a learning tool in the case of students with Special Educational Needs (SEN) and in particular in a student with Williams Syndrome.

1.7 Research Methodology

The aim of this study was to study an individual in a real-life context in a particular point in time. The case study approach was employed in this study because it best suited the in-depth investigation required. A mixed-methods research design was utilised to collect both qualitative and quantitative data. Qualitative research tools included interviews with resource teachers and unstructured observations by participant observers. Quantitative research tools included a questionnaire designed for teachers
using iPad/tablets with students with SEN, a formal assessment tool known as Assessment of Basic Language and Learning Skills - Revised (ABLLS-R), and structured observations using observation schedules.

1.8 Research Limitations

It should be noted that the author is the class teacher in this study. While the author strove to be objective throughout the study, this factor must be considered as a limitation of the study.

The study was carried out over a period of nine weeks. Extending the duration of the study period would give a more accurate insight into the long term effects of iPad use on student achievement, behaviour, concentration, motivation and communication. A longer study period would also assist in negating any novelty effects in using the iPad for the first time.

1.9 Research Outline

Pre Implementation Period

- Two months before the study period, the student was assessed using the ABLLS-R tool to assist in the identification of the student’s current skills acquisition and to guide identification of skill areas for further development. These skills were included as objectives in the student’s Individual Education Plan (IEP) (Appendix C).
- Guided by objectives identified in the student’s IEP, appropriate iPad software applications were selected for the period of study.
- The student was observed using the laptop.
- A sample of the student’s handwriting was acquired and the level of handwriting skill was assessed.
Implementation Period

- An iPad device was introduced to the student in April 2013. Over a period of nine weeks the student was observed using a variety of software applications on a daily basis.
- An online questionnaire was distributed to teachers of students with SEN using iPads or other tablet devices.
- Interviews were conducted with two Resource teachers.

Post Implementation Period

- The student’s skills level in handwriting, fine motor, literacy and numeracy was assessed using the ABLLS-R tool following the period of the study.
- The handwriting test administered in the pre iPad period was repeated.

1.10 Structure

This study contains six chapters.

Chapter One - Introduction, outlines the research background, questions, and relevance. It provides an outline of the research study and the methodologies adopted.

Chapter Two – Literature Review, examines the rare genetic condition known as Williams Syndrome, with particular emphasis on cognition and behaviour. The value of the iPad as an educational tool is explored. The importance of incorporating principles of child development and pedagogy in software design and development is discussed. The Apple iPad will be analysed and reviewed in terms of its operating system, software and user interface. The chapter concludes with an overview of the trials and studies that have explored the influence of iPad use in educational settings.

Chapter Three – Methodology, describes the research question to be investigated, and details the research subjects and setting. The reliability and validity of the chosen research instruments are explained. Finally, ethical considerations are outlined.
Chapter Four – Findings, firstly presents the profiles of the students and teachers that participated in this study. Then the findings are presented and aligned with the research questions.

Chapter Five – Discussion, examines the findings of this study and compares or contrasts them with the literature reviewed in Chapter Two.

Chapter Six – Conclusion, summarises the research outcomes, makes some recommendations and presents suggestions for future research.
Chapter Two  Literature Review

2.1 Introduction

This literature review examines the rare genetic condition known as Williams Syndrome. The associated strengths and difficulties associated with Williams Syndrome will be examined, with special regard to how they contribute to the development of appropriate educational intervention strategies.

The iPad or tablet device is the most recent form of assistive technology to be introduced in the area of special needs education. Although many companies have produced high quality tablets and smartphones, the Apple iPad has been to the forefront of affordable touchscreen mobile technology. For the purpose of this study the Apple iPad will be analysed and reviewed in terms of its operating system, software and user interface.

The chapter will conclude with an overview of the trials and studies that have explored the influence of iPad use in educational settings.

2.2 Definition of Special Educational Needs

The Education for Persons with Special Educational Needs (EPSEN) Act 2004 defines the term ‘special educational needs’ as

a restriction in the capacity of the person to participate in and benefit from education on account of an enduring physical, sensory, mental health or learning disability or any other condition which results in a person learning differently from a person without that condition…

(EPSEN 2004b, section 1)

2.3 Education Provision for Special Needs Students

Until the 1990’s, special needs education in Ireland was disconnected from mainstream education, and mainly provided for in special schools. Such schools were seen to be
providing the most appropriate placement of students with special educational needs. The Special Education Review Committee (SERC) presented a report in 1993, where it described special education as:

any educational provision which is designed to cater for students with special educational needs, and is additional to or different from the provision which is generally made in ordinary classes for pupils of the same age.

(SERC 1993a, p.18)

The Committee reported that it favoured ‘as much integration as is appropriate and feasible with as little segregation as is necessary’ (SERC, 1993a, p.22). The SERC report supported the provision of a range of options for education of students with special educational needs, and advocated integration of students, where practical, in mainstream schools. Subsequently, successive Governments supported the principles proposed in the SERC report. In addition, the EPSEN Act (2004) refers to inclusion rather than integration, and provides for the provision of a range of services including an IEP or individualised programme of education for every student with special educational needs. The services must be provided in consultation with the parents/guardians of the student.

2.4 Williams Syndrome (WS)

According to the Williams Syndrome Association, Williams Syndrome is a rare neurodevelopmental disorder that is present from birth and affects about 1 in 10,000 people worldwide.

2.4.1 Cognitive Profile

Williams Syndrome is a genetic condition that exhibits strengths and frailties in terms of cognitive abilities (Rossi et al 2012). According to the Williams Syndrome Association, learning difficulties and development delays are characteristics of Williams Syndrome. Williams Syndrome is associated with a particular uneven cognitive profile. Strengths are found in such areas as language abilities, object and face recognition, whilst characteristic weaknesses are in the area of spatial cognition (Landau and Hoffman
2005). Even within a domain of cognition, a person with Williams Syndrome may demonstrate typical ability in one area and have severe impairments in another. Thus, Williams Syndrome is known for its “selectivity in cognitive impairments” (Nakamura et al. 2001).

2.4.2 Spatial Cognition

Many studies in Williams Syndrome report severe impairments of spatial cognition (Nakamura et al. 2001, Hoffman et al. 2003, Landau et al. 2006, Rossi et al. 2012, Farran and Jarrold 2003, Mervis and John 2008, Landau and Hoffman 2005). The nature of spatial impairment is complex (Landau and Hoffman 2005). Within the domain of spatial cognition, there is inconsistency, with some preserved abilities such as object recognition and some aspects of spatial language. However, Landau and Hoffman (2005) suggest that there is severely impaired ability in “visuospatial-constructive tasks”. Such tasks include the copying of a design, or drawing, or by assembling blocks in a pattern.

2.4.2.1. Visuospatial Cognition

Farran and Jarrold (2003), researchers from the Department of Experimental Psychology University of Bristol United Kingdom, have critically reviewed research carried out in the field of visuospatial cognition in Williams Syndrome. The research considered results of the following nonverbal tasks;

- **Picture Completion** - involves indicating what is missing from a picture
- **Picture Arrangement** - placing a series of pictures into the correct order
- **Block Design** - constructing a pattern to copy an example pattern
- **Object Assembly** - jigsaw task
- **Coding** - a timed task involving use of a key/code to draw symbols under a set of numbers

The researchers concluded from the studies that tasks on Block Design and Coding resulted in the lowest performance scores whereas Picture Completion and Object
Assembly tasks resulted in consistently higher scores. The results of this study indicate strengths in tasks such as jigsaw puzzles and identifying omission from a picture.

### 2.4.2.2 Drawing and Tracing

It is recognised that visual spatial construction tasks such as writing and drawing pose great difficulty for individuals with Williams Syndrome. Researchers at the Laboratory for Cognitive Neuroscience in The Salk Institute for Biological Studies California, found that children with Williams Syndrome were capable of verbalising the features of an object e.g. bicycle or a house, but unable to draw a picture of the object (Bellugi et al. 1997).

The severe impairments in drawing and copying are notable because success in these tasks would seem to rest on the capacity to locate multiple objects within a common frame of reference, and to use a parallel frame of reference to assemble the parts in the copying space.

(Landau and Hoffman 2005, p.165)

Whilst it has been suggested that deficits in visual spatial construction tasks is a result of a developmental delay, Japanese researchers (Nagai et al. 2011) question this suggestion and maintain that the deficits are as a result of an atypical visual processing ability.

In Japan, Nagai et al (2011) studied the performance of Williams Syndrome individuals in a fading-figure tracing task, requiring subjects to trace a target figure that is gradually disappearing from a computer screen. This differed from previous drawing studies that relied on the participants simply copying or drawing from memory.

Nagai et al 2011 suggest that the fading-figure tracing task is similar to the Block Design test employed by earlier researchers (as reviewed by Farran and Jarrold (2003). The Block Design test involved constructing a pattern by copying an example pattern.

The fading-figure tracing task employed by Nagai et al (2011) did not require judgements regarding workspace nor transfer of target figure since the tracing was carried out in the same space. This allowed the researchers to closely examine visual
spatial working memory - remembering ‘location’, and ability to recognise features of the target figure. They found that longer fading time did not result in improved performance in the case of the Williams Syndrome participants. In particular, an amalgamation of deficits in visual spatial working memory, and deficits in visual scanning ability were identified as the cause of drawing disabilities in Williams Syndrome.

In studying Williams Syndrome and associated difficulties in the writing of Japanese characters, Nakamura et al (2007) found deficiencies in visual spatial abilities of participants with Williams Syndrome. However, they concluded that the participants’ ability to distinguish colours was not affected by Williams Syndrome. They suggested that this ability may help compensate for their visual spatial difficulties. In the case of visual cognition, they refer to the existence of two general information processing ‘streams’: a dorsal stream for visual motion and spatial organisation, and a ventral stream concerned with colour and form recognition. They recognise that people with Williams Syndrome have more difficulty in the dorsal processing stream than the ventral stream. The impairment of the dorsal stream and its associated impairment of visual spatial processes, explain the difficulties found in people with Williams Syndrome in the area of writing. However, they also found that the preserved abilities to distinguish colour found in the ventral processing stream, “may help compensate to some extent for the deficits in other processing streams”.

2.4.2.3 Object and Face Recognition

Within the area of spatial cognition, individuals with Williams Syndrome have been shown to have strong performance in object recognition tasks, even when severe impairments in other aspects of spatial representation prevail (Landau et al 2006). Individuals with Williams Syndrome are also known for their strengths particularly in face recognition. Research carried out at the Department of Cognitive Science Johns Hopkins University Baltimore USA found that although children with Williams Syndrome were found to have difficulty in reproducing a drawing or figure, they were able to recognise a wide variety of familiar objects, similar to typically developing children of the same chronological age (Landau et al 2006). It was also found that
children with Williams Syndrome found it more difficult to recognise objects when presented from different or unusual viewpoints. It is likely that different recognition strategies are used to identify such objects. The authors of the study suggest that recognition of objects from unusual orientation employs different cognition mechanisms. One such explanation suggested was that spatial impairment in the case of Williams Syndrome is characterised by deficits in the dorsal stream. Whilst object recognition (including face recognition) is mainly a function of the ventral stream, recognising objects from unusual orientations involves additional visual processing requiring dorsal stream functioning (Landau et al 2006).

2.4.3 Audio and Visual Information Processing

Rossi et al, 2012, explored auditory and visual information processing in individuals with Williams Syndrome living in Brazil and Spain. It was found, that in the case of Williams Syndrome, the auditory processing abilities are inferior in comparison to visual information processing.

Rossi et al (2012) also discovered that Williams Syndrome participants responded much better when verbal and visual information was presented simultaneously. They added that

adding visual input modalities to the presentation of stimuli should be considered when planning intervention programs for this clinical group.

(Rossi et al 2012 p. 823)

2.4.4 Language

Mervis & John 2008, from the Department of Psychological and Brain Sciences University of Louisville USA, state that ‘vocabulary ability is generally considered to be the greatest language strength for children with Williams Syndrome.’ However, the researchers found that this strength is not in vocabulary in general but specifically in concrete vocabulary ability i.e. naming of objects and actions. Similar to earlier studies by Bellugi et al 1997, Mervis and John (2008) found severe impairments in language related to spatial concepts. In summary,
...concrete vocabulary and phonological skills are relative strengths, grammatical abilities are at the level expected for overall intellectual abilities, and relational language and pragmatics are clear weaknesses.

(Mervis and John 2008, p.977)

2.4.5 Literacy and Numeracy Skills

Individuals with Williams Syndrome possess strengths in memory skills which are especially advantageous when used in educational contexts. Memory skills such as rote learning facilitate acquisition of reading and spelling skills. Individuals with Williams Syndrome can memorise poems, songs and stories, and many have a flair for learning a foreign language. Whilst working in the Laboratory of Cognitive Neuroscience in the Salk Institute, Semel & Rosner (2003) compiled current research on Williams Syndrome. In their resulting publication, they suggest that the skill to learn by rote be used as “a focal point in formal learning situations that would otherwise overtax their academic capabilities” (Semel and Rosner 2003, p.233). However the authors also state that the flair for memory skills does not benefit acquisition of numeracy in the case of students with Williams Syndrome. Whilst, students with Williams Syndrome can effortlessly count by rote they have greatly impaired knowledge and manipulation of number.

Paterson et al (2006) examined impairments in number skills in individuals with Down’s syndrome (DS) and Williams Syndrome. In general they found the individuals with DS and Williams Syndrome had similar cognitive abilities, the exception being in the area of number. They found that Williams Syndrome infants had a higher level of number skill than children with DS but the opposite was true when they examined number skill in adults. In the case of individuals with DS, acquisition of number skill followed a typical developmental pathway. Weaknesses in this area were attributed to delayed development. However, individuals with Williams Syndrome seemed to follow an atypical developmental pathway in the area of number. In the case of Williams Syndrome weaknesses in number skills were attributed to irregular cognitive processing.
2.4.6 Behavioural Profile

Children with Williams Syndrome tend to have highly social personalities, are friendly and endearing and possess an affinity for music. They are typically unafraid of strangers and show a great interest in contact with other people. Individuals with Williams Syndrome sometimes display behavioural issues such as fears and anxiety, impulsivity, distractibility and attention problems, and poor adaptability. Some Williams Syndrome individuals exhibit specific behaviour conditions such as Attention Deficit Hyperactivity Disorder (ADHD), or without hyperactivity ADD (Mervis and Velleman 2011). Difficulty with impulsivity can lead to aggressive incidents of hitting out at other people.

Individuals with Williams Syndrome are sensitive to criticism and fear failure. Students with Williams Syndrome “benefit from feedback that is immediate, informative, and constructive whenever possible” (Semel & Rosner 2003, p. 232). The authors recommend the use of personalised rewards as essential to effective teaching of students with Williams Syndrome.

2.4.7 Conclusion

Such studies contribute to the development of education intervention strategies for children with Williams Syndrome. Identification of strengths and weaknesses in the area of cognition in individuals with Williams Syndrome, enable educators to enhance learning opportunities.

2.5. Assistive Technology

Increasingly, computers play an important role in the education of students with special needs. Assistive technologies refer to “any device or system that helps to improve the functional capacity of people with disabilities” (Special Education Support Services (SESS)). When choosing the most appropriate technology, the SESS recommends that the physical, sensory and cognitive needs of the student are paramount. Characteristics of the student to be taken into account include physical and cognitive ability,
temperament, attitude and motivation. When the best match is made between student and technology, the student is enabled to “achieve their optimum potential”.

2.6 Human Computer Interaction (HCI)

Human Computer Interaction involves the study, planning and design of the interaction between people and computers. Inkpen (1997) identifies some important areas of HCI research for children as users of educational multimedia, learning environments, and children as computer users.

Firstly, Inkpen recognises the differences in terms of objectives and approaches in the workplace compared to that of the learning environment. He proposes that the foremost objective in using computers in the workplace is to help improve productivity. In contrast, learning is the foremost objective for using computers in an educational setting. For computers to be effective in the workplace, they need to be easy to use. Whereas, for computers to be effective for children at school, they need to be fun.

Secondly, Inkpen recognises that, for the most part, the computers children use for educational purposes were developed and designed for adult use in the workplace.

Children are not adults: their motor skills are not fully developed, their cognitive capabilities are different, and their motivation for using computers is different. If we carelessly develop educational multimedia tools we may jeopardize our children’s ability to learn with the tools.

(Inkpen 1997, p.3)

In the subject area of HCI, the interface is the link or point of interaction between a computer user and the machine. Thimblely (2001) proposed the term *permissive* for interfaces that ‘permit’ alternative ways of working. According to Thimbleby, “good user interfaces – whether for computers or for consumer devices – are flexible, and empower users, giving them confidence and mastery” (Thimbleby 2001, p.1). He suggests that poor interface design restricts what the user can do, so that there is only one right way of working. He claims that this causes frustration affecting self-confidence and performance on a task.
2.7 Input Devices

Input devices are an example of a hardware interface. In particular, a pointing input device is a piece of hardware that controls input of data to an information processing system such as a computer or other device. Pointing input devices may be classified as direct or indirect depending on whether the position of the input corresponds directly with the spot where the input is required (direct) or whether the input occurs remotely (indirect). While the touch screen is an example of a direct input device, the mouse, keyboard, joystick, trackball are all examples of indirect input devices.

Input devices place varying levels of demands on a user’s motor and cognitive skills. In operating an input device, the user must employ such skills as hand and eye coordination, fine motor, visual memory and visual spatial skills (Wood et al. 2004). According to Wood “the match between user and input device is critical” in creating optimal learning opportunities for young children through the use of technology. The input device is the “crux” in the relationship between user and computer and acts as a crucial interface (Wood et al., 2004). Recognising individual developmental differences can help educators make the best choice of input method. The level of ease and efficiency or usability in operating a certain input device will positively affect a child’s engagement in computer activities.

2.7.1 Indirect Input Devices

In the past, educators have often questioned the suitability of indirect input devices such as the mouse or keyboard as input devices for young children (Inkpen 2001).

Alloway (1994) suggests that the abstract link between the operation of the keyboard and the object on the computer screen demands more time, attention and cognitive processes than the discernible link that exists between the mouse and the effect on objects on-screen.

In a study carried out at the Interactive Technologies Department of the Children’s Television Workshop New York, Revelle & Strommen (1990) studied sixty four pre-
schoolers using a mouse, joystick and trackball over a five day period. The researchers suggested that reducing the cognitive processing skills required to operate an input device can help children focus on the educational content of the software activities.

2.7.2 Direct Input Devices – The Touchscreen

Whilst it was recognised that age, stage of motor and cognitive development were important factors in the usefulness of indirect input devices in early childhood education, the touchscreen as an alternative had its own shortcomings. The Canadian researchers Woods et al (2008) identified the touchscreen as an expensive alternative that would exceed financial resources.

The touchscreen in its early form was recognised for its ease of use and durability but also was found to be the least accurate input device. Researchers from the Human-Computer Interactive Laboratory University of Maryland USA, Sears & Shneiderman (1991) claimed that the most natural and convenient way to select something is to point and to touch. Their study was motivated by a need to create a method to reduce the rate of error when using the touchpad. The touchscreens of the time were effective in selecting large targets but inadequate in provision of accurate information about location of touch. Lack of screen resolution and the inability to select a single pixel were the main reasons proposed for difficulties in selection.

Nine years later, the difficulties with touchscreen inaccuracy of selection are still evident in a study by the American occupational therapist Julie Durfee (Durfee and Billingsley 1999). A mouse was found to be more effective than a touchscreen when used by a nine year old boy with cerebral palsy and visual and cognitive deficiencies. The boy experienced frustration when using the touchscreen and expressed preference for the mouse. However, the authors note that the mouse was also new and a novelty to the participant, who had been using the touchscreen for two years previously. The authors were also aware of the limitation that was imposed by the use of a single participant with his own unique set of disabilities. We do not know if the same results would be obtained for other people with similar disabilities.
2.8 Software Design

Susan Haugland (1992) investigated the link between the developmental growth of children and the quality of software that they used. She observed that children who used software with supporting activities that provided opportunities for reinforcement had significantly greater developmental gains when compared to children without computer experience in similar classrooms.

In creating appropriate software for technology, principles of child development and learning must be considered in order to advise on developmentally appropriate material (Cooper 2005). The Zone of Proximal Development is a principle developed by the Russian psychologist Vygotsky. It refers to the difference between the level of ability a learner achieves independently and what the learner can achieve with support. The support provided is perceived as a scaffolding “which is tailored to the needs of the student with the intention of helping the student achieve his/her learning goals” (Sawyer 2006). Vygotsky saw the role of education as one that provides experiences that are within the learner’s zone of proximal development and thus encouraging and advancing their learning.

Shute and Miksad (1997) found that software with substantial scaffolding features increased general cognitive abilities significantly more than software with basic scaffolding. Grover (1986) found that children working with software designed with cognitive-development principles had significantly more correct responses than the control group did.
Linda Cooper (2005) collated criteria for best practice software design.

**Developmentally appropriate digital environments should:**

- support the child as a unique individual;
- be child controlled;
- be open-ended rather than close-ended;
- be active rather than passive;
- involve many senses;
- encourage exploration, experimentation, and risk taking;
- encourage critical thinking, decision making, and problem solving;
- offer quick feedback, be interruptible, and keep records;
- balance familiarity with novelty;
- be user friendly;
- be progressively levelled, offering new challenges;
- be responsive to child input;
- build on previous learning;
- encourage reflection and metacognition;
- support social interaction.

(Cooper, 2005, pp. 298)

**Table 2.1: Best Practice Criteria for designing developmentally appropriate digital environments for young children**

2.9 Tablet computers

The tablet computer, or tablet, appeared on the market in the late 20th century. It is a type of mobile personal computer that utilises touchscreen technology as its primary input device. The tablet is one-piece mobile computer with the hardware components in-built.
The first tablet computers were costly and limited in usability. In 2010, the American Corporation Apple INC., released the first commercially successful tablet product known as the iPad. The iPad was relatively cheaper than its predecessors, had a longer battery life, less weight, increased usability and therefore appealed to a wider cohort. The iPad has been identified as defining a new genre of mobile technological device. Other brands of tablet computers soon followed the release of the iPad. However the iPad has remained the tablet of choice in many schools due to its ease of use, consistency of interface, and availability of educational software (Heinrich 2012).

It is important to bear in mind, that the iPad and similar tablet products are designed and marketed as personal lifestyle devices and are not designed solely for educational use. According to Traxler (2010), the relationship between education and technology “has always been parasitic”, where devices originally intended for the work environment have been adapted for educational use. He claims that technological devices “continually challenge educationalists to develop educationally sound applications” for them.

Traxler (2010) expressed reservations and advised caution about the merging of multiple technologies in modern mobile devices. Whilst he admitted that mobile devices are difficult to ignore due to their ubiquitous nature, he believed that they are not designed for educational use and unsuitable for learning. Although Traxler’s cynical view of mobile technology might be somewhat true, his opinion was expressed prior to the release of the iPad.

One of the main uses of the iPad as a technology tool is in individualising and personalising learning opportunities in an educational setting. Whilst the iPad can easily be used in a collaborative setting and shared by users, it is really designed as a device for the individual user. The Faculty of Education in the University of Hull (Burden et al. 2012) were the first to investigate the effect and impact of the iPad across homes and schools in Scotland. They reported that personal ownership was seen as the single most important factor for successful use of the iPad.
The ability to customise the iPad/tablet to suit a single user especially suits the nature of special needs education, where each individual presents with unique needs and learning objectives.

2.10 Tablet Operating System (OS)

The tablet utilises a different kind of operating system from that of the traditional desktop interfaces. The OS adopted by Apple Inc. is known as iOS. An operating system is a form of software that allows communication with the hardware on a device and allows other programmes to run. Corporations such as Samsung and others, use operating systems such as Unix, Darwin or Linux.

A tablet personal computer utilises touchscreen technology as its primary input device. The iPad touchscreen is capable of interpreting multi-touch finger pad gestures such as swipe, tap, pinch, and reverse pinch. The touchscreen may respond to shaking of the device or rotation which results in the screen switching from portrait to landscape mode.

2.11 Tablet Software and Applications (Apps)

Mobile applications or ‘Apps’ are packaged pieces of software designed to run on portable devices such as the tablet computer and mobile phone. A significant trait of Tablet computers is that software is supplied through online distribution – download, instead of the traditional physical format. Mobile application sources are mainly known as ‘App stores’ and contain many categories of software packages designed by institutions or third-party developers.

With access to a wide variety of Apps, a user can select applications to suit their specific needs and objectives. Similarly, careful software application selection for iPads in a learning environment can help meet the specific learning needs of a student.

Many of the Apps available are designed to take advantage of the features of the tablet computer such as touchscreen input interface, internet access, camera, video, audio
reader, recorder and large display (Educase 2011). Similarly, any tools absent can be added to the device in the form of an App e.g. calculator or e-reader.

2.11.1 Educational Apps

There are currently over 1 million mobile applications available for the Apple iPad on their distribution platform known as iTunes. According to an iTunes App Store Metric on the website 148Apps.biz, Education is the second most popular App category, with approximately 82,000 applications available. Games is the most popular App category exceeding the Education category by 50,000.

Murray and Olcese from the Pennsylvania State University (Murray and Olcese 2011) are critical of the distribution platform offered by the Apple-based iTunes web site and claim that it is not user friendly. In their evaluation of applications found in the Education category, they found that many of the more useful applications to educators are not in the Education category, and conclude that the average user would have difficulty in locating relevant applications.

Whilst Murray and Olcese (2011) applaud the many innovations offered by the iPad such as the multi-touch interface, improved energy consumption and innovative distribution software methods, they find shortcomings in the educational software applications. They claim that the advances in technology inherent in the iPad are underused in applications relevant to teaching and learning, and see little difference with the applications created for other devices such as iPhone and iPod.

Murray and Olcese (2011) believe that iPad applications are inhibited by their over-dependency on traditional behavioural models of teaching such as drill and practice. Whilst they recognise the need for content–based drill and practice applications, they claim that there is a deficiency of applications that focus on creation or collaboration of content. Development of collaboration skills, creation of content, and construction of knowledge are all valued and aspired modern-day models of teaching.
…the bulk of the applications written to run iOS devices are woefully out of sync with modern theories of learning and skills student will need to compete in the 21st century. (Murray and Olcese 2011, p.48)

2.11.2 Evaluation of Educational Apps

The high quantity of available Educational Apps makes it very troublesome and time-consuming for the educator to find a suitable App. As with all education tools at an educator’s disposal, careful selection of Apps is a requisite. To accomplish this, it is necessary for educators to be able to critically evaluate the Apps on offer. This may be achieved by trialling a free version of an App (if available), referring to online reviews and rating, or use of a Rubric or evaluation checklist or tool.

2.11.2.1 Free Downloads

All Apps for the iPad must first be reviewed and approved by Apple and can only be downloaded from the iTunes Store. Many Apps are free to download or relatively inexpensive to purchase. The free downloads frequently come with unwanted advertisements and purchase is often necessary to get access to the complete features of a free App. However, exploration of the free version of an App prior to financial commitment can also be viewed as a good means to assess a particular App.

2.11.2.2 Online Reviews

Software review websites provide educators with a forum for reviewing and evaluating software applications. Such web reviews are invaluable, particularly when schools are under pressure to make thrifty software purchases following a big spend on hardware. The website, Learning in Hand, is one such Educational App review website that has been created by the educator Tony Vincent. In addition to providing a comprehensive list of websites that review Educational Apps, he refers to a number of checklists that can be used when making a decision on App selection. Scott Meech, an educator has developed the website www.IEAR.org which functions as a platform where educators, App developers and students can submit reviews of Educational Apps.
2.11.2.3 An App Evaluation Rubric

A principal of a Baltimore elementary school in the USA and doctoral candidate at John Hopkins University, Harry Walker (2011) identified a need for an evaluation system for assessing Educational Apps. He created an *Evaluation Rubric for iPod Apps* in 2010 - the iPod being the precursor of the iPad. The Rubric has subsequently been adopted as an assessment tool for all mobile software educational applications including those for tablet technology. The Rubric was designed with a focus on six criteria important to educators; curriculum connections, authenticity, feedback, differentiation, user friendliness, and student motivation (Walker 2011, p.60).

The Evaluation Rubric has been widely adopted as the most suitable tool for assessing the educational value of mobile Apps. According to Walker, its immediate demand and application worldwide in the educational community, “demonstrates the need for a common language and structure to facilitate the selection of high quality apps” (Walker, 2011, p.63).

2.12 iPad Research Studies

Following release of the iPad in 2010, three million devices were sold in the first eighty days. It was reported at the time that there was an “unanticipated” response from the autistic community (Herbert 2010). There is evidence of increased uptake of iPads in education systems worldwide (Quillen 2011, Johnson et al. 2012, Clark and Luckin 2013, Heinrich 2012). According to Philip Schiller, senior vice-president of Worldwide Marketing Apple Inc., as of January 2012 there were 1.5 million iPads in use in education institutions in the U.S. and around the world. An internationally recognised Horizon report (Johnson et al. 2012) highlighted tablet computers such as the iPad as one of the top trends for technology adoption for schools in 2013.
2.12.1 iPad Research in General Education

Research carried out in the United Kingdom by Paul Heinrich (2012) in the Longfield Academy, Kent, studied the effect of iPads on teaching and learning in the case of students aged between eleven and eighteen years of age. The outcomes of the report indicate enhanced levels of motivation, engagement, collaboration and attitudes towards learning.

The positive impact on learning found in the Longfield Academy study is mirrored in the findings of other studies such as:

- “Exploring iPads in Learning” Centre for Excellence – Learning Exchange, New South Wales (Australia) 2012
- “The iPad Classroom”, Morrison High School, Illinois (USA)
- “Use of Tablet Technology in the Classroom” NSW Curriculum and Learning Innovation Centre, New South Wales (Australia) 2012
- “iPad Scotland Evaluation”, University of Hull (United Kingdom) 2012
- “Is the iPad suitable as a learning tool in schools? Department of Education and Training, Queensland Government (Australia)
- “iPads in the Classroom Pilot Project” University of Pennsylvania Libraries, (USA) 2012

2.12.2 iPad Research in Special Education

To date, there is limited published research on the effect of the iPad on teaching and learning concerning students with cognitive impairments. In the United States of America, Conley (2012) investigated the effect of the iPad on five students with severe cognitive impairments over a period of four weeks. Conley found that the iPad fulfilled and surpassed the goals and objectives that the researcher set out to achieve.

In the case of one student, benefits in iPad use included a reduction in frequency of the need to redirect or refocus attention, reduction in undesired behaviours, increased attention span, and improvement in fine motor skills and writing ability.
In a trial report published by the Queensland Government 2012 entitled “iPads in Special Education”, the iPad was found to be an effective assistive device in the special education setting. The aim of the study was to research the suitability of the iPad in a primary school setting, for students with multiple impairments.

In particular, it was noted that in the case of cognitively impaired students, the touchscreen interface of the iPad “removed a level of abstraction that was putting a barrier between the student and the curriculum”. The researchers found that the touchscreen enabled the students to interact directly with the objects and text on the screen rather than interacting indirectly using a mouse pad. The study also reported that iPad use in special education resulted in increased levels of student engagement.

“iPads for Learning – In Their Hands” is a study carried out by the Department of Education and Early Childhood Development in Victoria, Australia (Victorian Government 2011). The study is unique to other iPad studies in that it examines the impact of the iPad in learning in a range of educational settings including primary, secondary and special schools.

Teachers in the special school settings reported that the iPad facilitated new possibilities for engaging special needs students and provided increased opportunities for personalised leaning.

iPads provide visual interactive touch-based earning that is better suited to the learning needs of many students in special schools. Teachers are seeing deaf students tap into their visual learning mode. Students who have limited fine motor skills and find it hard to write or use a PC, as well as students with communication needs, can use the iPad to extend learning through touch capabilities and communication programs. 

(Victorian Government 2011, p.1)

The iPad facilitates personalised learning, an essential feature of special needs education. The wide range of Apps enhance and enable customised learning opportunities to suit the wide range of learning styles and abilities present in a special educational setting.

The study found that the impact of the iPad differed in the mainstream schools when compared to special schools. Teachers in special schools were more optimistic about the
extent to which using iPads would increase student motivation and engagement, and improve students’ literacy and numeracy levels.

2.12.3 Role of the Teacher

The research studies contain strong evidence in support of the iPad as a valuable educational tool. However, the role of the teacher is crucial to the successful use of iPad technology in the classroom. To ensure optimal use of iPad devices, teachers need to be adept at matching curriculum requirements with effective teaching methodologies and then consider how iPad technology can assist as a learning tool in this process (NSW 2012).

The New South Wales (NSW) report recommends teachers use an App evaluation rubric to guide decisions in reviewing and purchasing Apps. This will help to reduce the time spent evaluating Apps and allow them to make informed purchasing decisions.

2.12.4 Limitations of the Research Studies

All the research outlines positive benefits in using iPads in the classroom. However, as the iPad was only released in 2010, the available research is only examining the short-term impact of iPad use in education. Some researchers highlight the need to stand back from the “hype” that surrounds technology following release, and to investigate the implications of such new technology in the long term (Quillen 2011).

2.13 Conclusion

The literature presented in this chapter helped to create a profile of an individual with Williams Syndrome, with particular emphasis on cognition and behaviour. The discussion into the strengths and weaknesses in Williams Syndrome, serve to aid the identification of enhanced learning opportunities.
The value of the iPad as an educational tool was explored. The importance of incorporating principles of child development and pedagogy in developing software design was discussed.

Whilst, the international research studies provide strong evidence in the support of the iPad as a valuable educational tool, the long term impact of iPad use in fostering deep meaningful learning, in the case of children with special educational needs and in particular in a child with Williams Syndrome, remains to be seen.
Chapter Three Methodology

3.1 Introduction

This chapter presents the research methodology used in this study. It describes the research questions to be investigated, and details the research subjects, background and setting. This chapter explores some research instruments used to collect data in educational research. The reliability and validity of the chosen research instruments are explained. Finally, ethical considerations are outlined.

3.2 Background to the Research

The author of this study is a senior infant primary mainstream class teacher. It became apparent that a six year old student with Williams Syndrome needed help in accessing the curriculum in an alternative way to other students in the class. Williams Syndrome is a rare neurodevelopmental genetic disorder that affects the student cognitively, socially and behaviourally. The student has been assessed as having a mild general learning disability, difficulties in attention span, poor co-ordination and delayed communication skills. In common with other children with Williams Syndrome, the student experiences difficulty with number concepts and gross and fine motor skills, including handwriting. Difficulties in concentration and distractibility posed a major barrier to learning for the student. This affects the student’s ability to concentrate and to complete tasks.

The student has emerging verbal communication ability and benefits from the use of PECS (Picture Exchange Communication System). Scheduling and routine elements of the TEACCH approach (Treatment and Education of Autistic and Communication related handicapped Children), are used to guide the student in daily activities. Strengths include a great sense of rhythm and love of music, an outgoing social nature and a good ability for memorising rote information.
The student in this study qualifies for extra resource teaching hours under the *multiple disability* category as recognised by the Department of Education and Skills (DES) and National Council for Special Education (NCSE) for the purpose of allocating additional resources. The student has sole access to a Special Needs Assistant (SNA) and qualifies for three and a half hours of one-to-one Resource Teaching a week. As class teacher, the researcher of this study has full contact with the student.

Williams Syndrome children respond best when verbal information and visual information are presented simultaneously (Rossi et al, 2012). The aim of the study is to investigate the suitability of the iPad as a learning tool in the case of students with special educational needs, and in particular in a student with Williams Syndrome. The student has previous experience of desktop and laptop computer use but no experience of use of tablet, iPad or any form of touchscreen technology.

### 3.3 Research setting

The setting for the case study is in a primary school in a village located in the west of Ireland. The study took place mainly at an individualised workstation at the rear of the senior infant classroom, and also in the school’s laptop room. The classroom has a teacher’s laptop computer, one desktop computer, one iPad tablet computer, and wireless internet access. The school’s laptop computer room has twenty-eight laptops, a projector for displaying the teacher’s laptop and broadband internet access.

### 3.4 Research Questions

The main aim of this study is to investigate the effects of iPad/tablet device use by students with special educational needs, and in particular in the case of a student with Williams Syndrome. The study will address the following research questions;

- What evidence is there of improvement in student academic achievement that can be attributed to the use of iPads/tablets?
- What effect does iPad/tablet use have on a student’s behaviour?
- What capacity does the iPad/tablet have to enhance the concentration levels of special needs students?
- To what extent does iPad/tablet use affect motivation levels in a student with special educational needs?
- Do students with special needs have better communication skills as a result of iPad use?

### 3.5 Research Methodology

This section discusses two main research methods used in educational research; action research and case study.

#### 3.5.1 Action Research

Action Research is a method of research that was first developed by Kurt Lewin in 1946. As suggested by its name, it involves a combination of *action* and *research* and can occur in a wide variety of settings and situations. Action research involves the process of actively participating in implementing change whilst conducting research with the aim of improving a situation or practice. Cohen and Manion define action research as:

> a small-scale intervention in the functioning of the real world to address practitioners’ own issues, and a close examination of the effects of such an intervention.

(Cohen and Manion 1994, p.186)

The primary aim of action research is “to create change rather than to produce new knowledge” (Mukherji and Albon, 2009, p.90). The action researcher is involved in self-analysis of practices and gathering of evidence resulting in identification of elements for change in one’s practice. According to Kemmis and McTaggart action research is:

> a form of collective self-reflective enquiry undertaken by participants in social situations in order to improve the rationality and justice of their own social or educational practices as well as their understanding of these practices and the situations in which these practices are carried out.

(Kemmis and McTaggart 1988, p.5)
Critics of action research claim that it is overly subjective and bias in the gathering of data. Wilson 2012 claims that when teachers act as researchers “ethically committed action” is required, where teachers must act in a detached role from the context being examined. Also, teachers as researchers may produce results that are specific to their situation alone, thus reducing the ability to generalise any findings (Wilkinson 2000).

Due to its focus on improving practice and creating change, action research was deemed an inappropriate methodology for use in this study.

### 3.5.2 Case Study

A Case study approach allows for an in-depth examination of a particular situation. Cohen et al 2007 refer to the case study as providing for an examination of an ‘instant in action’, and of an ‘evolving situation’.

When deciding if the case study approach was an appropriate research strategy, Yin maintained that case studies are relevant when identifying ‘how’ or ‘why’ particular things happen (Yin 1994, p. 4).

Some critics of the case study approach cite over-reliance on subjective evidence as a limitation to this method of research. Simons 2009 maintains that subjectivity of the research provides an essential role in the case study approach. If carefully managed and examined, Simons does not see it as a problem, and argues that:

> It is through analysis and interpretation of how people think, feel and act that many of the insights and understandings of the case are gained.  
>  
> (Simons 2009, p.4)

However, whilst Simons acknowledges the central role of the researcher in the case study approach, the need for the researcher to be ‘self-reflexive’ at all stages of the study is emphasised.

Another disadvantage of the case study method is the over-generalisation of the results (Mukherji and Albon 2009). It may be questioned if it is acceptable to generalise when
a set of results apply to one unique situation. Simons (1996) refers to the paradox of the case study approach, and claims that “by studying the uniqueness of the particular we come to understand the universal.”

### 3.5.3 Chosen Research Method

The aim of this study was to study an individual in a real-life context in a particular point in time. The case study approach was employed in this study as it best suited the in-depth investigation required. A mixed-methods research design was utilised to collect both qualitative and quantitative data. Qualitative research tools included interviews with resource teachers and unstructured observations by participant observers. Quantitative research tools included a questionnaire designed for teachers using iPad/tablets with students with special educational needs, a formal assessment tool ABLLS-R, and structured observations using observation schedules.

### 3.6 Research outline

#### Pre Implementation Period

- Two months before the study period, the student was assessed using the ABLLS-R tool to assist in the identification of the student’s current skills acquisition and to guide identification of skill areas for further development. These skills were included as objectives in the student’s IEP (Appendix C).
- Guided by objectives identified in the student’s IEP, appropriate iPad software applications were selected for the period of study.
- The student was observed using the laptop.
- A sample of the student’s handwriting was acquired and the level of handwriting skill was assessed.
Implementation Period

- An iPad device was introduced to the student in the study in April 2013. Over a period of nine weeks, the student was observed using a variety of software applications on a daily basis.
- An online questionnaire was distributed to teachers of students with SEN using iPads or other tablet devices.
- Interviews were conducted with two Resource teachers.

Post Implementation Period

- This student’s skills level was assessed using the ABLLS-R tool following the period of the study.
- The handwriting test administered in the pre iPad period was repeated.

3.7 Research Materials

3.7.1 Hardware

In light of the issuing of a new circular in February 2013 (DES 2013) from the Department of Education and Skills, an application was made to the NCSE for grant-aid for the purchase of an iPad/tablet device for the student in the study, on the 6th of March 2013. The preceding circular applied only to second-level schools. As there was no response to the application prior to the study period, the student used the author’s personal iPad device (retina display iOS 6) for the duration of the study.

3.7.2 Software

The results of the ABLLS-R assessment guided the focus and selection of appropriate iPad applications for the period of study. Website reviews were the primary method of identifying appropriate apps. Additional details were obtained from reviewing the screenshots and information in the iTunes App Store. Suitable apps were finally selected following a trial of the free version. The following are the apps that were used by the student in the study;
<table>
<thead>
<tr>
<th>Subject Area</th>
<th>App</th>
<th>Developer</th>
<th>Price</th>
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<tr>
<td>Handwriting</td>
<td>LetterSchool</td>
<td>Boreal b.v.</td>
<td>€2.69</td>
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<td></td>
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<td>Innovative Mobile Apps Ltd.</td>
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</tr>
<tr>
<td></td>
<td>First Words Deluxe</td>
<td></td>
<td>€4.49</td>
</tr>
<tr>
<td>Maths</td>
<td>Counting Bear</td>
<td>Innovative Investments Limited</td>
<td>€0.89</td>
</tr>
<tr>
<td></td>
<td>Counting with the Very</td>
<td>Night &amp; Day Studios, Inc.</td>
<td>€2.69</td>
</tr>
<tr>
<td></td>
<td>Hungry Caterpillar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.8 Research Instruments

A combination of qualitative and quantitative data was collected using the following research tools; structured and unstructured observations, interviews, formal assessment tool ABLLS-R, and a questionnaire.

3.8.1 Questionnaire

Both questionnaires and interviews are used widely in educational research to collect information that cannot be directly monitored. Gall et al 2006 describe them as data collection methods that “typically inquire about the feelings, motivations, attitudes, accomplishments, and experiences of individuals” (Gall et al 2006 p. 288). The “standardized, highly structured design” of the questionnaire is more commonly used in quantitative research (Gall et al. 2006, p.290).

An online questionnaire was designed using the Survey Monkey web-based tool to collect information on the use of iPad or tablet computers in the case of students with Special Educational Needs (Appendix D). Questions were chosen as a result of issues that presented themselves in the literature review.

Table 3.1: Case Study Software Application

<table>
<thead>
<tr>
<th>Category</th>
<th>Software</th>
<th>Developer</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>General/Fine Motor</td>
<td>Toca House</td>
<td>Toca Boca AB</td>
<td>€2.69</td>
</tr>
<tr>
<td></td>
<td>Oolly Lite</td>
<td>Ido Gal</td>
<td>Free</td>
</tr>
</tbody>
</table>
The questions were categorised and separated into five sections. The segmenting of the survey questions reduced the amount of scrolling necessary by the participants thus making the survey more manageable. The questions in Section One were designed to gather general information such as teaching position, category of disabilities, iPad/tablet ratio and use. Section Two of the survey dealt with the effects of the iPad/tablet use in the case of students with SEN. Section Three dealt with the software applications or apps, whilst Section Four sought opinions on the iPad/tablet interface. Finally, Section Five dealt with the Guided Access features of the iPad.

A mixture approach to questioning was used in the survey, including closed structure questions, multiple-choice, dichotomous and rating scales. The Likert scale was employed to measure the degree of sensitivity of a response to a statement or a question. Comment boxes were included at the end of most questions to encourage further comment or clarification where necessary. Some of the questions were laid out in a matrix style to facilitate rapid input of responses. The “standardized, highly structured design” of the questionnaire is more commonly used in quantitative research (Gall 2006, p. 290).

The sampling procedure has been purposive and distributed to teachers, all of whom teach children with special needs and use iPad technology in the learning environment. Whilst the survey was available on the internet, participants were informed that a hard copy of the questionnaire was also available if they preferred. Prior to its distribution, the questionnaire underwent a pilot test carried out by a peer who is not familiar with touchscreen or tablet technology. The main purpose of the pilot test was to reveal any weaknesses in the questionnaire. The pilot test provided the opportunity to measure the time necessary to complete the questionnaire, and to check the wording and possible misinterpretations in the questionnaire. The questionnaire was re-drafted and re-piloted prior to distribution.

3.8.2 Observations

The distinguishing characteristic of observations as a research method is that it offers the researcher “the opportunity to gather ‘live’ data from naturally occurring situations”
Cohen et al 2007. Observational data can consist of facts, events or behaviours in a particular situation.

Due to the distractible nature present in an individual with William’s Syndrome, the presence of a person unfamiliar to the student would have directly affected the behaviour of the student. Therefore observations were made by two participant observers – the class teacher (author of this study) and the Special Needs Assistant.

The SNA in the study has worked exclusively with the student since September 2012. The SNA is well qualified (BA (hons) in Psychology), and has experience in working with children with special needs. The SNA is skilled in recording and making accurate observations of student behaviour. Some of the roles of the SNA include; encouraging independence in everyday tasks, assisting the student with difficult tasks, observing and recording frequency of behaviour, and implementing interventions to promote good behaviour.

A combination of structured and unstructured observation techniques were used in this study. Observations were recorded in writing either in situ or as soon as possible following the event.

3.8.2.1 Structured Observations

Structured observation schedules were designed to record the incidence of behaviour of the student in the study. Prior to the introduction of the iPad, the student was observed using a desktop computer. Behaviours and necessary interventions were recorded on an observation schedule. An intervention can be defined as any intentional action taken to improve a difficult situation or prevent it from getting worse (Cambridge). Interventions can range from gentle verbal prompts to removing the source of the difficult behaviour.

Behaviour modification is a practice commonly used in education and in particular in special education, which aims to change behaviour in a particular situation.
3.8.2.2 A-B Design

A-B design is a model used in investigations concerned with studying behaviour (Gall 2006). An investigation using the A-B design involves a single participant and examines the effect of one variable on another (Carlson et al. 2009). The letters A and B refer to the two phases of the investigation. The A phase represents the baseline condition of the investigation. The B phase represents the intervention phase.

An A-B designed investigation was used for the purpose of observing behaviour of the student operating the iPad. According to A-B design, two variables are identified in order to conduct the investigation. One variable is designated as the dependent variable, and in this case was identified as the behaviour of the student exiting the assigned task on the iPad. The dependent variable is measured by the researcher.

According to A-B design, the second variable is designated as the independent variable and is controlled by the researcher e.g. switched on or off. In this study, the independent variable was identified as the activation of the Guided Access feature – a feature exclusive to the Apple iPad. Guided Access is a feature that can assist the user to stay focussed on a task by enabling the following actions:

- temporarily restricting the device to a particular App
- disabling of areas of the screen irrelevant to a task
- disabling of the hardware buttons on the iPad.

In the A phase of the investigation the baseline measure of the student’s natural behaviour pattern was created. In the B phase, the researcher observed and recorded the behaviour patterns when the Guided Access facility of the iPad was activated. The investigation led to the creation of data which when graphed, provided a picture of a student’s behaviour under the conditions outlined in the investigation. Such graphs allow for the identification of trends and provide information on the effectiveness of an intervention on a particular behaviour.
3.8.2.3 *Unstructured observations*

The unstructured observations consisted of field notes on behaviours, settings, activities, comments, reactions, reflections, attitudes etc. observed when the student was using the iPad. Brewer 2000 (cited in Waddington 2004) claims that the process of ‘critical self-reflection or reflexivity’ is a crucial element of participant observation. The observer must consider the influence that their personality, background, or level of interaction between themselves and the participant may affect the data. The observations made by the author of this study and by the student’s SNA were recorded daily in a journal.

3.8.2.4 *Limitations of observations as a research tool*

Whilst it is argued that ‘immediate awareness’ is a unique strength of using observations as a data source, unstructured observations can carry the risk of subjectivity and bias (Wilkinson 2000). However, Simons (2009) defends the qualitative nature of observations, claiming that “subjectivity is not seen as a failing needing to be eliminated but as an essential element of understanding” (Simons 2009, p. 45).

3.8.3 *Interviews*

An interview can be defined as consisting of “oral questions by the interviewer and oral responses by the research participants” (Gall et al 2006, p. 289). In this way, interviews are the most common method for collection of information in qualitative research (King, cited in Cassell and Symon 2004). In contrast to the use of questionnaires to collect information, interviews can enable a more in-depth exploration of a topic.

> Interviews enable participants – be they interviewers or interviewees - to discuss their interpretations of the world in which they live, and to express how they regard situations from their own point of view.  
> (Cohen et al 2007, p.349)

Simons (2009) indicates her preference for the interviewing method, as it provides a more time efficient, flexible method enabling the researcher to ‘get to the core issues in the case more quickly and in greater depth’.
In this study, an interview was carried out with two Resource teachers. One teacher is in daily contact with the subject of the case study and is unfamiliar with iPad technology. The second teacher is a teacher that uses the iPad with children with autism. A combination of structured and unstructured style of interviewing was employed which provided the opportunity to further discuss, explore and clarify themes relevant to the area of research.

3.8.4 Assessment

In the guidelines for assessment for primary schools, assessment is defined as;

the process of gathering, recording, interpreting, using, and reporting information about a child’s progress and achievement in developing knowledge, skills and attitudes.

(NCCA 2007a, p.7)

Assessment assists educators to create a complete picture of the needs of a child and enables the teacher to use that information to create learning experiences based on appropriate objectives from the primary school curriculum. Bowman et al. (2001) maintain that “careful assessment is even more critical to effective strategies for working with children with disabilities and special needs.” (Bowman et al. 2001, p.11)

3.8.4.1 Assessment Tool: ABLLS-R

The Assessment of Basic Language and Learning Skills –Revised (ABLLS-R) was developed by Partington Behaviour Analysts Inc., and is defined as

an assessment tool, curriculum guide and skills-tracking system used to help guide the language and critical learner skills for children with autism or other developmental disabilities

(Partington 2010, p.3)

The ABLLS-R is divided into four skills assessment sets:

- basic learner skills
- academic skills
- self-help skills
- motor skills.
It assesses the strengths and weaknesses of an individual in each of twenty-five skill sets. Each skill set is broken down into twenty-five multiple skills, ordered by typical development or complexity. The skills tracking system enables the observation and documentation of the child’s progress in the acquisition of critical skills and thus aids identification of skill areas in need of support and development.

The ABLLS-R test was administered two months before the study period and repeated after its completion. Although the ABLLS-R assesses a wide range of skills, academic skills in the areas of reading, maths and writing were to be the focus for the purpose of this study. As the skill areas of writing and fine motor are inherently linked, the fine-motor skills area was also examined as deficits in this area interferes with the acquisition of writing skills.

The student’s level of skill in the areas of reading, maths, writing and fine-motor, were established. The skills in need of further support and development were identified and included as goals in the student’s Individual Education Plan (Appendix C).

3.8.4.2 Limitations

The skills and tasks in the ABLLS-R are arranged in order of childhood development. Preceding skills are generally acquired before those that follow. However, many children with language delays may not acquire skills in the typical development order. For example, in the ABLLS-R, the skill of *colouring between lines* precedes that of *tracing letters and numbers*. This suggests that the skill of colouring should be acquired before that of tracing. However, it is clear that due to the deficiencies in visual spatial cognition typical of individuals with Williams Syndrome, the student in this study will acquire the skill of tracing letters and numbers before that of colouring between lines.

3.9 Reliability and Validity

In this case study, multiple sources of evidence were employed in order to create triangulation and therefore increase validity of the findings of the study.
The purpose of triangulation is to obtain confirmation of findings through convergence of different perspectives. The point at which the perspectives converge is seen to represent reality. (Kasunic 2005, p.108)

Case studies can consist of qualitative and quantitative methods of research so as to improve validity and to triangulate data. For the purpose of this study, qualitative data was obtained through the use of unstructured observations and interviewing. Quantitative data was collected throughout the use of a formal assessment tool (ABLLS-R) and structured observations. A questionnaire for teachers using iPads with students with SEN was designed also to collect quantitative data.

### 3.10 Ethical Considerations

Ethical issues were considered during all stages of the research. Permission was sought from the Board of Management and the parents of the student in the study. It was communicated to all participants of the research that they would not be identified in the research and anonymity of all respondents was ensured. It was conveyed to the respondents of the questionnaire that the results of the survey would be made available to them following the research if they so desired.
Chapter Four  Findings

4.1 Introduction

4.1.1 Overview

This investigation set out to explore the effects of iPad/tablet device use by students with Special Needs and in particular in the case of a student with Williams Syndrome.

Data was collected using both qualitative and quantitative research tools including the ABLLS-R formal assessment tool, structured and unstructured observations (using observation schedules), interviews with resource teachers, and a questionnaire designed for teachers using iPad/tablets with students with SEN.

This chapter presents the findings of the investigation in line with the research questions outlined in Chapter Three. Initially, a profile of the participants in the study is established. Then in accordance with the research questions, the effects of iPad use are examined in the areas of - academic achievement, behaviour, concentration, motivation and communication. The chapter concludes with a summary of the main findings of the investigation.

4.1.2 Case Study Participant

The student who participated in this case study is six years of age, is in a senior infants mainstream class environment and has been diagnosed with Williams Syndrome. At the age of four years and ten months, the student was assessed by a Clinical Psychologist, using the Wechsler Preschool and Primary Scale of Intelligence (WPPSI-III) and scored within the Mild General Learning Difficulty Range. According to the psychology report, the student also presents with difficulties in attention span, poor co-ordination and delayed communication skills.
The Assessment of Basic Language and Learning Skills - Revised (ABLLS-R) test was administered two months before the study period to assist in the identification of the student’s current skills acquisition and to guide identification of skill areas for further development. The student was 6 years and 10 months (82 months) of age at the time of the assessment. The test showed the lowest level of skill (<15%) in the areas of intraverbals, group instruction, classroom routines, reading, spelling and maths.

Intraverbals are a type of verbal behaviour that involve words, phrases and sentences that are emitted in response something another person says relating to an item, action or property that is not present. The student can fill in words from songs and simple phrases, and name people previously observed. Although the student can label many items such as objects, people and actions, the student is unable to answer what/where/who/when and why questions, discuss the function of items, or identify the categories of items e.g. cat, dog, cow belong to the animal category.

The student scored low (<40%) in the skill areas of visual performance, motor imitation, labelling, play and leisure, reading, grooming and gross motor.

Visual performance skills include tasks in attending to and manipulating nonverbal stimuli. High scores in this area were achieved in the tasks with puzzles (jigsaw) and shape sorter and no scores were achieved in tasks involving block design, copying patterns, sorting pictures by function, class or feature.

Motor imitation skills involve imitation of a variety of actions. The student in the study is able to imitate some gross and fine motor actions, especially when in a social situation when others are also doing the action. The student has difficulty imitating a sequence of actions, discriminating between static and kinetic motor movements and imitating changes of speed in an action.

The test showed the highest scores (>70%) in the skill areas of spontaneous vocalisations and social interaction. The student in the study uses language skills spontaneously throughout the day, labelling items and activities, singing songs and imitating words said by others. The student displays strong social skills, initiating social
interactions and making eye contact when interacting with others. The student shows interest in the behaviour of others, imitates peers and searches for a person when that person leaves the student’s visual field.

Figure 4.1 presents the percentage scores of the student in the study with normative data measured by the ABLLS-R assessment tool. The ABLLS-R was developed by Partington Behaviour Analysts and used to help guide the instruction of language and critical learner skills for children with autism or other developmental disabilities. The behaviour analysts compiled data of 81 typically developing children from 6 months to 60 months of age. The data presented in the graph below is from typically developing children at 60 months of age.
The data indicates that in the case of typically developing children most of the learning and language skills have been achieved by 60 months of age. The exceptions to this are evident in the academic skill areas of reading, maths, writing and spelling where there are still significant skills to be developed. Although the student in the study was 82 months of age when assessed with the ABLLS-R, the normative data demonstrates that the development of skills in the academic skill areas comes at a later development stage than other skill areas.

Figure 4.1: ABLLS-R Scores for Case Study Participant and Typically Developing Children
Similarly, the student in the study shows lack of skill development in academic areas with the greatest discrepancy from the norm to be found in the academic area of writing. However, the social influence of other students in the class has strongly encouraged the student’s interest in reading and writing and the student is eager to imitate peers.

4.1.3 Questionnaire Participants

Twenty teachers completed the online questionnaire on iPad/tablet device use by students with SEN. Seventeen of the respondents teach at primary-level whilst three participants teach at mainstream second-level schools. Of the seventeen primary-level respondents, twelve teach in a mainstream setting whilst eight of the respondents teach in special schools.

4.1.4 Profile of Students in Questionnaire

The questionnaire respondents had the opportunity to respond to the questions with regards to one, two or three students. In total, forty-seven students were referred to in the questionnaire. Forty-one of the students attend primary level and six students attend second level.

The questionnaire respondents were presented with categories of disabilities in regards to their SEN students. These categories are recognised by the DES and NCSE for the purpose of allocating additional resources.
Some students are diagnosed with more than one disability. For example, some children diagnosed with an Assessed Syndrome may also be categorised as having another category of disability, such as a Learning Disability or a Physical Disability. As a result, the number of disabilities exceeds the number of students referred to in the survey.

Almost half (twenty-four) of the students referred to in the questionnaire are categorised as having Autism Spectrum Disorder (ASD). Forty per cent (nineteen) of the students in the survey are categorised as having a Learning Disability. Eight of the students are categorised as having an Assessed Syndrome, though none have a diagnosis of Williams Syndrome.

All of the students referred to in the questionnaire use Apple iPad devices. Figure 4.3 depicts the ratio of availability of iPad/tablet devices to students. In nine of the survey responses the ratio of iPad to student is 1:1. Four of the survey responses indicate use of an iPad that is shared between five or six other students.

<table>
<thead>
<tr>
<th>Category of Disability</th>
<th>Primary</th>
<th>Secondary</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessed Syndrome</td>
<td>7</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Autism Spectrum Disorder</td>
<td>20</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Emotional or Behavioural Disturbance</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Hearing Impairment</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Learning Disability</td>
<td>16</td>
<td>3</td>
<td>19</td>
</tr>
<tr>
<td>Multiple Disabilities</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Physical Disability</td>
<td>8</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Speech and Language Disorder</td>
<td>5</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Visual Impairment</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 4.1: Categories of Student Disabilities
One respondent commented that the students use the teacher’s personal iPad.

When questioned about uses of the iPad, *learning in specific subject areas* was identified as the primary use of the iPad in special needs education. Other popular uses are communication, daily routines/timetabling and rewards. Entertainment and creating custom-made resources were the least popular uses of the iPad.
Figure 4.3: Purpose of the iPad/tablet device

Two secondary school students use the iPad for access to textbooks (known as e-books) to help reduce the weight of their schoolbags. Another secondary school student uses the iPad for the typing of homework.

4.2 What evidence is there of improvement in student academic achievement that can be attributed to the use of iPads/tablets?

Forty-five per cent of questionnaire respondents agreed or strongly agreed that student achievement had increased since the introduction of the iPad. However, forty per cent of respondents remained neutral whilst fifteen per cent disagreed with this statement. A small number of respondents disagreed with the statement. It was noted that the respondents who disagreed with the statement also reported having a high device to user ratio; some had a ratio of one device to six students.
4.2.1 Literacy

In the case study, the ABLLS-R scores in the skills area of *reading* doubled when assessed following use of the iPad.

![ABLLS-R Reading Skills Score](chart.png)

**Figure 4.4: ABLLS-R Percentage Score in the Skills Area of Reading**

When first assessed with ABLLS-R, the student was able to identify and label at least fifteen upper or lower case letters of the alphabet. The student was able to select and make the sounds of at least 10 letters of the alphabet. Following the use of the *First Letters and Phonics* and the *First Words Deluxe* Apps during the iPad study, the student was re-assessed using the ABLLS-R test. Whilst the student was unable to identify all twenty-six upper and lower case letters (the criteria for achieving the next score in the assessment), the student was able to select and make the sounds of at least twenty letters of the alphabet.

Before the iPad use, the student was unable to match words with pictures, read some simple words or read small groups of words from left to right. Following iPad use the student was able to match twenty words with corresponding pictures, read at least twenty words and read two three word phrases.
It also became clear from the study that the student uses the skill of *whole word recognition* to read rather than sounding out the words phonetically (i.e. sounding each letter sound in c-a-t). The student was unable to identify position of sounds in a three-letter word such as the initial sound ‘c’ in the word ‘cat’.

Seventy-five per cent of questionnaire respondents agreed or strongly agreed that the iPad is an effective tool in learning to read. The case study interviewee acknowledged that great progress was achieved in the case of the student in literacy.

### 4.2.2 Writing and Fine-Motor

The skill areas of writing and fine-motor are inherently linked and will be examined together.

![Bar chart showing ABLLS-R Percentage Score in the Skill Areas of Writing and Fine-Motor](image)

**Figure 4.5:** ABLLS-R Percentage Score in the Skill Areas of Writing and Fine-Motor
4.2.2.1 Writing

When first assessed with ABLLS-R, the student in the case study was able to hold a pencil or crayon and make marks on paper with correct writing hand position. The student was able to roughly trace or copy simple straight lines with prompts or reminders. The student was unable to colour within boundary lines. The main learning aim in the area of handwriting was that the student would be able to write her name.

Following iPad use, the ABLLS-R score increased by eleven per cent in the writing skills area. The student was able to roughly copy straight lines and shapes; but on this occasion, without prompts. In addition, the post iPad assessment revealed that the student could roughly copy simple curved lines and at least five letters.

Prior to the iPad study, the student was practicing tracing of the letters in her name with pencil/crayon and paper on a daily basis. An observation schedule (Appendix A) was designed and a sample of handwriting was taken before and after the iPad study period. The student completed the handwriting with little or no intervention from the SNA. The sample consists of four parts;

1. **Tracing** of whole name on paper
2. **Writing** of whole name on paper
Task 1: **Tracing** of whole name

<table>
<thead>
<tr>
<th>Pre iPad use</th>
<th>Post iPad use</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Before Image" /></td>
<td><img src="image2.png" alt="After Image" /></td>
</tr>
</tbody>
</table>

Task 2: **Writing** of whole name

<table>
<thead>
<tr>
<th>Pre iPad use</th>
<th>Post iPad use</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Before Image" /></td>
<td><img src="image4.png" alt="After Image" /></td>
</tr>
</tbody>
</table>

**Figure 4.6:** Handwriting samples before and after the iPad implementation period

**Task 1:** The letters were traced more accurately in the post handwriting sample than in the pre sample. The post sample handwriting demonstrated improved letter formation.
The student used the correct starting position for each letter and there was less deviation from the trace lines. There was increased confidence in letter formation and better hand control demonstrated.

**Task 2:** As depicted in the pre sample of the whole name, the student was unable to write her name without trace lines before the iPad study period. The student was dissatisfied with the formation of the first letter ‘s’ and attempted it again. It is possible that in attending to the letter ‘s’ that the student either forgot or was unsure of the starting position of the next letter - ‘a’. In the post sample, it can be observed that the student can spell her name, write the letters in correct order, make a rough approximation of the appropriate letter formation, and spatially place each letter accurately relative to the next letter.

The interviewee in the case study suggested that the natural development or progress of the student must also be taken into account. The interviewee considered the length of time of the iPad study and strongly agreed that the student achievement levels in letter formation had risen considerably since the introduction of the iPad.

The App known as *LetterSchool* by Boreaal b.v was the app most used to develop handwriting skills in the study period. There are no verbal instructions as it relies exclusively on visual information to demonstrate letters. Effective visual and auditory feedback is provided to guide the user. Every letter or number is presented in its maximum scale.

At first the letter’s shape, name and sound is introduced. The user is then presented with three main opportunities (steps) to learn correct letter formation. Figure 4.7 below illustrates the three steps.
Step 1: **Tap**  
The user is visually guided to observe correct starting position and to positions where there is a change of direction in the formation of the letter. Visual feedback is provided in the form of an animation.

Step 2: **Trace**  
The user learns the letter trajectory by tracing it. The starting position for each stroke is clearly identified visually and aurally. A pulling effect is created when the finger traces the trajectory. If the finger loses contact with the screen, it recoils back to the starting position. Visual and auditory feedback is provided on completion of the task.

Step 3: **Write**  
When given the starting position, the user must trace the letter. The trace lines disappear immediately and the letter must be traced from memory. After three incorrect attempts, guide arrows appear to guide the user on the correct trajectory.
The student’s progress was recorded using an observation schedule (Appendix B). In the early stages of using the LetterSchool Application, the student relied heavily on the trace lines to guide letter formation. The student found tracing straight lines as in the letter ‘l’ easier than letters or numbers with curves as in ‘s’. The letter ‘a’ and the numbers ‘3’ and ‘5’ proved most difficult for the student due to the presence of curves and change of trajectory in formation. The student relied heavily on the reappearance of the arrows to guide the trajectory at Step 3. In particular, writing the number three was problematic, as the student repeatedly found it difficult to remember which direction to drag the finger when the trace lines disappeared.

Frequently, the student was observed changing the tracing hand especially when having difficulty completing a letter or number. At times, the student was observed trying with fingers from both hands at the one time in her determination to complete the task. The tasks encouraged sustained hand-eye co-ordination. It was noted that when the student was writing with pencil and paper, the connection between hand and eye was frequently broken. The student continued to mark the page even when looking away. This particularly occurred when the student was distracted by sounds and movement in the environment.

When first using the LetterSchool App, the student hastily attempted each activity. At the end of the iPad study period, the student’s attempts were at a slower pace and the student took greater care when tracing. As time evolved, the student chose to return to Step 1 to observe a repeat demonstration of the letter or number formation when in difficulty.

The primary level interviewee recognised great improvement in the student’s hand-eye coordination and suggested that progression to using a stylus pen would be the next step. The interviewee also recognised the necessity for further observation in order to determine hand dominance so as to encourage writing with one hand only.
4.2.2.2 Fine motor

When first assessed with ABLLS-R, the student was able to do a variety of fine motor activities such as manipulating multi-puzzle pieces, snip with scissors, place pegs on a pegboard, remove lid from a jar, and use pincer grip to put clothes pegs on a line. The student has difficulty using a pencil accurately, turning pages one at a time, stringing beads, replacing lids on jars and pasting shapes on an outlined picture.

_Toca House_ and _Ooly_ are the Apps used by the student in the study to help develop fine-motor skills. In _Toca House_ the user uses the touchscreen hand gestures to help the characters do chores around the home such as ironing, mopping, cleaning, brushing, mowing, laundry etc. These Apps utilise the iPad touchscreen gestures. In _Ooly_, the main fine-motor skill utilised is the pincer grip action. The user utilises the pincer grip to pick up items on the screen and move them to a different location.

Following iPad use, the ABLLS-R score increased by ten per cent in the fine-motor skills area (Figure 4.6). The student’s skills developed to include such skills as turning a page one at a time, stringing beads and pasting shapes to an outlined picture.

In the questionnaire, the teachers were asked for their opinion on the iPad and its effect on hand-eye coordination and fine motor skills. In each case, sixteen out of twenty participants indicated that they agreed that the iPad had a positive effect. Sixteen participants agreed that iPad gestures such as pinching, touch-dragging and sliding enhance fine motor skills.

4.2.3 Numeracy

There was no change in the student’s ABLSS-R score in the skills area of Maths when tested after the iPad implementation period.

The apps chosen to help meet objectives in the area of Maths were _Counting with the Very Hungry Caterpillar_ and _Counting Bear_. These Apps deal with the basic maths
foundation skill of counting from one to five. The user learns how to count by touch. Each time an item is touched, the child hears a number.

Figure 4.8: ABLLS-R Percentage Score in the Skill Areas of Maths

Fifteen of the twenty questionnaire respondents agreed or strongly agreed that the iPad is an effective tool in improving numeracy.

4.3 What effect does iPad/tablet use have on a student’s behaviour?

It was recognised early in the academic year that the student at the centre of the case study was a visual learner and learned best when offered visual material accompanied with music. Observations were made of the student operating the class computer. The student was captivated by the computer but any attempts at using the computer for learning were short-lived due to the onset of undesirable behaviour such as hitting, pinching and shouting. Incidents of such behaviour occurred especially when transitioning from the computer to the next activity. The student had difficulty in
recognising and accepting that when computer time was finished, it was time to proceed to the next task.

It was identified that an intervention was necessary to help the student transition from tasks using the iPad to the next task. Before the iPad session, the student was shown their *First-Then* visual schedule to demonstrate that the iPad session would be happening *First*, and that it would *Then* be followed by the next task displayed.

![Figure 4.9: The First-Then Visual Schedule](image)

The desired or positive behaviour of transitioning away from the iPad was reinforced by rewarding the student with a strong reinforcer in the form of a small piece of chocolate.

The student was given a verbal reminder for the next task one minute to the end of the iPad session. The *First-Then* visual schedule was changed to show the next activity. The student was invited to help switch off the iPad to give the student some control in the process. The *First-Then* visual schedule was held up in front of the student. Smooth transition to the next activity was promptly rewarded with the reinforcer.

This intervention was implemented for a two week period, at the end of which the student was able to transition to the next activity without any display of negative behaviour. The student transitioned smoothly using only the one minute reminder to the end of the task and the *First-Then* visual schedule. No further material reinforcement was required as verbal praise was sufficient as a reinforcer for the positive behaviour.
It was reported in the questionnaire that 61% of the students experienced no negative behavioural effect as a result of iPad use. The behaviour of 33% of the students was negatively affected sometimes by iPad use whilst the behaviour of 6% of the students was affected frequently or most of the time.

**Figure 4.10: Frequency of Negative Effect of iPad on Student Behaviour**
It was also reported in the questionnaire that 51% of the students experienced no difficulty in transitioning to the next activity after using the iPad. 33% of the students sometimes had difficulty transitioning whilst 16% usually or always had difficulty with transitioning.

![Pie chart showing frequency of negative effect of iPad on transitioning]

**Figure 4.11: Frequency of Negative of iPad on Transitioning**

### 4.4 What capacity does the iPad/tablet have to enhance the concentration levels of special needs students?

The student was observed using the class computer prior to the iPad study period. The student was skilful and accurate in independently operating the mouse. The student found the desktop icons colourful and attractive and repeatedly tried to click on desktop icons launching other applications. The student had great difficulty at staying on task. The SNA directed the student back to task each time. The student was observed to impulsively click repeatedly on icons on the bottom toolbar of the desktop. The student
was unwilling to go back to the task when verbally encouraged by the SNA and eventually completely refused to return to the task and squeezed and slapped the SNA.

For the purpose of measuring the student’s concentration when using the iPad, the student was observed using the App *Toca House App*, with minimum intervention from the SNA.

Initially, it was observed that the student reacted rapidly by exiting the application once the student found the task difficult or challenging. After a while, the student did not even attempt the tasks but visited and viewed all the levels offered in the App and opened other Apps on the iPad. The student quickly identified the back arrow button and the home button on the iPad as a means to avoid a task and navigate to other iPad applications.

The need for an intervention in order to modify this behaviour was identified. The intervention in the form of Guided Access (a built-in feature of the iPad) would also restrict the student’s ability to leave a task unless completed. Using Guided Access, the home button and the area of the screen where the back arrow was located were disabled.

An investigation was conducted for the purpose of observing the behaviour of the student operating the iPad. In accordance with A-B single study design, two variables were identified in order to conduct the investigation. One variable was designated as the dependent variable, and was identified as the student exiting the assigned task. The second variable was designated as the independent variable, and was identified as the Guided Access feature of the iPad.

In the first three iPad sessions the baseline measure of the student’s natural behaviour pattern was created – *Phase A*. In iPad sessions four to eight, the researcher observed and recorded the behaviour patterns when the Guided Access features of the iPad were activated – *Phase B* of the investigation.
The student made less attempts to exit the activity when the home button and the navigation arrows were disabled. The student was observed to stay on task for longer when the Guided Access features of the iPad were enabled. As the student was unable to proceed to the next activity without completing the preceding activity, the student was observed to stay on task for longer periods.

Ninety per cent of the questionnaire respondents agreed or strongly agreed that their students were able to concentrate for longer with an iPad/tablet than on paper tasks. Eight out of twenty of the respondents admitted to having knowledge of the Guided Access features offered by the iPad. However, only five out of eight of these respondents used the Guided Access feature a moderate amount or a great deal. The remaining three respondents used the Guided Access feature very little or not at all.

**Figure 4.12: AB Single Study Behaviour Investigation**

The student made less attempts to exit the activity when the home button and the navigation arrows were disabled. The student was observed to stay on task for longer when the Guided Access features of the iPad were enabled. As the student was unable to proceed to the next activity without completing the preceding activity, the student was observed to stay on task for longer periods.

Ninety per cent of the questionnaire respondents agreed or strongly agreed that their students were able to concentrate for longer with an iPad/tablet than on paper tasks. Eight out of twenty of the respondents admitted to having knowledge of the Guided Access features offered by the iPad. However, only five out of eight of these respondents used the Guided Access feature a moderate amount or a great deal. The remaining three respondents used the Guided Access feature very little or not at all.
4.5 To what extent does iPad/tablet use affect motivation levels in a student with special educational needs?

The majority of the respondents of the questionnaire agreed or strongly agreed that special needs students are more motivated with the iPad.

![Bar Chart](chart.png)

**Figure 4.13: Effect of iPad use on Motivation of Students with Special Needs**

The secondary school interviewee spoke about the strength of the Pad as a motivator for her students. She understands why the iPad is used as a reward in some situations as students “will do anything” to earn time on the iPad. The interviewee finds that students concentrate for longer periods of time when using the iPad. The interviewee finds that to the contrary, it can be difficult to curtail iPad time as the students can be deep in concentration on a task. The interviewee works with ASD Students and finds that their concentration on the iPad is much greater than table work such as writing on paper or manipulating concrete material.

It was recognised early in the academic year, that the student at the centre of the case study was a visual learner and learned best when offered visual material accompanied with music. These characteristics were features considered in choosing suitable
applications for the study period. It was a priority that the Apps chosen awarded all efforts and attempts at a task. Rewards with emphasis on visual and auditory special effects had the best effect on the student. Rewards, such as those with cheers, applause, animations, music, trumpet fanfare and star bursts were most popular with the student and instilled a sense of achievement. The LetterSchool App in particular, contains a variety of stimuli that are strong motivators for the student. On one occasion, the pulling or drawing effect created when dragging the finger along the trajectory of the letter motivated the student to repeat the task up to eight times until success was achieved. The LetterSchool App rewards the user with different animations on the completion of each task.

All twenty of the teachers surveyed in the questionnaire agreed or strongly agreed that in particular, students who are visual learners benefit from using an iPad/tablet.

The auditory features of the LetterSchool App appealed to the student in the case study. An ascending melody is used when moving in the correct direction and a descending tune indicates when the finger is drawing in the incorrect direction. The completion of each stroke is indicated with an accented sound demonstrating finality.

4.6 Do students with special needs have better communication skills as a result of iPad use?

Half of the teachers surveyed disagreed or strongly disagreed that the iPad does not encourage the use of expressive language - use of speech to communicate.
Figure 4.14: Effect of iPad use on Expressive Language

Over half of the questionnaire respondents agreed or strongly agreed that students interact less with the teacher and SNA when using the iPad. One quarter of those surveyed remained neutral whilst one fifth disagreed.

Figure 4.15: Students interact less with Teacher and SNA when using iPad
In the case study, the student’s frequency of communication was observed when using the *Toca Home* app. The student was unwilling or unable to engage in conversation whilst concentrating on a task.

The primary-level interviewee expressed reservations on the benefits of the development of two-way communication skills using the iPad. The interviewee explained that the vital communication skills of turn-taking in conversation, responding appropriately to facial expression and intonations, could not be addressed by iPad use.

### 4.7 Conclusion

This chapter presents findings from the research carried out. Results reveal an increase in achievement levels in the areas of reading and handwriting due to iPad use. Apple iPad use had little or no effect on the case study student’s numeracy skills, though other teachers surveyed thought that iPad use did have an effect on improving numeracy skills. Following the intervention of Guided Access features of the iPad, the student’s concentration levels increased considerably. Apple iPad use led to increased levels of motivation. It was observed that visual learners in particular benefit from iPad use. In Chapter Five these findings will be discussed in light of current literature as reviewed in Chapter Two.
Chapter Five  Discussion

5.1 Introduction

5.1.1 Overview

The main aim of this study is to investigate the effects of iPad/tablet device use by students with special educational needs, and in particular in the case of a student with Williams Syndrome. The effects of the iPad will be investigated in the following areas; student achievement, behaviour, concentration, motivation and communication.

The study aims to address the following research questions;

- What evidence is there of improvement in student academic achievement that can be attributed to the use of iPads/tablets?
- What effect does iPad/tablet use have on a student’s behaviour?
- What capacity does the iPad/tablet have to enhance the concentration levels of special needs students?
- To what extent does iPad/tablet use affect motivation levels in a student with special educational needs?
- Do students with special needs have better communication skills as a result of iPad use?

A combination of qualitative and quantitative methods such as observations, interviews, a questionnaire, and both formal and informal tests were used to collect findings from the research.

This chapter discusses the findings of the study and relates them to existing knowledge outlined in the literature review in Chapter Two.
5.1.2 Tablet Device Preference

Initially, the intention of this study was to research the effect of tablet devices including the Apple iPad in education. However, it quickly became clear that the Apple iPad is the primary tablet device in use in educational settings. Similarly, the iPad was the tablet of choice of all of the respondents to the research questionnaire. All of the international research studies reviewed in this study involve the Apple iPad device. In fact, at the time of this research there were no studies available involving any other mobile tablet device.

5.1.3 iPad Ownership Models

The iPad device is marketed as a personal lifestyle device and designed for the individual user. The international research studies involve a number of ownership models that differ on their level of personalisation. The most traditional model of use involves a class set of iPads that are used by different student at different times. This is recognised at the least personalised model of iPad use. The University of Hull’s report on the impact of the iPad across schools and homes in Scotland found that the personal ownership of the device was the single most important factor for successful use of the iPad. Possession or ownership of a device enables the user to add particular content and tools to suit the users own specific needs.

The student in the case study had sole access at school to the iPad. More than half of the students in the study questionnaire did not have exclusive access to an iPad. In one case a student used the teacher’s own personal iPad device. It is unclear from this study how the ratio of device to user affects the impact of the iPad on learning outcomes.
5.2 What evidence is there of improvement in student academic achievement that can be attributed to the use of iPads/tablets?

The extent to which a student progressed or achieved learning outcomes was rated highly by all teachers in the study.

According to the respondents in this study questionnaire, *learning in specific subject* areas was the main purpose for using the iPad. This is consistent with the participants of the research study “iPads for Learning – In Their Hands” Victoria, Australia. The Australian study examined the impact of iPad in learning in a range of educational settings including primary, secondary and special schools. The teachers from the special school setting emphasised that student achievement in numeracy and literacy was to be the main focus throughout their particular iPad trial. Similarly, the main learning objectives chosen in the case study involving the student with Williams Syndrome were in the academic areas of numeracy, literacy, including writing.

The international research studies provide limited evidence on the effect of iPad use on achievement in learning outcomes. There is anecdotal evidence in the form of opinions to support increased achievement levels due to the iPad. The research study from Longfield Academy, Kent on the introduction of iPads, reports reserved staff opinions on the effect of the iPad on student achievement. The Longfield study comments on the high percentage of staff that remained ‘neutral’ when questioned on this topic. The report suggests that this indicates a lack of assessment data available to verify or otherwise, any impact of the use of iPads. Despite the lack of assessment data, eight per cent of staff at Longfield Academy reported very strongly that the use of the iPad had a positive impact on achievement.

Similar to the questionnaire distributed as part of this case study, a high proportion (forty per cent) of the respondents to the questionnaire in this study remained neutral when asked if they agreed that student achievement had improved since the introduction of the iPad. A small number of respondents disagreed with the statement. It was noted that these respondents reported having a high device to user ratio; some had a ratio of
one device to six students. A student sharing an iPad with five or six other students would not have as much access to the iPad as a student with a personal device and thus progress would be slower.

It is possible, that in the case of special needs education, the respondents may have had an alternative primary use of the iPad such as communication or rewards. If this was the case, student achievement would not have been the primary objective in using the iPad.

It can be argued, that there are difficulties with attributing achievement to iPad use. It is the nature of education that learning cannot be unlearned thus making it difficult to measure the effectiveness of an intervention such as an iPad.

5.2.1 Literacy

In the case study, the ABLLS-R scores in the skills area of reading doubled when the student was assessed following use of the iPad. It became clear during the iPad study period, that the student used the skill of whole word recognition to read a word rather than sounding out the words phonetically (i.e. sounding each letter sound in c-a-t). The ability to read a word by sight recognition is consistent with the evidence that individuals with Williams Syndrome demonstrate strengths in memory skills (Semel & Rosner 2003). The student has acquired the ability to recognise a word by its specific size and shape and then commits the word to memory. The increase of reading ability was attributed to the use of the First Letters and Phonics, and the First Words Deluxe Apps. The combination of clear verbal and vibrant visual cues presented, helped the student to connect the word to a colourful picture, acting as a support to assist recollection of the word.

Rossi et al (2012) discovered that Williams Syndrome participants responded much better when verbal and visual information was presented simultaneously. The iPad applications chosen for literacy development in the case study facilitated this mode of presentation.
Most of the questionnaire respondents agreed or strongly agreed that the iPad is an effective tool in learning to read.

5.2.2 Numeracy

In the case study, no improvement was found in number skills when assessed with the ABLLS-R tool following the iPad implementation period. A number of reasons are offered to explain this result.

Firstly, numeracy is an area of deficit in all individuals with Williams Syndrome. Contrary to individuals with Down’s syndrome where deficits in numeracy are attributed to developmental delays, in Williams Syndrome weaknesses in number skills are attributed to irregular cognitive processing (Paterson et al 2006). Acquisition of number skills does not follow the typical development pathway.

It is possible that the student was not developmentally ready for numeracy skills acquisition. According to the ABLLS-R guidelines, readiness to learn is an important factor to consider when considering appropriate learning objectives for an IEP.

Whilst vocabulary ability is considered one of the greatest strengths in individuals with Williams Syndrome, this ability does not apply in general to all areas of language. Disparities in the area of language are evident in Williams Syndrome, with strengths in concrete vocabulary ability e.g. naming objects, and severe impairments in language related to spatial concepts (Mervis and John 2008). Deficiencies in spatial concepts can affect the ability to manipulate numbers and recognise how numbers relate to each other. Language associated with spatial concepts is known as relational language and includes such concepts as more or less, and big and small.

Individuals with Williams Syndrome have excellent ability to learn by rote. Whilst Semel & Rosner (2003) suggest that the skill be used as “a focal point in formal learning situations” they acknowledge that the flair for memory skills does not benefit
acquisition of numeracy. Whilst, students with Williams Syndrome can effortlessly count by rote they have greatly impaired knowledge and manipulation of number.

Contrary to the results for the case study participant, three quarters of the questionnaire respondents agreed or strongly agreed that the iPad is an effective tool in improving numeracy.

### 5.2.3 Handwriting

The student’s ABLLS-R scores in the areas of writing and fine motor skills increased significantly following the iPad study period.

It is recognised, that visual spatial construction tasks such as writing and drawing pose great difficulty for individuals with Williams Syndrome. Deficits in visual spatial construction are not just as a result of developmental delays, but due to specific difficulties in the area of visual spatial cognition. Nagai et al (2011)

The main objective in the IEP was that the student be able to write his/her name following the iPad study period. Samples of the student’s tracing efforts and writing were analysed before and after the iPad implementation period. The student’s tracing sample collected after the iPad study period clearly demonstrates less deviation from the trace lines than the pre-iPad sample. Similarly, there was great improvement in the student’s writing without trace lines in the post-iPad study sample. The objective that the student be able to write his/her name was achieved.

A similar study carried out by Conley (2012), investigated the effect of the iPad on students with cognitive impairments. A nineteen year old student with a severe cognitive impairment among other disabilities was found to be able to write her name independently after a period of four weeks as a result of using a handwriting App on the iPad.
5.2.4 Software Applications for Handwriting

Grover (1986) found that children working with software designed with cognitive-development principles achieved better results than those in a control group. The Apps known as LetterSchool and Little Writer–The Tracing App for Kids were used to develop handwriting skills in the iPad study period. Many of the criteria for quality software design as outlined by Cooper (2005) are evident in these applications.

The LetterSchool App relies exclusively on visual information to demonstrate letter form and formation. Every letter or number is presented on screen in its maximum scale to make best use of the large screen size in the iPad. Rossi et al (2012) found that in the case of Williams Syndrome, the auditory processing abilities are inferior in comparison to visual information processing. The visual stimuli in the LetterSchool App are strong and provided excellent motivation for the student to work towards. The starting positions for each stroke are clearly identified. A pulling or drawing effect is created when the finger traces from the correct starting position. Further reinforcement of letter form is provided in the final animation where the eye is drawn to the overall form or shape of the letter.

There is a high level of instructional scaffolding or support present in the writing applications. In the LetterSchool App, there are pulsating graphics to denote starting position or change of direction in trajectory. The App is lenient with mistakes and allows for many attempts at a task. Following three attempts at a task, flashing guide arrows appear to show the user the correct direction. Shute and Miksad (1997) found that software with substantial scaffolding features increased cognitive abilities significantly more than software with basic scaffolding.

In tracing tests carried out by Nagai et al (2011), deficits in visual spatial working and scanning abilities were identified as the cause of drawing disabilities in individuals with Williams Syndrome. Nagai found that longer fading time did not result in improved performance in the case of Williams Syndrome participants.
Nagai’s tracing test was somewhat different to the tracing activity offered by the LetterSchool application. The fading time in Nagai’s test was varied and timed at 0.5sec, 2sec, 5 sec and the figures faded in random order. The random order of the fading figures is in direct contrast to the sequential learning approach offered in the LetterSchool application where each step assists the learner to achieve his/her next goal.

In Nagai’s tracing test, the users were presented with black drawings on a white background. This is in contrast to iPad application LetterSchool, where the letters were presented in a variety of colours and backgrounds.

Nakamura et al (2007), found visual spatial deficits in participants with Williams Syndrome and suggests that the deficits explain the difficulties found in the area of writing. However, they concluded that the participants’ ability to distinguish colours was not affected by Williams Syndrome. They suggested that this ability may help compensate for their visual spatial difficulties.

It is possible, that the vibrant colours and repeated reinforcement of letter form present in the iPad application LetterSchool help compensate for the visual spatial difficulties experienced by Williams Syndrome individuals and result in improved handwriting skills.

LetterSchool software developers claim “that verbal instruction would be counterproductive, as they place an extra load on the working memory.” Whilst there is an absence of verbal instruction, there is effective auditory feedback provided to the user. Completion of letter stroke is clearly indicated with an accented audio effect. Tracing in the correct direction is rewarded with an ascending melody and a descending melody is used when the finger is tracing in the wrong direction. The use of audial prompts and audial rewards has a strong appeal to the innate musicality present in individuals with Williams Syndrome.
5.3 What effect does iPad/tablet use have on a student’s behaviour?

The student in the case study displayed difficulties in transitioning from the iPad to the next activity. It was noted however that the student also had difficulty in transitioning in other areas of the curriculum. Poor adaptability is recognised as a feature of Williams Syndrome. An intervention was implemented to encourage smooth transition for a two week period at the end of which the student was able to transition from the iPad to the next activity without any display of negative behaviour. The student transitioned smoothly using only the one minute reminder to end of task and a First-Then visual schedule.

Half of the students referred to in the study questionnaire also had difficulty in transitioning to the next activity following use of the iPad. It is unclear however, if the iPad was responsible for these difficulties in transitioning or if the students also had difficulty in transitioning in other areas of the curriculum.

5.4 What capacity does the iPad/tablet have to enhance the concentration levels of special needs students?

Special Needs Education encompasses a diverse range of needs. “Each child has individual strengths, personality and experiences so particular disabilities will impact differently on individual children” (NCSE 2011). Impulsivity, distractibility and attention problems are recognised difficulties of individuals with Williams Syndrome. The student in the case study was observed using the class computer prior to the iPad study period. The student was unable to stay on task for any functional length of time. The student was easily distracted by the colourful icons on the desktop and impulsively clicked on icons at random launching non relevant applications.

Similar impulsive distractible behaviour was observed when the iPad was first introduced to the student. Without some urgent intervention it was obvious that meaningful learning was not possible. The Guided Access feature of the iPad was
identified as an appropriate intervention to prevent the student leaving applications and to enable the student to stay on task.

When Guided Access was activated, the home button and the area of the screen where the back arrow was located were disabled. The student was observed to make fewer attempts to exit the activity. In addition, the student was unable to proceed to the next task without completing the activity. As a result of the Guided Access, the student remained on task for longer periods of time.

A high proportion of the questionnaire respondents agreed that their students can concentrate for longer when using the iPad than when working on paper tasks. The use of the Guided Access feature was not as popular amongst the teachers who responded to the questionnaire in the study. However, less than half of the teachers admitted to having knowledge of the Guided Access features offered by the iPad. Although the iPad is recognised for its ease of use (Heinrich 2012) and intuitiveness, these results suggest that some form of technology training is necessary to learn about the features of the iPad in order to experience the full potential of the device.

Conley (2012) found a reduction in undesired behaviours as a result of iPad use, in the case of a student with severe cognitive impairments. According to Conley, iPad use resulted in a reduction in frequency of the need to redirect or to refocus attention and it also increased attention span. Conley noted, that in the case of one particular student:

> Her attention and focus on the tracing application proved how powerful of a tool the iPad can actually be because direct instruction for this student could be impossible at times.

(Conley 2012, pp. 3987)

This research has indicated that the iPad greatly assists in lengthening the attention span of children with difficulties in concentration.
5.5 To what extent does iPad/tablet use affect motivation levels in a student with special educational needs?

In selecting Apps for the case study, one of the criteria for selection of Apps was the quality of feedback provided by the software. Semel and Rosner (2003), with the help of the laboratory of cognitive neuroscience in Salk Institute USA, compiled research obtained from three hundred individuals with Williams Syndrome. They found that individuals with Williams Syndrome have difficulty in maintaining motivation due to uncertainty about adequacy of performance. They claimed that students with Williams Syndrome “benefit from feedback that is immediate, informative, and constructive whenever possible” (Semel and Rosner 2003, p.232).

Rewards with emphasis on visual and auditory special effects had best effect on the student in the case study. Rewards such as those with cheers, applause, animations, music, trumpet fanfare and star bursts were most popular and instilled a sense of achievement. The LetterSchool App in particular, contained a variety of visual and aural stimuli that were strong motivators for the student. Every successfully written letter or number is rewarded with a star in the menu screen. On one particular occasion, the pulling effect created when dragging the finger along the trajectory of the letter motivated the student to repeat the task up to eight times until success was achieved. The LetterSchool App allowed an infinite number of attempts at a task and rewarded all efforts and attempts.

Reinforcement, in the form of rewarding desired behaviour, is a teaching strategy frequently used by teachers to motivate students with special educational needs. In the case of the Williams Syndrome student, rewards for tasks had to be changed more frequently than for typically developing students. What might be recognised as a reward one day by the Williams Syndrome student might not be viewed as a reward the next. The student was strongly attracted to new or novel rewards.

The Little Writer App allowed the user to create personal rewards. There was a facility to record verbal reinforcement and the facility to insert a personal picture or photograph.
In the case study, the student was highly motivated when achieving a particular reward that had been personalised specifically to suit the student. The reward was in the form of a photograph of the student in a victorious pose that appeared on task completion. Semel & Rosner (2003) recommend the use of personalised rewards as essential to effective teaching of students with Williams Syndrome.

The majority of the teachers who responded to the questionnaire agreed or strongly agreed that special needs students are more motivated when using an iPad. When questioned about uses of the iPad, creating custom-made resources (such as customising rewards to suit an individual student), with was identified as one of the least popular uses of the iPad in special needs education. It is unclear from the survey, if this is indicative of a lack of teacher training in iPad use which would encourage using the iPad to its full potential, including learning how to create personalised resources. The fact that not all special needs students in the questionnaire had access to their own device would restrict the extent of customising resources on the iPad. Customised resources including personal photographs or an individual’s preferences to sounds or rewards would be particular to one individual student and be unsuitable for other students using the same device.

Results from the study questionnaire identified that one of the most popular objectives of the iPad in special needs education was to use the iPad as a reward. The second-level interviewee highlighted the strength of the iPad as that of a motivator in the case of students with autism. She acknowledged and fully understood why the iPad itself is used as a reward in some situations as students “will do anything” to earn time on the iPad.

5.6 Do students with special needs have better communication skills as a result of iPad use?

Students with difficulties in communicating can use specific communication applications on the iPad to achieve their communication goals. The importance of the
role of the iPad in assisting students with communication needs was recognised by the Victorian Government Australia (2011), in its study on the impact of the iPad in learning in a range of educational settings.

In the case study, the student’s frequency of communication using language was observed when using the Toca Home app. The student was unwilling or unable to engage in conversation whilst concentrating on a task. The primary level interviewee expressed reservations on the benefits of the development of two way communication skills using the iPad. The interviewee maintained that the vital communication skills of turn-taking in conversation, responding appropriately to facial expression and intonations, could not be addressed by iPad use.

5.7 Conclusion
This chapter has discussed the findings of this study in light of the literature reviewed in Chapter Two. Chapter Six will conclude this thesis by summarising the outcomes of the investigation and identifying areas for future research.
Chapter Six  Conclusion

6.1 Introduction

The purpose of this study was to investigate the effect of iPad use in special needs education, and in particular, in the case of a student with Williams Syndrome. A profile was established of a six year old student with Williams Syndrome to assist in the identification of objectives for the student’s Individual Education Plan. The objectives in the IEP guided the focus and selection of appropriate iPad applications for the period of study. Over a period of nine weeks, the student was observed using an Apple iPad device on a daily basis. In addition, an online questionnaire was distributed to teachers of students with SEN using iPads or other tablet computers. A combination of qualitative and quantitative methods such as observations, interviews, and both formal and informal tests were used to collect findings from the case study research.

This chapter summarises the research outcomes, makes some recommendations and presents suggestions for future research.

The effects of the iPad were investigated in the following areas; student achievement, behaviour, concentration, motivation and communication.

6.2 Research Outcomes

The Apple iPad was found to be the only tablet device in use in special educational settings involved in this study. Almost half of the students referred to in the study questionnaire were categorised as having Autism Spectrum Disorder. The students had sole access to an iPad in less than half of the survey responses. Learning in specific subject areas was identified as the primary use of the iPad in special needs education. Other popular uses were communication, daily routines/timetabling and rewards. The results obtained from this study indicate that
teachers are very positive about the benefits of SEN students using the iPad to access the school curriculum.

The study findings indicate that:

- The iPad is an effective learning tool for special needs students in learning to read. The student with Williams Syndrome in the case study made significant progress in literacy skill development as a result of iPad use.

- The iPad offers many opportunities for creating personalised learning opportunities that strongly motivate students with Williams Syndrome. Rewards with emphasis on visual and auditory stimuli had best effect on the student in the case study.

- The iPad facilitates the presentation of visual learning opportunities. This particularly suits students with strengths in visual information processing including students with Williams Syndrome.

- No improvement was found in numeracy as a result of iPad use in the case of the student with Williams Syndrome. However, this was attributed to an innate deficit in the area of numeracy in individuals with Williams Syndrome. It was also uncertain if the student was developmentally ready for numeracy skills acquisition. Contrary to the results for the case study participant, most of the questionnaire respondents found the iPad to be an effective tool in improving numeracy.

- Activation of the Guided Access feature of the iPad was effective in enabling the student with Williams Syndrome to stay on task and concentrate for longer periods.

- Teacher training in using the iPad is necessary as not all teachers surveyed were aware of the in-built features of the iPad such as Guided Access.
The use of handwriting applications on the iPad resulted in significant improvements in handwriting in the case of a student with Williams Syndrome.

6.3 Recommendations

The research studies contain strong evidence in support of the iPad as a valuable educational tool. However, the role of the teacher is crucial to the successful use of iPad technology in the classroom. It was apparent from the survey that teachers would benefit from professional development in the form of iPad training. Teachers would learn how to use the iPad device to its full potential and effectively use the iPad device to enhance teaching methodologies.

It would be recommended that teachers have access to a personal iPad so as to have frequent opportunity to explore the iPad. In this way teachers would become familiar with the iPad, with all its features and be confident in its use.

Successful use of the iPad as a learning tool is dependent on the use of developmentally appropriate software material. It is recommended, that the use of a rubric or checklist would help to identify and evaluate appropriate software applications.

Special Needs Education encompasses a diverse range of needs. The use of customised resources in teaching students with special educational needs supports the need to move away from the traditional model of the sharing of devices evident in special needs classrooms. Allocating one device per student would enable the student to access the full potential of the iPad as a personal learning device.

One of the optimum uses of the iPad as a technology tool in special needs education is in individualising and personalising the device to suit the unique needs (strengths and weaknesses) of a particular student.
6.4 Future Research in this Area

The iPad or tablet device is the most recent form of assistive technology to be introduced in the area of special needs education. Much of the international research available has been conducted in mainstream education. There is limited international research available on iPad use in the area of special education. Future research could examine the use of iPad devices in special needs education in the Irish context and in particular in the case of students with cognitive impairments. If the results of such studies continued to be positive, then wider implementation and increased access to iPad devices in special educational settings could be considered.

It would be interesting to see further research into the different models of iPad use. The most popular model evident in this study was the shared device model. The sole access to device was also present in the study. Such research would provide evidence to support the optimum use of the iPad device as a learning tool.

The student in the case study benefited from iPad use in the areas of reading and writing. The case study was limited to one student with Williams Syndrome. It would be beneficial to research other students with Williams Syndrome to determine if they would react and engage with the iPad in the same way as this student. The iPad study was carried out over a short period of time. It would be beneficial to observe the student in the case study over a longer period of time to observe the long-term effects of iPad use in learning.

The international research studies provide strong evidence in the support of the iPad as a valuable educational tool. However, the impact of iPad use in fostering deep meaningful learning in the long term remains to be seen.

6.5 Conclusion

Whilst this research acknowledges that the iPad was not solely designed with education purposes in mind, careful selection of developmentally appropriate software applications to match curriculum requirements leads to the astute implementation of the
iPad/tablet device as a learning tool. In particular, the iPad is a worthwhile tool to be considered in personalising learning situations such as those found in the area of special educational needs.
Bibliography


<table>
<thead>
<tr>
<th>Task</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tracing of individual letters in name on paper</td>
<td>s -</td>
</tr>
<tr>
<td></td>
<td>a –</td>
</tr>
<tr>
<td></td>
<td>l –</td>
</tr>
<tr>
<td></td>
<td>y -</td>
</tr>
<tr>
<td>2. Writing of individual letters in name on paper</td>
<td>s -</td>
</tr>
<tr>
<td></td>
<td>a –</td>
</tr>
<tr>
<td></td>
<td>l –</td>
</tr>
<tr>
<td></td>
<td>y -</td>
</tr>
<tr>
<td>3. Tracing whole name on paper</td>
<td></td>
</tr>
<tr>
<td>4. Writing whole name on paper</td>
<td></td>
</tr>
</tbody>
</table>

**Field Notes:**
## Appendix B: *LetterSchool* App Observation Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Letter/Number</th>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>14/1</td>
<td>S</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Success after 5 attempts</td>
</tr>
<tr>
<td>5</td>
<td>a</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Success after 6 attempts. SNA assisted as student was getting frustrated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Straight lines are easier for student</td>
</tr>
<tr>
<td>1</td>
<td>y</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Helpful hint provided on where to start 2\textsuperscript{nd} part of ‘y’</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>After 6 attempts</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Curves difficult</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Started to slap screen in frustration when no success. Hand-over-hand assistance necessary.</td>
</tr>
</tbody>
</table>
Appendix C: Student Individual Education Plan (IEP)

Handwriting Targets

1. The student will learn correct letter formation of the letters in her name using the LetterSchool application on the iPad.
2. The student will be able to trace and write the letters of her name using the iPad.
3. The student will be able to trace her name accurately using pencil and paper.
4. The student will be able to write her name accurately and independently with pencil and paper without guide lines.

Literacy Targets

1. The student will be able to identify and label all 26 upper & lower case letters.
2. Student will be able to identify the sounds of at least 20 letters.
3. Student will be able to match at least 2 words with corresponding pictures.
4. The student will be able to point to and name the letters of three letter words with only one prompt per word.
5. The student will be able to match letters of words of up to 3 letters in length when not given extra letters.
6. The student will be able to read at least 5 simple words.
7. The student will be able to sound-out any consonant-vowel-consonant words using known phonemes.

Numeracy Targets

1. The student will be able to count the number of given items up to 5.
2. The student will be able to count an amount of items up to 5 from a larger set of items.
3. The student will be able to match numbers up to 5 with the same amount of items and vice versa.
Appendix D:  Questionnaire on iPad/tablet Device Use by Students with SEN
## Questionnaire on iPad/Tablet device use by students with SEN

### What is the ratio of availability of iPads/tablets to students in your setting?

- [ ] 1:1
- [ ] 1:2
- [ ] 1:3
- [ ] 1:4
- [ ] 1:5

Other (please specify)

---

### The iPad/tablet is used for the following purposes.
You can respond to the question with regard to one, two or three students.

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Student 1</th>
<th>Student 2</th>
<th>Student 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily routines or timetabling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creating custom build resources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.g. flashcards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rewards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entertainment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning in specific subject</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Others (please specify)
Questionnaire on iPad/Tablet device use by students with SEN

Section 2 - Effect of iPad/Tablet on Students

Please indicate how much you disagree or agree with each of the following statements based on your personal opinion/experience.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students are more motivated with use of an iPad/tablet than without.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iPad/tablet use enhances hand-eye coordination skills.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iPad/tablet gestures such as pinching, touch-dragging and sliding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>enhance fine motor skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students can concentrate for longer with an iPad/tablet than on paper tasks.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students are less engaged on paper tasks as a result of iPad/tablet use.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students who are visual learners in particular benefit from using an iPad/tablet.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student achievement seems to have risen since introduction of an iPad/tablet.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The iPad/tablet is an effective tool in improving literacy.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The iPad/tablet is an effective tool in improving numeracy.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iPad/tablet does not encourage use of expressive language.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students interact less than usual with the teacher or SNA when they are using an iPad/tablet.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comment:

---

How often has iPad/tablet use had a negative effect on student behaviour? You can respond to the question with regards to one, two or three students.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Student 1</th>
<th>Student 2</th>
<th>Student 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequently</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usually/Always</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comment:
### Questionnaire on iPad/ Tablet device use by students with SEN

How often do the students have difficulty moving on to next activity after using the iPad/tablet? You can respond to the question with regards to one, two or three students.

<table>
<thead>
<tr>
<th></th>
<th>Student 1</th>
<th>Student 2</th>
<th>Student 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequently</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usually/Always</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other (please specify):

---

Page 4
Questionnaire on iPad/Tablet device use by students with SEN

Section 3 - Apps

What category of apps do your students use on the iPad? (tick all that apply)

- Subject specific e.g. phonics
- Scheduling
- Gaming
- Life skills
- Entertainment
- Social Stories
- Social media
- Other category

How difficult do you find it to identify good quality Apps?

- Extremely difficult
- Very difficult
- Moderately difficult
- Slightly difficult
- Not at all difficult

Which of the following methods do you use to select and critically evaluate Apps?

- Ask a colleague
- Special Needs related website review & rating
- iTunes review & rating
- Trial the free version
- Use an evaluation checklist or rubric

Other (please specify)
Questionnaire on iPad/Tablet device use by students with SEN

Please indicate how much you disagree or agree with each of the following statements based on your personal opinion/experience.

- Researching and evaluating Apps takes time
- When using free Apps I find advertising intrusive.
- Free Apps or Lite versions are useful for trying out a new App.
- My students mainly use free Apps.

Comment:

[Box for comments]
Section 4 - iPad/Tablet Interface

How easy do your students find the iPad/tablet as a device to use?

- [ ] Extremely easy
- [ ] Very easy
- [ ] Moderately easy
- [ ] Slightly easy
- [ ] Not at all easy

Other (please specify)

Students find the touchscreen technology easier to use than other technologies such as the mouse or mouse pad (as on a laptop).

- [ ] Strongly disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree

Other (please specify)

Approximately how long do the students use the iPad in one sitting?

- [ ] < 5 mins
- [ ] 5-10 mins
- [ ] 10-15 mins
- [ ] > 15 mins
- [ ] It varies

Comment


Questionnaire on iPad/ Tablet device use by students with SEN

Approximately how often do the students use the iPad?

☐ Less than once a day
☐ Once a day
☐ Twice a day
☐ Three times or more a day
☐ It varies from day to day

Comment

Has the iPad/tablet been used by the students outside of the classroom setting? e.g. on a field trip

☐ Yes
☐ No

Comment

Which of the following inbuilt features of the iPad/tablet have your students used?

☐ Internet
☐ Camera
☐ Video
☐ Audio recorder
☐ Voice Over
☐ Zoom
☐ Black on White (invent colours)
☐ Siri
☐ FaceTime
☐ Message
☐ Braille Displays
☐ Large Text
☐ Closed Captioning

Other (please specify)


Questionnaire on iPad/Tablet device use by students with SEN

Section 5 - Guided Access

The following section deals with Guided Access features associated with the iPad. Please select the 'Done' button at the bottom of the page to submit your responses to this survey.

Are you aware of the Guided Access features of the iPad. (e.g. ability to limit access to one app by disabling the home button; ability to disable certain areas of the screen)

☐ Yes
☐ No

Comment

If you have an iPad with Guided Access features, how often do you use them to restrict access to certain activities when using the iPad?

☐ A great deal
☐ A lot
☐ A moderate amount
☐ A little
☐ Not at all
☐ Not applicable

If you are using an iPad with Guided Access which of the following features have you used?
(Skip this question if you are not using Guided Access features.)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Student 1</th>
<th>Student 2</th>
<th>Student 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>restrict access to a single app</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>disable certain areas of the screen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>disable hardware buttons</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>disable all screen touches</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>disable auto-rotate feature of the screen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>restrict access to purchasing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>restrict access to deleting apps</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other

Comment
### Appendix E: Toca Boca House Observation Schedule

<table>
<thead>
<tr>
<th>App Name:</th>
<th>Toca Boca House</th>
<th>Developer Name:</th>
<th>Toca Boca</th>
</tr>
</thead>
</table>

#### Learning Objectives:
- to introduce the iPad in a fun attractive interesting way
- to encourage conversation on the theme of “house”
- to develop an awareness of the types of everyday tasks carried out in the house

#### Comments on App suitability, App intuitiveness, Interventions necessary

Colourful graphics, music easy to listen to, low level of distractions on screen. just one back arrow. Stars sparkling around character punching the air with a yippee for completion of tasks. Scroll up or down for next level view. No vocabulary or voices in app only for yippee in reward.

Orientation locked on this app.

*Interventions necessary:* interventions identified at first time with App – record frequency or pressing of back button to leave app and pressing of back arrow to get out of a level before completion.

#### Field Observations

**Date:** 16_04

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressing Home Button</td>
<td>9</td>
</tr>
<tr>
<td>Pressing Back Arrow</td>
<td>10</td>
</tr>
</tbody>
</table>

#### Behaviours observed

**Setting:** Classroom workstation. Wearing earphones to hear App background music.

**Observer:** Deirdre.

**Guidance level:** No/low intervention by J. Second time for S on this app

Putting clothes in the washing machine task – completed 10 items(total) in activity and recognised that she had to press button to turn on machine to finish. Remembered this from 1st time where she was shown this. Observed reward stars character punching air and seemed to enjoy this.

Washing plates activity. Dropped plates and smashing sound three times and then S gave up and pressed back arrow to leave task.
Sorting rubbish (baubles) task not sure what to do so back arrow

Posting letters into matching coloured post box. Completed 10 parts of activity. One letter took 5 attempts but S was determined to get it right.
Kitchen scene with ironing board…attempts to hit iron but no success so scrolls onto next part of house or scene

Moves logs onto fireplace and lights with match. Task completed

5 mins
Hanging picture activity…has correct figure movement but picture doesn’t hang 4 attempts to hang first picture then back arrow
Hovering activity – good but doesn’t wait to complete task – back arrow
Mopping activity – good but doesn’t wait to complete task – back arrow

6 mins
Presses home button. Gets out of app and attempts to get into other apps
First verbal prompt from J. “Just Toca House”. J Took control of iPad momentarily to exit app and get Toca Boca House open again. The easy grip handles on the iPad case enables easy ‘taking control’ of the iPad.

Back in game for 20 secs: Presses home button. Gets out of app and attempts to get into other apps – Safari. Verbal prompt from J. “Toca House” and took control of iPad momentarily to exit app and get Toca Boca House open again.

Presses home button. Gets out of app and attempts to get into other apps.
Verbal prompt. J Took control of iPad momentarily to exit app and get Toca Boca House open.

7 mins
Continues with game.
Hanging clothes activity. One attempt fails. Back arrow
Bathroom bubbles. Enjoys this rubbing away bubbles,( new activity) back arrow
In again, back arrow


10 Mins
J Took control of iPad momentarily to exit app and get Toca Boca House open. Presses home
J took control of iPad momentarily to exit app and get Toca Boca House open. Presses home button. Verbal prompt “Just Toca House”

S likes this game. Clear visual display when task is completed will encourage S to see activities through to completion.

Next time – disable home button with iPad guided access facility to “lock into the app” and remove any other distractions.

disable back arrow to encourage task completion.

Future test – disable music to see it encourages conversation during task
Appendix F: Letter Requesting Permission from Board of Management

12th December 2012

Dear Chairperson,

I am doing a masters course in the University of Limerick in Digital Media Development for Education. As part of my course I wish to conduct research and investigate the effectiveness of the iPad in assisting a child with special educational needs to access the curriculum.

The child will be observed whilst using the iPad and short assessments will be carried out before and after the research period.

I would like to request your written consent to carry out this work. Consent will also be obtained from the parents of the particular child at the centre of the study.

Anonymity and confidentiality will be maintained throughout the study. You can withdraw your consent at any time.

I look forward to receiving your written consent.

Yours sincerely,

__________________
Deirdre Kelliher
Appendix G: Letter Requesting Permission from Parents

Dear Parents,

I am doing a masters course in the University of Limerick and as part of the course I will be conducting research in the area of Digital Media Development for Education.

The main aim of the research is to investigate the effectiveness of the iPad in assisting your child to access the curriculum. Your child will be observed whilst using the iPad and short assessments will be carried out before and after the research period.

Anonymity and confidentiality will be maintained throughout the study. You can withdraw your consent at any time.

I would be grateful if you would complete the following consent form.

Yours sincerely,

Deirdre Kelliher

-------------------------------------------------------------

Do you give permission for your child to take part in the study?

Yes □

No □

Signed ______________________________________