The experiences of university students diagnosed with dyslexia as they use assistive learning technologies for their studies



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Abstract

This study investigates ways in which assistive learning technologies shape the learning experiences of university students diagnosed with dyslexia. The research investigates the experiences of students from various backgrounds, studying different subjects, within numerous contexts at two institutions (a modern and traditional university). The study closely examines how these students use assistive learning technologies to support their studies as well as the wider influential strategies used in different institutional environments.

The research took an in-depth qualitative approach to examining academic and disability coordinators views and practices and students' experiences through semi-structured interviews. In addition to the interviews, students were asked to record their daily use of technologies and to talk through their processes of using assistive learning technologies when completing an assignment. The research involved 10 university staff and 41 dyslexic undergraduate and postgraduate students.

The findings of the research showed that the majority of students, once they had developed confidence in the use of assistive learning technologies, were able to use them in order to enhance and adapt their learning to create a personalised and accessible university experience. The findings also indicated that students' backgrounds, such as school and family, can influence their adoption of assistive learning technologies and coping strategies, but are also governed by their inner-capacity of being motivated and determined to succeed. The role of the Disabled Students' Allowance (DSA) and the university were instrumental in providing support and provisions that included funding for a diagnosis, face-to-face tuition and assistive learning technologies. Additionally, students regular contact time with tutors was identified as being beneficial in both accommodating their needs and providing extra support. With the integration of assistive learning technologies, the findings identified that students less experienced in the writing process and with a greater cognitive weakness followed a more structured scaffold approach. Finally, through the adoption of multi-modal methods of enablement and engagement with assistive learning technologies, students were able to reduce working memory stress and increase their independence of learning.

For my wonderful parents, Patricia and Barry, who never gave up on teaching me to read and encouraging me to overcome my dyslexia with the use of technologies. I am forever grateful.

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List of Abbreviations

ADHD	Attention Deficit Hyperactivity Disorder
AFC	Adaptive Firmware Card
ALF	Access to Learning Fund
APA	American Psychological Association
BDA	British Dyslexia Association
BECTA	British Educational Communications and Technology Agency
CAI	Computer Assisted Instruction
CUREC	Central University Research Ethics Committee
DAST	Dyslexia Adult Screening Test
DCD	Developmental Coordination Disorder
DES	Department of Education and Science
DfE	Department for Education
DfEE	Department for Education and Employment
DfES	Department for Education and Skills
DIUS	Department for Innovation, Universities and Skills
DRC	Disability Rights Commission
DSA	Disabled Students' Allowance
DSM	Diagnostic and Statistical Manual
DST	Dyslexia Screen Test
DTA	Dyslexic Teachers' Association
EU	European Union
FAST	Foundation for Assistive Technology
HEFCE	Higher Education Funding Council England
HEFCW	Higher Education Funding Council for Wales
HESA	Higher Education Statistics Agency
HMSO	Her Majesty's Stationary Office
ICT	Information Communication Technology
IDA	International Dyslexia Association
IDEA	Individuals with Disabilities Education Act
IQ	Intelligence Quotient

ISC	Independent Schools Council
LADS	Lucid Adults Dyslexia Screening
LD	Learning Disability
LEA	Local Education Authorities
LMS	Learning Management System
MPT	Matching Person and Technology
NFAC	National Federation of Access Centres
NHS	National Health Service
NNAC	National Network of Assessment Centres
OCD	Obsessive Compulsive Disorder
OCR	Optical Character Recognition
PDF	Portable Document Format
PPD	Phonological Processing Deficit
QAA	Quality Assurance Agency
RAN	Rapid Automatised Naming
RNIB	Royal National Institute for the Blind
SEN	Special Educational Needs
SENDA	Special Educational Needs and Disability Act
SENNAC	Special Educational Needs National Advisory Council
SpLD	Specific Learning Difficulty
SpLDs	Specific Learning Difficulties
UCAS	Universities and Colleges Admissions Service
UPIAS	Physically Impaired Against Segregation
VLE	Virtual Learning Environment
WAIS-IV	Wechsler Adult Intelligence Scale-Fourth Edition
WATI	Wisconsin Assistive Technology Initiative
WHO	World Health Organisation
WISC-R	Wechsler Intelligence Scale for Children-Revised
WRIT	Wide Range Intelligence Test

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Chapter 1: Introduction

1.1. Background to the Study

From 2000 to 2010, higher education institutions have embraced the use of learning technologies to support and engage learners both online and face-to-face. The expansion of digital learning has coincided with disability legislation, financial support and the broader disabled community becoming socially aware of support and provisions in the higher education sector. The present study investigates university students diagnosed with dyslexia and the extent and ways in which assistive learning technologies are used for their studies. It will explore how students from diverse backgrounds experience studying different subjects within two distinct UK universities – one traditional university (Redwood University) and one modern university (Owen University). The study will examine the students' experiences utilising assistive learning technologies and will look at how each institution enables and supports the use of these technologies.

One of my roles as an educational developer in the professional field of learning technology and higher education is to provide support, training and leadership in the use of assistive and online learning. My own experiences from working with students and academic staff have influenced my research investigation on understanding the academic and institutional discussions on technologies and learning strategies. In addition to my professional role, my personal experiences as a student with dyslexia and grant receiver of the Disabled Students' Allowance (DSA) have allowed me to identify and discuss issues

around my proposal for investigating the technology experiences of students diagnosed with dyslexia.

Through my personal and professional experiences, I have identified three perspectives that informed my research questions and influenced this study: (i) the range of support and provisions provided by institutions; (ii) my own working relationships with students identified with learning difficulties; and (iii) the appropriate selection of assistive learning technologies within different contexts and environments.

My first perspective was gained working within and studying at several universities from 2007. This experience has allowed me to identify very different supports and provisions available to students across institutions. Despite the availability of technology and support, there are many other factors that affect students' uptake of the wide range of support and provisions available. Often, the support and facilities provided are greatly influenced by the institution's understanding of research, teaching and delivery of academic content and, most importantly, the institution's financial resources. Additionally, students may not fully understand the implications of their learning conditions while being at university, and in some cases, they may attempt to access support halfway through the term because they are unaware of the supports on offer. A research study by Goode (2007) gave insight into students' experiences of the support and difficulties of an inclusive learning environment at university. It highlighted the difficulties of transitioning into higher education and understanding the processes for disclosure of disability – including to whom those disclosures should be made in order to ensure the activation of appropriate support (Goode, 2007). From exploring qualitative experiences of the support and provisions made available to students at university, I could identify whether the implementation of assistive learning technologies was influencing the learning experiences of students with dyslexia.

My personal perspective as a student with dyslexia has helped focus the research on the very different types of students attending each university and has helped me to forge strong working relationships with university disability offices and with other students identified with dyslexia and Specific Learning Difficulties (SpLDs). These working relationships have enabled me to develop my understanding of the issues around identifying dyslexia and using technologies to provide appropriate support. The issues are complex and multifaceted. For example, the majority of students with dyslexia studying at some universities have come from the state education system and were not formally identified with a learning disability until their first or second year of university. Indeed, universities play an essential role in identifying students with dyslexia, with an estimated 57 per cent of students identified for the first time upon entry to university (Singleton *et al*., 1999). Some students may have been informally identified with such difficulties when they were at primary school, but this may not have been a diagnostic assessment due to funding issues or current education policy. Moreover, the support or provision they may have had access to would not necessarily have followed them to secondary education. This would have been influenced by disability legislation at the time, financial restrictions and/or their family, community or school's understanding of supporting students with learning disabilities. Nonetheless, these experiences influence students' progression into higher education and direct their understanding of how to manage their difficulties with technologies and study skills.

The third and final perspective that has informed the study's focus arises from the knowledge gained from my experiences using technologies to aid my own dyslexia-related problems and my experiences advising students on the selection and use of technology for their own studies. There is little evidence to indicate whether a student's background, such as their previous educational experiences and family support, can affect

how they use assistive and learning technologies. These factors play a part in the student's experience and the process of using assistive learning technologies to support learning. A qualitative research study by Price (2006) discovered that the key to successful use of technologies and software is its flexibility of use and the ability to individualise features to the students' cognitive profile with the demands of their course. However, students using assistive learning technologies need not only direct their strategies but also understand the process and technical side of adapting their learning to their cognitive profile.

In my own professional experience, when advising students with dyslexia on the appropriate use of software or hardware, I would ask them to describe their cognitive processes for completing a standard assignment or task. Once outlined, the aim would be to match their cognitive processes with more effective technological scaffolds that would support their learning with planning, drafting, editing or note-taking. These technological scaffolds proved to be an important element in this study, particularly in the variations of students across the two sample universities. A research study by Mortimore and Crozier (2006), conducted at old and new universities examining dyslexia and difficulties with study skills in higher education, identified that students from new universities reported more difficulties in articulating ideas in writing, concentration, spelling and note-taking. However, Mortimore and Crozier (2006) suggest that this may be due to the differences in subjects of degree programmes at the two universities, with new institutions recruiting more students from non-traditional entrance routes who may have had more difficulties with study skills. Thus, there are continued efforts to streamline and improve the support and provisions offered to the disabled community in higher education. It is thus timely that the present study seeks to investigate the current support and provisions provided so

that its findings might be of value in helping institutions understand the broader influence assistive learning technologies can have on an individuals' ability to learn.

1.2. Research Focus

Since the introduction of disability discrimination legislation in the United Kingdom (UK), higher education institutions have been required by law to accommodate and support all students with disabilities. Since 2002, the number of disabled students in higher education has increased, and institutions have thus had to rediscover the policy of providing equality using Information Communication Technologies (ICT), online learning environments and face-to-face support.

Today, the British Dyslexia Association (BDA, 2012) states that the frequency of dyslexia across the general population is approximately 10 per cent, with 4 per cent of these affected severely. Across the landscape of higher education, the most significant proportion of disabled students is represented by dyslexics. There are many reasons for this: the implementation of government widening policies, increased social awareness and the earlier identification of dyslexia-related disorders at school. The number of students in higher education diagnosed with dyslexia (or SpLDs) has risen from 0.74 per cent in 1996 to 5.6 per cent in 2016 (Dearing, 1997; HESA, 2016; Lockley, 2001). This increase may be attributed to the proliferation of diagnostic testing, legislation in educational institutions and greater awareness of dyslexia across the wider population.

The rise in higher education students diagnosed with dyslexia has coincided with growth in the development of assistive learning technologies, financial support for disabled students through the DSA and the broader higher education culture of implementing technology to enhance learning (Price, 2006). The combined advancement of learning technology and disabled student grants has expanded the growth of adaptive

and assistive learning technologies. Despite considerable improvements in areas of disability legislation and technology, very little research has explored the broader context of assistive learning technologies and in-depth learning experiences of students.

Since 2000, researchers have investigated how e-learning environments and accessibility can improve the study experience of students with dyslexia and other disabilities (e.g., Cooper, Colwell, and Jeffs, 2007; Phipps and Kelly, 2006; Seale, Draffan, and Wald, 2008; Sloan, Stratford, and Gregor, 2006; Woodfine, Nunes, and Wright, 2008). However, while several studies have investigated the use of assistive learning technologies by dyslexic students (e.g., Diraä *et al.*, 2009; Draffan, Evans, and Blenkhorn, 2007; Draffan *et al.*, 2013; Hughes, Herrington, and McDonald, 2011; Price, 2006), the vast majority have not taken into account the more extensive institutional provision by services within universities, or how the DSA-funded assistive learning technologies have influenced the learning experiences of students from different backgrounds, studying different disciplines, within a range of environments and ICT proficiency levels. Instead, existing research studies only focus on one specific issue or area –writing or exam provisions, for example – and not on the wider perspective of the institution or the learning experience and background (i.e., diagnosis, family, early school education) of the student. Further, a systematic review of students with dyslexia in higher education by Pino and Mortari (2014) found 8 studies that addressed the use of assistive technologies and ICTs. However, from reviewing these studies (e.g., USA: Dziormy, 2012; UK: Farmer, Riddick, and Sterling, 2002; Hughes *et al.*, 2011; Pollak, 2005; Riddick, Farmer, and Sterling, 1997), it is apparent that they do not address the broader issues of students' experiences with assistive learning technologies, including students' backgrounds, disability support in UK universities and the processes involved during the writing process. More broadly, these studies do not reflect the students' experiences with

DSA and access to technologies. Thus, this study is well placed to provide practical assistance, empirical evidence and theoretical contributions which add to the literature on assistive learning technologies and university students diagnosed with dyslexia.

It should be noted that the use and understanding of the term dyslexia have been widely argued and debated since the end of the nineteenth century (e.g., Hinshelwood, 1895; 1917; Kussmaul, 1877; Morgan, 1896; 1914). Although this thesis acknowledges the problematic status of the term dyslexia and accepts that it is a contestable term with questions around diagnosis, it will be using the term and discussing it in-depth in Chapter 2.

1.3. Research Questions

The fundamental purpose of this qualitative study was to examine university students' experiences of assistive learning technologies and how students use these technologies within different university environments. The study explored the way in which students' personal and educational backgrounds and experiences with dyslexia can play a role in how they use assistive learning technologies with their studies. As previously outlined, given the limited research on assistive learning technologies with university students diagnosed with dyslexia, this study proposes a basis for future research into the likely impacts of these experiences.

The study investigated the support and provisions provided by the universities and government grant authorities (Student Finance England), such as the DSA, investigating how students with dyslexia are provided with assistive learning technologies and study skills to support their learning. Specifically, the variation in university environments for engaging with the assistive learning technologies together with the different types of students attending each university constitutes an important element of this study.

Associated with students' background influences and their engagement with assistive learning technologies, the study also seeks to investigate the role these technologies play in the writing process. The study is not intended as an evaluation of universities or students, but rather aims simply to learn more about the nature of the different environmental factors shaping students' experiences. Thus, to facilitate this study, the primary research question is:

> What are the experiences of university students diagnosed with dyslexia as they use assistive learning technologies for their studies?

In association with the primary research question, the sub-research questions are identified as follows:

1) How can students' personal and educational backgrounds enable them to use assistive learning technologies in their studies?

2) What disability support and provisions do universities provide to their students?

3) What educational roles do assistive learning technologies play in the writing process for students?

By investigating a variety of students from two higher education institutions, Redwood University and Owen University, a case study design was selected as the most appropriate method for examining students' experiences of assistive learning technologies. The study

makes use of an array of data from 41 students from the two universities, including a diary log of use of technologies, in-depth semi-structured interviews and a narrative task analysis exploring students' processes when using technologies. It also includes semi-structured interviews with a combined 10 disability support staff from both universities.

1.4. Background to the Research - My Journey with Dyslexia

As a young age, I could always remember wanting to learn through the interaction of play with electronic media, such as the handheld game console or the use of the world's first home computers in the 1980s. The engagement and structure of learning at school had a significant impact on my ability to learn information. The traditional classroom-based teaching practices became inappropriate: my teachers would introduce a subject with more written than spoken explanation.

One day, my mother approached the head teacher of my school to discuss my reading difficulties and the possibility of me being dyslexic. However, he was adamant that there was no such thing as dyslexia and that I was merely 'a thick kid with a pushy mother'. The problems I was experiencing at an early age were those associated with phonological processing, working memory, sequencing and the necessary skills to read: dyslexia. A SpLD caused by lower efficiencies in areas of cognitive processing, needed for reading and writing. In the event, the identification of the dyslexia label would evade me for nearly fifteen years, something that would have given me an insight and understanding into the disorder. In the meantime, the only available support outside my family was from speech therapists, even though this was short and brief due to government cutbacks. I soon became confused and withdrawn in an environment that did not support my way of thinking and learning. However, I had one advantage over other

children with learning difficulties: my fraternal twin, Philip, who is not dyslexic, could help with my class work when the teacher was too busy or engaged with other children.

During my time at primary school I learnt to hide my disability as much as possible, mainly for two reasons: firstly, there was no extra support for my difficulties with literacy, so raising awareness was pointless; and secondly, government funding for special education was being cut, thus informing teachers and requesting additional support would have proved useless. From an early age, it became apparent that, if I were to succeed, it would be through developing my learning strategies and engaging with technology. Most importantly, the encouragement and support from my parents in using educational technology allowed me to explore the potential of using portable devices to aid my learning at school and independently with my homework. My fixated way of using technologies, learning to program and experimenting with whatever electronic device I could find, allowed me to understand different ways of learning that would benefit my school work. This was eventually achieved through a combination of software programmes, animations, tape-recorded lecture notes with colour coded markers (known today as podcasts), interactive quizzes and a controlled exam with the use of a self-designed software programme.

In addition to my use of technological discoveries at home, in 1995, the Disability Discrimination Act was introduced. The act forbids providers of services, facilities and goods from treating disabled people unreasonably due to their disability. However, the Disability Discrimination Act did not apply to most education providers, and I was required to continue developing and implementing my own technology-enabled learning strategies both inside and outside of the classroom. Consequently, my experimentation with learning continued through secondary school where I received some additional support and mentoring from sixth form students. This new support and connection

allowed me to ask questions and discover new processes for organising and structuring my essays, all at a time when desktop PCs were becoming more prevalent in the classroom, and the Internet was available for use.

By the late 1990s, I had adapted the traditional classroom-based learning processes by creating my own personalised strategies. These strategies were developed with coloured visual identifiers and emerging assistive learning technologies, such as speech-to-text technologies and visual organisational software. My experience with these technologies and developing learning strategies allowed me to discover new ways of processing the written word and progressing with my academic work within an independent and focused environment.

When I was formally identified with dyslexia at university, the need for support and confidence was welcomed. In time, the problems and difficulties I experienced were understood and acknowledged. Despite the challenges of my early years, I worked positively with the support I received at university, and was able to all but disregard the lack of understanding of dyslexia and the awful name associations I was identified with when I was at school. From personal experiences, my motivation is to examine and determine effective teaching and learning strategies with technologies for individuals with dyslexia. The present thesis is a part of that journey.

1.5. Organisation of the Thesis

The thesis consists of seven chapters, including this introduction.

Chapter 2 provides a review of the literature concerning the identifications and perspectives of dyslexia. It explores the identifications of dyslexia, the arguments raised about its diagnosis and its existence. It also discusses the various discrepancy definitions and how behavioural characteristics and environmental interactions can impact dyslexia.

Chapter 3 presents the second review of the literature that examines the broader perceptions of disability and dyslexia. It presents contextual information across three prominent subjects: disability in schools and higher education, identification and labelling, and dyslexia in higher education. The second part of the chapter examines the role assistive learning technologies play in cognitive development. By first defining 'assistive learning technologies' and the close association of the more general term 'assistive technology', the chapter explores existing research in the field. Finally, it examines students' needs and explores how they can be mapped to a combination of learning strategies and technologies related to scaffolding techniques.

Chapter 4 presents the rationale for the methodology underpinning the study. It provides the outline for the overall structure of the study including the case study approach. The chapter discusses the specific data collections and analysis procedures through grounded theory, concluding by examining the areas of access, issues of reliability, validity and the overall limitations of the study.

Chapters 5 and 6 present the findings of the study from Redwood University and Owen University. These two chapters outline the findings based on the three research questions. Firstly, they examine students' background influences that can enable their use of assistive learning technologies. Secondly they look at the role the university plays in support and provisions provided to students, and finally, they examine the integration of assistive learning technologies to aid the writing process.

Chapter 7 brings together the findings from the two universities. It firstly discusses and analyses students' background influences on the adoption of assistive learning technologies and proposes an environmental framework model for assistive learning technologies based on the literature. The chapter also addresses and emphases the wider learning strategies by universities and the DSA, and how it impacts learning. Lastly, the

chapter examines and explores students' use of the assistive learning technologies to support and structure the writing process with the literature.

Finally, Chapter 8 draws together and concludes the significant findings of the study. By emphasising the unique contribution of the research to the discipline, it presents a reflection of the limitations of the study and proposes suggestions for future research on assistive learning technologies and dyslexia.

Chapter 2: Literature Review

Identifications and Perspectives of Dyslexia

2.1. Chapter Overview

This chapter begins by firstly outlining the early ideas of understanding dyslexia from the initial identification in the late nineteenth century. It then explores the concepts and various discrepancy definitions found in the increasing volume of experimental research that argue against the validity of dyslexia. Additionally, it covers detailed insight, including an examination of advantages and disadvantages, on the use of the Intelligence Quotient (IQ) in the assessment and diagnosis of dyslexia. Following a review of the literature on the more recent discussions of the dyslexia debate, this chapter examines the significance of the term 'SpLDs' with an emphasis on the working memory deficit for cognitive functioning. It also includes an analysis of the student-centred procedures of screening and assessment as they pertain to the student journey and the use of compensatory strategies. Finally, this chapter explores the models of disability including the relationship between intellectual differences and social environments. This exploration looks at the social and medical perspectives as well as the causal model by Morton and Frith (1995), which explains dyslexia as a cultural phenomenon that influences literacy (Frith, 1997). Appendix A contains a detailed discussion of the theories of dyslexia: phonological, magnocellular, cerebellar, and visual deficit. The chapter concludes with an outline of the main points reviewed through the context of the dyslexic adult student.

2.2. Historical Perceptions of Dyslexia

Over the past one hundred years, the discussion around dyslexia and the labels associated with its definition, causes, symptoms and treatment has been extensively debated. Today, dyslexia is widely known as a literacy or reading difficulty, and is also associated with difficulties relating to organisation, planning and short-term memory (McLoughlin, Fitzgibbon, and Young, 1994; Shaywitz and Shaywitz, 2005; Snowling, 1996; Thomson, 1984; Tunmer and Greaney, 2010). Drawing on Greek roots, the word 'dyslexia' combines the prefix dys-, meaning bad or abnormal, the root -lexis, meaning word and the suffix -ia representing a condition (Coleman, 2009, p. 232). The word 'Dyslexia' has also been described more broadly as an 'absence of language' (Lawrence, 2009, p. 12). However, though the word itself is a descriptor of dyslexia's associated complexities, dyslexia is, at its most fundamental level, not a collection of outward manifestations, but rather, a congenital neurological condition.

For well over a century, researchers have continued to explore the existence of dyslexia and have started to make sense of its effect on learning. Although during the late nineteenth-century educational psychology was starting to emerge, there were very few scientific studies undertaken or research articles published. However, the studies that were published shed light on early perceptions of dyslexia. Originally described as 'Congenital Word Blindness' (Hinshelwood, 1895; 1917; Morgan, 1896; 1914; Siegel, 2006), the first recorded evidence of literacy difficulties was in 1877 by a German neurologist, Adolf Kussmaul. From his patients, he noticed that the blindness of words is possible as an isolated condition (Hinshelwood, 1917, pp. 1-2). Studies by Kussmaul and Berlin associated dyslexia as a type of brain impairment, today known as acquired dyslexia. However, in 1896 a medical doctor from England, W. P. Morgan, conducted a series of literacy and numeracy tests on a 14-year-old boy, the first instance in which

developmental dyslexia was first acknowledged (Macdonald, 2009). Morgan described the boy as 'a bright and intelligent boy… his great difficulty has been - and is now - his inability to learn to read'. He went on to explain that he believed the boy would be the smartest in the school if the instruction were entirely oral. After a series of literacy and numeracy tests, W. P. Morgan concluded that the boy's visual memory for words was defective or absent and that the boy was suffering from a congenital illness: *word blindness*. For many years, it was the leading view among researchers that visual processing deficiencies were the cause of dyslexia.

The medical view of reading difficulties continued into the twentieth century with Dr. James Hinshelwood, a Scottish ophthalmologist who concluded from his research that reading difficulties were a fault of eyesight due to a brain defect (Lawrence, 2009, p. 12). It was not until 1925 that Dr. Samuel Orton, an American Neurologist, introduced the term *strephosymbolia*, which recognised and named for the first time the phenomenon of children with reading difficulties often reversing or transposing letters (Orton, 1928). Orton also criticised the prevailing practice of 'sight reading' and was one of the first researchers to focus on phonics instruction for students with reading disabilities (Orton, 1925). He later went on to define and take the lead in the idea of multi-sensory training and emphasise the role of the kinaesthetic meaning by having students use sight, touch, movement and hearing to enable them to connect language with letters and words (Orton, 1937). Orton's research later became the idea for the work of Gillingham and Stillman (1936) who built on the ideas of connections between visual, auditory and kinaesthetic learning processes. It should be noted that this approach to learning is not without debate. While some studies suggest the effectiveness of the treatments within advocacy and parent groups (Alexander and Slinger-Constant, 2004; Rose and Zirkel, 2007), questions

remain in the scientific community about the 'effectiveness of its approach without empirical data' (Earnshaw and Seargeant, 2005, p. x).

Following the foundation period of defining and understanding dyslexia, researchers such as Heinz Werner and Alfred Strauss began to focus on perceptual, perceptual-motor and attention disabilities. Werner and Strauss (1941; 1943) researched a broad range of learning difficulties and highlighted the prominence of assessing the unique educational needs of each child (Strauss and Lehtinen, 1947).

Towards the mid-twentieth century, attention to dyslexia became more wide-spread in literature, and literacy difficulties started to be considered outside of the domain of the medical model (Lawrence, 2009, p. 12). The era of medical research into childhood learning difficulties and intelligence testing moved into an emerging educational psychology perspective on learning difficulties. This progression in the UK was aided through the Warnock Report (1978) which introduced the term 'special educational need' to identify children who required additional or different support (discussed further in the following chapter).

During the 1970s several researchers, such as Peter Bryant and Lynnette Bradley, were beginning to discover a phonological deficit in 'backward learners'. The perspective of this research moved from the understanding of visual processing to language development where Vellutino (1979) argued that dyslexia was not a visual disorder but a language disorder, mainly encompassing the phonological processing of words. Since this discovery, there have been numerous in-depth studies examining the phonological deficit theory and the associated complexities of decoding and processing language (Wagner and Torgesen, 1987; Snowling *et al.*, 1997; Snowling, 2006; Tanaka *et al.*, 2011; Vellutino *et al.*, 2006). Today, the phonological deficit theory remains one of the major theories of

dyslexia and is widely acknowledged in the communities of research, advocacy and educational interventions. Appendix A examines these theories in more detail.

This rich and at times complicated history and terminology of dyslexia gives insight into the very first discovery of inherited literacy difficulties from nearly 140 years ago. Since then, communities, societies and governments around the world have learnt to understand how dyslexia manifests itself throughout an individual's life, irrespective of culture, gender or nationality (Stampoltzis and Polychronopoulou, 2009). This summary presents a reflection of advancement in scientific research, the multi-faceted difficulties that dyslexia can cause, as well as the need to understand individual needs with dyslexia.

2.3. Defining Dyslexia

The understandings and concepts around dyslexia have continued for over a century. Originally introduced in the academic and medical worlds, various views and opinions on the subject have been argued and debated to give meaning to the neurological condition, and define the phenomenon (Frith, 1995; Mortimore and Crozier, 2006). The notion of dyslexia and definitions have primarily focused on young children and the underlying literacy difficulties experienced, with less significance for higher education and the problems faced by students (Price, 2006).

Since the notion of dyslexia emerged, there have been more than 50 attempts in research and literature of defining dyslexia to achieve an overarching position of its causes and understanding (Ott, 1997). In a systematic analysis of dyslexia in adults, Rice and Brooks (2004) conclude that there are many definitions of dyslexia with some very descriptive and without a consensus. They affirm that there is no 'overall' agreement on the definition of dyslexia, and there are many theories and interpretations relating to reading skill deficits and difficulties. It can appear somewhat confusing to educators and

policymakers that the terminology used in reading research has been inconsistent and vague for many years. As proposed by (Tønnessen, 1997), definitions should be formulated and treated as hypotheses. While a definition can play an important role in the understanding and defining of dyslexia in the scientific community, it has created various vague and confusing non-validated accounts of the disorder (Lyon, 1995).

As most early definitions of dyslexia centred around literacy problems, it is understandable that dyslexia came to be understood as a literacy difficulty where the process of diagnosis has been influenced by discrepancy definitions (McLoughlin, Fitzgibbon, and Young, 1994). McLoughlin, Fitzgibbon, and Young argue that there are two reasons why discrepancy definitions can be problematic. Firstly, they do not distinguish between dyslexics and those individuals who are poor readers (Siegel, 1992). Stanovich (1991) points out that the important aspect of learning disabilities is the understanding that applies to individuals whose reading irregularity could not be explained. The second reason for a discrepancy definition being identified as a problem is that it cannot be identified to older dyslexics who have acquired a deeper understanding to compensate for their problems and no longer have general issues with literacy (McLoughlin, Fitzgibbon, and Young, 1994).

Although dyslexia is often referred to by the term ‘specific learning difficulty (SpLD)’, in the educational context, it helps to emphasise the needs and issues of students (Soriano, 2004). However, some researchers view dyslexia as identical to or as an instance of a ‘SpLD’ (e.g., Nisbet, 2012; Pumfrey and Reason, 1991; Ramus *et al.*, 2003; Riddick, 1996; Rutter and Yule, 1975). According to Elliot, Davidson, and Lewin (2007), some Local Education Authorities (LEAs) still maintain the term ‘specific learning difficulties’ or ‘SpLDs’ as defining a broader term of learning difficulties instead of the label dyslexia. Moreover, the Dyslexic Teachers’ Association (DTA) also confirm that

‘dyslexia is a SpLD, which affects a person’s ability to learn and process information’. BDA defines dyslexia as ‘the most common of the SpLDs’ and ‘an umbrella term used to cover a range of frequently co-occurring difficulties, more commonly dyslexia, dyspraxia…’. Reid (2009) suggests that terms such as dyspraxia, dyslexia and dyscalculia are now categorised within the ‘umbrella term’ of SpLDs, a label that was previously exclusively associated synonymously with dyslexia (Ott, 1997). Mostly, SpLDs and learning disabilities are universally understood to be specific difficulties ‘at variance with a person’s general cognitive abilities or other educational attainments’ (Burden, 2008a, p. 396).

Developmental dyslexia is a term often used to identify individuals who have an inherited neurological condition that is identifiable by a severe difficulty with the spoken and/or written language that is independent of intellectual, cultural and emotional causation (Thomson, 1984; Richardson, 1992). It is also understood to not be a subtype of dyslexia, though it is widely known and described as ‘dyslexia’. In contrast, acquired dyslexia is caused by a genetic fault. It is defined by Patterson (1981, p. 151) as the instance of ‘reading deficits in previously literate adults who have suffered neurological damage’. Acquired dyslexia is a reading problem that occurs after a lesion to the left hemisphere of the brain where language is processed in a previously ‘normal’ reader (Blakemore and Frith, 2005). Both developmental and acquired dyslexia present the same difficulties with language, and throughout the twentieth century, there have been numerous attempts at defining the condition, several of which have either initiated a debate or help set the perspective for the research and current definitions we see today.

One of the earliest working definitions of ‘Specific Developmental Dyslexia’ that is still broadly used by researchers in this field is from the World Federation of Neurology (1968, pp. 21-22):

> A disorder manifested by a difficulty in learning to read despite conventional instruction, adequate intelligence and socio-cultural opportunity. It is dependent on fundamental cognitive difficulties which are frequently of a constitutional origin.

This definition has since brought about many criticisms due to their reliance on exclusionary criteria, which are often linked with assessments (Ott, 1997). However, Vellutino *et al.* (2004) suggest that this statement was held for many years as no more than an assumption founded on two sources of indirect information. For example, linguistic and behavioural characteristics, and the associations of nonspecific indicators of neurological dysfunction with dyslexia. More widely, the focus of the statement draws further censure for its limited focus on learning to read, the prominence on deficits and its neglect of the perspective in which literacy and numeracy skills are developed (Mortimore and Crozier, 2006). Riddick (1996, p. 2) suggests that definitions like the World Federation's are often referred to 'exclusion definitions' as they propose that a child 'can only be defined as dyslexic if a number of factors are excluded'. Thus, arguing that this kind of method can favour the identification of middle-class children and could have guided the misleading belief that dyslexia is a 'middle-class disorder' (Riddick, 1996).

As research advanced and the wider public became aware of literacy learning impairments and cognitive development, several organisations, charities and government policies began to redefine the understanding of this 'most common and best-defined learning disability' (Turner, 1997, p. 3). However, during the nineties the phonological deficit theory presented a dominant understanding of dyslexia which was reflected by the Orton Dyslexia Society (ODS) in 1994 when dyslexia was defined as a language-based disorder:

> Dyslexia is one of several distinct learning disabilities. It is a specific language-based disorder of constitutional origin characterized by difficulties in single word decoding, usually reflecting insufficient phonological processing abilities…

> Dyslexia is manifested by variable difficulty with different forms of language, often including, in addition to problems reading, conspicuous problem with acquiring proficiency in writing and spelling. (ODS, 1994, p. 5).

This definition presented a significant move in defining dyslexia, reflecting on the progress made in the sciences. Lyon (1995) acknowledges that the Orton Dyslexia Society collaborated with several research organisations and scientists in the USA to define and develop this working condition.

Following the UK's Disability Discrimination Act in 1995, several educational definitions were produced. The BDA redefined 'dyslexia' several times towards the latter end of the twentieth century and in 1998 broadened its definition to include other areas of functions:

> Dyslexia is a complex neurological condition which is constitutional in origin. The symptoms may affect many areas of learning and function, and may be described as a specific difficulty in reading, spelling and written language. One or more of these areas may be affected: numeracy, notational skills (music), motor function and organisational skills may also be involved. However, it is particularly related to mastering written language, although oral language may be affected to some degree. (BDA, 1997).

This definition confidently positions itself within a 'psycho-medical discourse which focuses on neurological dysfunctions' (Macdonald, 2009, p. 21), as well as the broader understanding that the concept of a 'lexical' difficulty includes numerical symbols and notational music skills (Thomson and Gilchrist, 1997). However, Helland (2007) suggests that this definition is in agreement with the clinical observation and the view that 'dyslexia' includes a 'dyslexia-spectrum' (Snowling, 1987) instead of definite under groups.

The creation and use of discrepancy definitions for dyslexia, as previously discussed, has long been adopted by the clinical practice to help define and give broader

understanding of the disorder. Snowling and Stackhouse (1996, p. 2) point out that the discrepancy definition considers the importance of the 'correlation between cognitive ability and educational achievement in the normal population'. It is understood that the discrepancy standard is founded on the belief that a child of above-average ability can read above the average for their age group, whereas a child of below-average ability is below the norm and thus have 'specific reading difficulties' (Snowling and Stackhouse, 1996). One of the leading points of discussion and disagreement in defining dyslexia has been the significance of intelligence as a means to identify an individual's ability level in reading and writing in comparison to their age and IQ (Tønnessen, 1997). However, Tanaka *et al.* (2011, p. 1442) acknowledge that although the role of IQ in dyslexia continues to be indecisive, the leading clinical and research methods trust that a definition of dyslexia 'requires reading skill to be significantly below the level expected given an individual's IQ'.

To provide context on the position between specific and general learning difficulties within the measures of general intelligence, Hulme and Snowling (2009) write that the average IQ of the population is 100, with an average deviation of 15. In the UK, individuals with scores between 50 and 70 are suggested as having 'moderate learning difficulties', and individuals below 50 are proposed as having 'severe learning difficulties'. In the case of a child, Hulme and Snowling also indicate that a diagnosis of a SpLD is identified within the average IQ range (85 or above). However, Hulme and Snowling do accept that theoretically, the difference between these individuals is 'probably a bit more slippery' (p. 3). In contrast to the belief of measured IQ and the hypothesis for defining dyslexia, several researchers have argued that there is no scientific evidence to support this view (Elliott and Grigorenko, 2014). Additionally, tests of cognitive ability have minimal significance in diagnosing dyslexia (Stanovich, 2005).

Elliott and Grigorenko (2014), known for their debate on the use of the term ‘dyslexia’, are also critical of using measured intelligence for diagnostic purposes of dyslexia. They argue that IQ scores cannot distinguish between poor readers, such as dyslexics who can take advantage of remedial programmes and non-dyslexic poor readers who are likely to be more resistant to intervention.

Within the wider community of advocacy and support, Elliott (2016) suggests that the use of the discrepancy model is no longer supported by leading dyslexia support groups such as the International Dyslexia Association (IDA) and the BDA. However, Elliott also argues that despite the detailed scientific evidence, school specialists, clinicians and the British university sector continue to use the discrepancy model. This is perhaps due to the continued use of IQ in the assessment of dyslexia as well as the lack of understanding of alternative assessment methods (Elliott, 2014).

On the critical examination of intelligence and reading relationships, Siegel (1989) argues that intelligence testing does not, in fact, measure intelligence but rather, achievement. For instance, although it is often thought that the term ‘intelligence’ might be considered to involve reasoning skills and problem-solving, one of the noticeable intelligence tests, the Wechsler Intelligence Scale for Children-Revised (WISC-R) (Wechsler, 1976) includes tests not directly related to intelligence. The tests involve word knowledge, understanding social situations, motor skills and incentive tests associated with the ability to work at speeds (Miles and Miles, 1999). In more recent research, Siegel and Himel (1998) contend that IQ is related to socio-economic status, reflecting that those from more disadvantaged environments are anticipated to attain lower scores on IQ testing.

Given the significant findings from research assessing the hypothesised causes of ‘specific reading disability’, Vellutino, Scanlon, and Tanzman (1994) acknowledge that

tests were evaluating sublexical knowledge. For example, phonological awareness, phonological decoding, spelling ability, and phonological skills such as name retrieval and verbal memory, were much better predictors of ability in word identification. This was compared to tests evaluating vocabulary and general knowledge, and syntactic processing, as these were discovered to be better predictors of ability in language comprehension. Joshi and Aaron (2008) also critical of the discrepancy between IQ scores and reading achievement argue for an alternate model of diagnosing and teaching children with reading difficulties based on the implementation of the Componential Model for Reading. The model recognises reading to include word recognition and comprehension aspects, all of which contain processes such as phonological awareness, decoding, instant word recognition, listening and reading comprehension, and vocabulary. The assessment model proposes the idea of identifying the source of the reading problems (decoding or comprehension) to provide an accurate representation of the poor reader's strengths and weaknesses, so suitable remedial procedures can be recommended.

As institutions, charities and societies begin to move forward in making connections to develop a more concise and universal understanding of specific reading difficulties, the debate continues about the origins of dyslexia and how best to define it. However, as identified by Rice and Brooks (2004), some definitions of dyslexia explain the manifestations of dyslexia by utilising descriptive definitions. The definition by the BDA (2007) can be identified as following a descriptive classification:

> Dyslexia is a specific learning difficulty that mainly affects the development of literacy and language related skills. It is likely to be present at birth and to be life-long in its effects. It is characterised by difficulties with phonological processing, rapid naming, working memory, processing speed, and the automatic development of skills that may not match up to an individual's other cognitive abilities.

> It tends to be resistant to conventional teaching methods, but its effect can be mitigated by appropriately specific intervention, including the application of information technology and supportive counselling. (BDA, 2007).

The use of the BDA's definition emphasises literacy and language related skills and shares key features with the IDA (2002). It defines such difficulties with 'accurate and fluent word recognition, poor spelling and decoding abilities'. Nonetheless, unlike the BDA, the IDA does not attempt to draw on possible neurological or biological causes of dyslexia, although the IDA states that 'dyslexia is a specific learning disability that is neurological in origin'. While both associations equally accept that difficulty can be characterised by a discrepancy in the phonological component of language, Lawrence (2009, p. 34) acknowledges that a descriptive definition of dyslexia 'avoids the controversy over the origins of dyslexia and offers a positive view of dyslexia with a focus on the remediation of the child's difficulties'.

While there is a range of definitions that help offer an insight into the difficulties experienced, McLoughlin *et al.* (2002) point out that several of these definitions refer to dyslexia as a 'childhood condition' with no reference to adult dyslexia. They argue dyslexia manifests itself differently in adults and the problems experienced are often much broader than literacy difficulties. It can usually present challenges to the individual in the working and social world, such as finance, employment and communication (Lawrence, 2009). Thus, this discussion and outline of the varied definitions of literacy difficulties, centred around defining dyslexia, has presented a range of detailed and concise understandings that society and the research community are still debating. From the variability of dyslexia presented in the thesis, it is important to consider a broader definition, particularly when looking at how the brain of those with dyslexia process language. Nonetheless, what researchers can agree on is the challenges and difficulties faced by children and adults identified with SpLDs. There is a need to find solutions

through interventions (identification, diagnosis, assessment, learning strategies, technologies) to support their difficulties.

2.4. Examining the Dyslexia Debate

The discussion around the definition of dyslexia continues to be discussed with researchers such as Elliott and Gibbs (2008), who assert that there is a misguided understanding that existing knowledge in genetics and neuroscience is 'sufficient to justify a category of dyslexia as a subset of those who encounter reading difficulties' (p. 475). Nevertheless, several studies (e.g., Habib, 2000; Schulte-Körne, Deimel, and Remschmidt, 1997; Shaywitz, Mody, and Shaywitz, 2006) suggest both neurological and genetic factors provide a strong foundation to consider that 'a very small percentage of impaired readers may be afflicted by basic cognitive deficits of biological origin, especially phonological deficits that lie at the root of their difficulties in learning to read' (Vellutino *et al.*, 2004, p. 31). Elliott and Gibbs (2008, p. 488) also suggest that dyslexia is a 'socially defined construct' and 'there appears to be no clear-cut scientific foundation for differential diagnosis of dyslexia versus poor reader versus reader'. However, Elliott and Grigorenko (2014) argue that the term 'dyslexia' has too many associated conditions attached, and because it is too wide-ranging for diagnosis, it should be replaced with the term 'reading disabilities'. Nevertheless, Elliott and Grigorenko raise the conceptual and diagnostic issue: how is it significant and possibly beneficial to create a dyslexia subgroup within a larger association of poor readers who essentially all find accuracy and fluency difficult? Rice and Brooks (2004) suggest that the fundamental question in dyslexia research is whether dyslexic individuals vary from 'normal' readers, but more so if dyslexic individuals differ from other poor readers. Thus, it is essential to understand and acknowledge that the significance of a definition could be modified by its purpose (Elliott

and Grigorenko, 2014). Nonetheless, Nicolson (2016a) proposes a more 'effective and cost-effective' process that leads to the wider-understanding of the identification and support, engaging the 'assessment for dyslexia' in contrast to 'of dyslexia'. However, Elliott (2005) suggests a change from the direct assessment and identification of dyslexia to the assessment of individual needs in teaching. This form of educational intervention is acknowledged by Ramus (2014) who supports the need to provide all poor readers with evidence-based support, in the first instance, regardless of putative causes.

While Elliott and Grigorenko (2014) argue that the concept of dyslexia is not valid, serves no practical purpose and is potentially harmful to an individual acquiring the label, I believe this view to be slightly misconceived. In part, this study aims to explore the reflections individuals follow on obtaining a diagnosis and review the research (e.g., Dale and Taylor, 2001; Hughes and Dawson, 1995; Ingesson, 2007; Tanner, 2009) for acquiring a diagnosis, in addition to acknowledging the negative consequences that a diagnosis could also present (see section 3.10 for identification and labelling of dyslexia). The following sections present a more detailed insight into the constructs of the criteria for defining a developmental disorder.

2.5. Specific Learning Difficulties (SpLDs)

The use of the terms 'SpLDs and 'dyslexia' are frequently referred to as comparable equals with some authorities using 'SpLDs' as an umbrella term (Elliott and Gibbs, 2008; Miles, 1995; Snowling, 2005). The statutory definition in the United States of America (USA) of learning disabilities is contained within the Individuals with Disabilities Education Act (IDEA, 2004):

> ‘Specific learning disability’ means a disorder in one or more basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in an imperfect ability to listen, speak, read, write, spell, or to do mathematical calculations. The term includes such conditions as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. (Code of Federal Regulations, Title 34, Subtitle B, Chapter III, Section 3).

Riddick (1996) points out that the umbrella term is regularly used for a spectrum of learning disabilities with dyslexia as an alternative term. However, Hall (2008) suggests that SpLDs are associated with restricted cognitive impairments which can affect an individual to learn in a typical educational environment. While the term ‘general learning difficulties’ is understood to be where there is global development delay combined with low intelligence (Hall, 2008; Snowling, 2005).

The use of the term ‘SpLDs’ dates to at least the 1970s where the Warnock Report (1978, p. 218) used the phrase ‘children with specific learning difficulties’ to highlight evidence from dyslexia associations on the needs of children with ‘difficulties in reading, writing and spelling’. In general, most educational practitioners and educational psychologists prefer the term ‘SpLDs’ (Riddick, 1996) rather than the ‘less emotive or pathological connotation’ it carries compared to dyslexia, but more significantly because it avoids the identification of the condition solely with the reading or word recognition process (Booth, 1988, p. 91).

The BDA along with many other researchers (e.g., Bell, 2009; Boxall, Carson, and Docherty, 2004; Mortimore, 2013; Williams, Jamali, and Nicholas, 2006) use ‘SpLDs’ synonymously with dyslexia. While dyslexia is the most recognised and researched SpLD, there are many different kinds of SpLDs. For instance, dysgraphia is a difficulty with writing expression, dyscalculia identifies problems with arithmetic, dyspraxia recognises difficulties with motor coordination. Attention Deficit Hyperactivity Disorder (ADHD) is linked to excessive activity or difficulty controlling behaviour. Dysgraphia, often

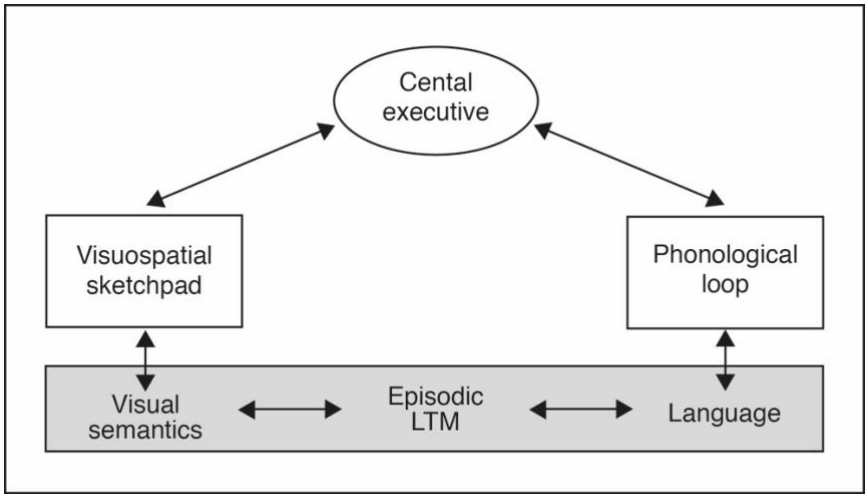
described in conjunction with dyslexia can sometimes be identified as 'linguistic dysgraphia' (Deuel, 1995). Its difficulties are often characterised by illegible handwriting with words frequently misspelt even though the child might be able to read the word correctly (Reid, 2011). Also, encompassed within the SpLDs term are those individuals experiencing difficulties with numeracy skills (McCloskey, 1992). These difficulties are referred to as dyscalculia, a term that is characterised by problems in learning and remembering arithmetic facts, and performing calculation processes (Geary, 1993). Moreover, short-term memory difficulties that affect arithmetical ability are one of the causes why many dyslexic individuals are also dyscalculic (Hulme and Roodenrys, 1995). One learning difficulty of the SpLDs group is identified as dyspraxia, or as it is often referred to, Developmental Coordination Disorder (DCD) (Jeffries and Everatt, 2004; Mackay, 2009; Snowling, 2005). Although the symptoms vary significantly between individuals, difficulties may include varied motor difficulties such as problems running, catching a ball and fine motor difficulties including handwriting, playing sports and even driving a car (Hall, 2008; Kirby, Sugden, and Edwards, 2011).

Finally, attention-based deficits or ADHD have often been associated with the longer-term difficulties related to reading and is often considered a SpLD. Defined as a 'clinical classification for the problem in inattention, impulsivity, and over activity', it is often used as a medical identification for children with behavioural and educational problems (Catts and Kamhi, 2005, p. 107). It is argued that ADHD is regularly confused with dyslexia as the disorder is manifested by problems of personality and behaviour as well as key characteristics of short attention span and an apparent weakness in short-term memory (Lawrence, 2009).

The relationship between dyslexia, dysgraphia, dyscalculia, dyspraxia and ADHD disorders is comorbid. Thus, it is likely for the disorders to exist both with one another

and with other disorders, exacerbating each other and contributing to increased academic failure (Hall, 2008; Rief and Stern, 2010; Snowling, 2005). Furthermore, Jeffries and Everatt, (2004, p. 197) also suggest that short-term memory is a factor in all SpLDs where there are deficits in the 'components of working memory within the patterns of cognitive functioning'. In their earlier study, Jeffries and Everatt (2003) discovered a link between working memory and SpLDs. Through testing adults with SpLDs, the results identified that dyslexics displayed deficits in recall tasks involving the phonological loop (working memory that processes sound and is responsible for speech-based information). However, dyspraxics showed deficits in tasks that involved the visual-spatial 'sketchpad' (working memory that processes visual and spatial information such as shapes, colours and objects). Both the dyslexic and dyspraxic adults displayed good retention skills with tasks that used the working memory sub-system that was not linked to deficits. The findings highlighted that the working memory model (Baddeley and Hitch, 1974, see Figure 1) could inform compensatory strategies for learning (Jeffries and Everatt, 2003; 2004).

Figure 1. The Working Memory Model including the Long-Term Memory (LTM) (Baddeley, 2000).



Dyslexia and selected SpLDs are characterised by deficits in poor verbal working memory such as connecting letters to sounds and understanding what has been read (de Jong, 2006). The 'Working Memory Model' (Baddeley and Hitch, 1974) presents three main components of short-term memory tasks; these include two slave systems: phonological, and visual-spatial subsystems. They are managed and organised by a central executive attention system, as shown in Figure 1. Thus, the information needed to acquire knowledge and complete multifaceted sequences is accomplished through the storage and rehearsal processes of the working memory subsystems (Baddeley and Logie, 1999).

2.6. Diagnosing Dyslexia

The number of UK students in higher education with dyslexia has increased between 2000 to 2010, partly due to widening participation (Bacon and Bennett, 2013; Hatcher, Snowling, and Griffiths, 2002). However, the increase can be accredited to the introduction of policy, legislation (Disability Discrimination Act, 1995; Special Educational Needs and Disability Act (SENDA), 2001; Equality Act, 2010) and funding measures intended to increase participation of disabled students at university since the mid 1990s (Jordan, McGladdery, and Dyer, 2014). Universities have a social and legal responsibility to provide reasonable adjustments and ensure students are not positioned at a disadvantage. Thus, through disability services, it has become standard practice to offer students universal support with diagnostic assessments and provisions.

The process of diagnosis begins with the student identifying that they have difficulties with their studies, or a peer, tutor or parent suggesting that they contact the university's disability office. Before a formal diagnosis, many universities have a form of screening process to determine if the student requires a full assessment. The screening process involves a semi-structured interview to highlight if there are any likely causes or

problems the student is facing. Other kinds of screening processes may include short tasks to identify an issue with short-term memory or an underlying phonological deficit (Jamieson and Morgan, 2008).

Some educational institutions may use a series of self-answer type questions such as the Revised Adult Dyslexia Check List (Vinegrad, 1994) to identify if there is a manifestation of dyslexia. The Revised Adult Check List comprises 20 questions which include 'Is your writing difficult to read?' and 'Do you find it difficult to remember the sense of what you have read?'. Vinegrad (1994) claims that nine or more definite answers are 'a powerful indicator of a difficulty'. Another form of assessment is the Dyslexia Adult Screening Test (DAST) (Fawcett and Nicolson, 1998) which involves eleven separate subtests, including, rapid naming, phonemic segmentation, non-verbal reasoning and verbal fluency. The DAST is centred around research from Fawcett and Nicolson (1996) and Nicolson and Fawcett (1997) exploring automaticity and where some of the subtests have originated from the Dyslexia Screen Test (DST). McLoughlin and Leather (2013) suggest that the DAST provides an 'at risk' score that can be helpful with the initial stage in a formal identification although it is not exclusive of its faults. For example, a Canadian trial of the DAST discovered that it was unsuccessful in recognising a satisfactory number of the known dyslexic students as 'dyslexic'. Although it recognised an unacceptable number of non-dyslexics as 'dyslexic' with a sensitivity of 74% and a specificity of 84% (Harrison and Nichols, 2005).

Other forms of computerised screening tests include the Lucid Adults Dyslexia Screening (LADS) (Singleton, 2002a; Lucid Research, 2002) and QuickScan (Zdzienski, 1997). In a survey of UK institution screening methods, Ball, Rainger, and Draffan (2005) identified that of the 23 institutions 8.7% were using the Revised Adult Dyslexia

Checklist (Vinegrad, 1994) and 17.3% for both the LADS and QuickScan computerised tests.

Some researchers have shown that the self-identification of dyslexia and other SpLDs are a valid measure of identifying reading difficulties (Gilger, 1992; Schulte-Körne, Deimel, and Remschmidt, 1997). However, Snowling *et al.* (2012a) suggest that one of the main advantages of adult self-checklists is the ability to identify risks to children. In support of the validity of self-identification for dyslexia, Wilson *et al.* (2009, p. 26) argue that 'although some individuals may self-identify as LD who, in fact, would not meet acceptable criteria, those who also identify as dyslexic would more likely typify those who meet the narrow criteria of reading difficulties within the more heterogeneous category of LD'. Nevertheless, Chanock *et al.* (2010) suggest that universities are unlikely to approve support adjustments based on students' self-identified difficulties as it could potentially be abused.

Following an initial screening, students are referred for a full diagnostic assessment. The purpose of the assessment is to diagnose difficulties and discover strengths by inviting the student to complete a series of cognitive tests in phonological processing (Backhouse and Morris, 2010, p. 7). Fundamentally, the assessment provides the student with a discussion and explanation surrounding coping strategies, interests, ambitions and reasons for studying. As outlined earlier in section 2.3, a large body of research in the field of dyslexia (e.g., Frederickson and Reason, 1995; Howe, 1997; Siegel, 1999; Stanovich and Stanovich, 1997) suggest the diagnosis of dyslexia is not founded on the identification of a discrepancy between general intelligence and performance in specific areas.

According to the Department for Education and Skills (DfES, 2005) (now Department for Innovation, Universities and Skills (DIUS)) criteria for the diagnosis of

dyslexia in higher education is not based on the discrepancy rule. Thus, students identified with a moderate or below-average IQ score and a deficit in phonological processing skills would satisfy the criteria for a diagnosis of dyslexia (Jamieson and Morgan, 2008). Rose (2009, p. 10) adds support to the conceptual understanding of dyslexia and intelligence where 'dyslexia occurs across the range of intellectual abilities' and 'it is best thought of as a continuum, not a distinct category, and there are no clear cut-off points'. However, McLoughlin and Leather (2013, p. 6) suggest that such statements are 'unhelpful' as they 'raise false expectations' with individuals who may have issues with literacy but their difficulties are far more complex. It also creates the belief that their difficulties are specific instead of being general, thus leading them to embark upon education programmes and pursue careers that could cause disappointment. As new evidence is published on the issue of diagnosing dyslexia, there needs to be an ongoing debate about the processes that currently exist and the wide-ranging types of screening and diagnostic assessments that take place in UK institutions. The issue of screening and diagnosing dyslexic students has long been a debated topic among academics, tutors, assessors and politicians (Elliott and Grigorenko, 2014; Siegel, 2003). The view by some academics and institutional support staff that every student who takes a diagnostic test is confirmed with dyslexia is worrying and should not be widely claimed across all institutions. There is also the view that some students are being assessed with dyslexia so that they can claim allowances and exam provisions. However, in a case study of students' insights into the provisions of dyslexia, Riddell and Weedon (2006) identified that there were 'considerable advantages' in having a diagnosis as it gave access to the DSA and allowed some students to argue for special allowances with assessment.

2.6.1. Diagnostic Criteria

The formal diagnosis of dyslexia can be an expensive and time-consuming process that can take up to several hours with a psychological assessment. The process involves an 'interview' to discuss students' educational and personal history, and several cognitive tests including observations and a clinical decision (Casale, 2006; McLoughlin, Fitzgibbon, and Young, 1994).

Following a lack of consistency in the style and length of diagnostic reports, LEAs were finding it increasingly difficult in evaluating the evidence provided. Thus, in 2003 the DfES organised a working group to develop guidelines for the assessment of SpLDs in higher education (Jamieson and Morgan, 2008). The DfES Guidelines (2005) recommend that diagnostic reports are produced by psychologists and specialist teachers with a practising certificate in SpLD assessment. The existing diagnostic criteria for identifying dyslexia contain five elements and are applied when applications for the DSA are considered:

1. *History of difficulty with the acquisition of literacy skills.*

   Some students will have been late in acquiring literacy skills with difficulties occurring in reading aloud (inaccuracy in literacy through phonics teaching methods), in addition to a history of poor spelling. Although students' difficulties may not have been identified or even acknowledged by teachers, some may have received early specialist speech therapy (Casale, 2006; Ryan, 2007).

2. *Persisting difficulty with literacy.*

   The persistent effects of dyslexia on the student may change over time, but with all cases of dyslexia, it will be continuously evident and identifiable in assessments. While some students' difficulties may change over time, areas of persistent problems are slow reading, decoding difficulties, poor spelling and punctuation, as well as difficulties in articulating ideas in writing and speed (McKendree and Snowling, 2011; Shaywitz *et al.*, 2001; Shaywitz and Shaywitz, 2005).

3. *Evidence of an underlying cognitive deficit.*

   The diagnosis of a SpLD requires evidence of an underlying cognitive deficit in aspects of phonological processing and auditory working memory (Singleton, Horne, and Simmons, 2009; Vellutino *et al.*, 2004). Simmons and Singleton (2000) acknowledge that while an impaired working memory and poor decoding automaticity emerge to be credible accounts for reading comprehension deficits, dyslexic adults can also experience issues with limited vocabulary or impairment in understanding verbal communication due to the limited exposure of complex texts.

4. *Exclusion of other factors.*

   Due to the various development and behavioural abnormalities frequently co-existing with dyslexia, consideration needs to be given with different barriers to learning (Elliot, Davidson, and Lewin, 2007). These can include sensory impairment, English as a second or additional language, wider environmental influences on students' educational experiences and opportunities for learning.

5. *Underlying ability – IQ / attainment discrepancy.*

   The final criteria suggest that the diagnosis of dyslexia is not solely based on the identification of a discrepancy between underlying ability and levels of literacy (e.g., Frederickson and Reason, 1995; Howe, 1997; Miles, 1996; Siegel, 1999; Stanovich and Stanovich, 1997).

2.6.2. Assessment of the Dyslexic Adult

The aim of a formal diagnosis is to best answer the question, 'why are tasks difficult?', in addition to understanding the difficulties and identifying the abilities and strengths of the student (McLoughlin and Leather, 2013, p. 61). As Blackmore and Frith (2005, p. 88) write:

> The diagnosis of dyslexia is often based on a formula where someone's performance on a reading test is seen as lagging significantly behind their performance on tests of general ability and other cognitive skills.

To determine if a student is dyslexic, and in accordance with the DfES (2005) guidelines, a series of tests are conducted on measures of literacy attainment, assessment of general intellectual ability (with measures of verbal and non-verbal reasoning) and assessment of cognitive processing such as phonological skills, working memory and speed of processing (Kindersley, 2010). Additionally, a detailed outline of the students' history is also included to provide context and relevant information to the development of any difficulties (Jamieson and Morgan, 2008). The use of basic psychometrics and tests have long been used by educational psychologists in diagnosing individuals and providing a detailed background of their differences. These tests help measure the difference between individuals but do not always 'reflect accurately the underlying cognitive or

behavioural traits that they purport to measure' (Thomson, 2002, p. 18). Nonetheless, the tests not only help provide a description of individual differences, but they also provide a measure of abilities for human behaviour, helping to eliminate a major deficiency in aptitude as a reason for difficulties and remove the fallacy of being described as 'thick' or 'stupid' (Ott, 1997; Thomson, 2002).

As discussed earlier in the chapter (section 2.3), the discrepancy based approach determines the existence of a 'severe discrepancy' by examining two important aspects: intellectual ability and academic achievement (Dombrowski, Kamphaus, and Reynolds, 2004). As McLoughlin and Leather (2013) explain, the discrepancy based approach should measure the 'fluid' and 'crystallised' intelligence, as both are significant predictors in what individuals can achieve. 'Fluid intelligence' is referred to as 'the ability to reason through and solve novel problems' (Shipstead, Harrison, and Engle, 2016, p. 771) and is autonomous of any knowledge from the past (Jaeggi *et al.*, 2008). As Jaeggi *et al.* (2008) explains, the 'fluid' approach suggests that individual's abilities are not solely reliant on previously acquired knowledge such as attention, memory capacity and processing speed, but are developed through training in areas of working memory. The reference to 'crystallised' intelligence refers to the ability to apply acquired knowledge such as problem-solving skills, vocabulary and information to a particular based task, problem or even experience (McLoughlin and Leather, 2013; Shipstead, Harrison, and Engle, 2016).

According to Dombrowski, Kamphaus, and Reynolds (2004, p. 366), the discrepancy approach is suggested as representing an assessment that appears to 'lack validity and reliability'. However, while researchers continue to question and debate the relationship between intelligence (IQ) and reading, the Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV) (Wechsler, 2008) is widely used by psychologists. The WAIS-IV consists of 15 subtests including 10 core subtests and 5 supplemental subtests (Sattler

and Ryan, 2009). It provides a full IQ score and produces four primary subtests Index Scores: Verbal Comprehension; Perceptual Reasoning; Working Memory; and Processing Speed.

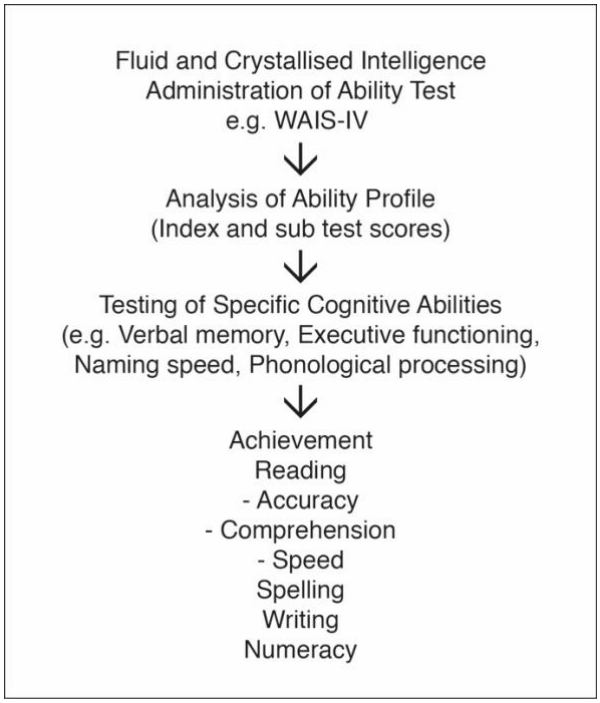
Although the WAIS-IV test is one of the most widely used IQ tests in the world for identifying underlying ability (Flanagan and Kaufman, 2004), there are other similar adult intelligence tests that exist such as the Wide Range Intelligence Test (WRIT). The subtest scores of the higher education student displayed in Figure 2 present the underlying ability using the WRIT. In this example, the student is measured to have an IQ of 109. A score in the range of 85-115 is regarded as being in the average range (Hulme and Snowling, 2009). Thomson and Gilchrist (1997) point out that when an IQ is within the average range dyslexia can appear to present itself in a more problematic way. For instance, a student with an IQ of 109 taking two or three A-Levels may find it entirely possible to achieve but could be 'severely compromised' if the underperformance caused by the SpLD is not supported appropriately (Thomson and Gilchrist, 1997, p. 42).

Figure 2. Identifying underlying ability of intelligence using the Wide Range Intelligence Test. Taken from a postgraduate student in 2011.

Name of Test	Wide Range Intelligence Test	
Test Ceiling	85 years	
<u>Verbal Subtests</u> Analogies Vocabulary Combined scores	 106 104 106	VERBAL SUBTESTS Ben's understanding of oral language (analogies), and his vocabulary are both within the average range.
<u>Visual Subtests</u> Matrices Diamonds Combined scores	 95 121 110	VISUAL SUBTESTS Ben's spatial and manipulative skills (diamonds) is above average and his reasoning skills (matrices) are within the average range for his age.
The results show that Ben's general IQ measures 109.		

During an assessment, students can also be expected to complete tests on attainments in literacy (reading, spelling, writing) and cognitive processing (working memory, phonological processing, the speed of processing). Figure 3 presents the stages leading to a formal diagnosis of dyslexia. It is recommended for educational psychologists and assessors to examine and evaluate the minimum standard set out by the DfES (2005) before a conclusion on an individual can be made (McLoughlin and Leather, 2013).

Figure 3. Steps in diagnosis adapted from McLoughlin and Leather (2013).



The early diagnosis of dyslexia and the development of reading strategies are necessary to aid struggling readers (Snowling, Gallagher, and Frith, 2003). However, it can be argued that because dyslexia is 'an inefficiency in working memory' (manifesting itself during childhood as a deficit in literacy skills), these difficulties have usually been overcome by adulthood and attainment in literacy –with scores being achieved within the average range (McLoughlin, Fitzgibbon, and Young, 1994, p. 30). The use of

compensatory strategies can thus help individuals process information that in turn enables them to achieve their goals. For some adults with dyslexia, and particularly those performing at a high academic level, they have developed advanced compensatory strategies for supporting their difficulties and can conceal their disability on initial screening tests designed for use by the general adult population (Casale, 2006; Miles, 1993). The use of compensatory strategies by dyslexics and the role technology can add strength to the ability of an individual (e.g., Björklund, 2011; Bråten, Amundsen, and Samuelstuen, 2010; De La Paz, 1999; Higgins and Raskind, 1995; Raskind and Higgins, 1999; Wolfe and Lee, 2007) will be examined in Chapter 3.

2.7. Models of Disability

Before attending to the details of each model of disability, it is important to acknowledge that in previous generations the discourse of disability was created without involvement from individuals with disabilities themselves (Goode, 2007). As Johnston (1996) explains, disabilities can occur from genetic disorders because of accidents or because of illnesses that happen more progressively. Thus, it has been widely acknowledged by researchers that the 'main approach to understanding disability arises from the medical model' (Johnston, 1996, p. 131). The medical model demands that the individual takes responsibility for their disability and ensure the necessary adjustments to their behaviour are appropriate within the expectations of society (Bell, 2010). However, through numerous support networks, disability legislation and charities, this understanding has moved towards a more socially inclusive society where it is seen to be disabling barriers and presenting society within the responsibility of creating inclusion. Chappell, Goodley, and Lawthom, (2001, p. 48) point out that the empowerment of a self-advocacy disability movement such as the People First Scotland has fought the

‘colonizers of disability’, bringing about their views and opinions into the public domain to emphasise the components of a social model. Thus, self-advocacy has helped construct a community that can facilitate and redirect actions to enhance the social model of disability (Oliver, 1996). A monumental shift towards a more socially inclusive education system came in 1978 when the Warnock Report recommended that the categorisation of children with learning difficulties or disabilities to abolish and replace with the umbrella term ‘Special Educational Needs’ (SEN) (Pumfrey, 2008). The Warnock Report aimed to progress towards a more social model of disability for children and move away from a customised medical model of disability that had been dominating the UK since 1944.

2.7.1. Social Model of Disability

Described by (Hasler, 1993) as ‘the big idea’ of the British disability movement, the social model of disability originated from grass-roots politics in the 1970s by a campaign group known as the Union of the Physically Impaired Against Segregation (UPIAS) (Barnes and Mercer, 2004; Priestly, 2003). The disability movement gave rise to activists and supporters for the ideology of exploring an alternative to the ‘social interpretation’ of the ‘disabling society’ and the causes of the frequent discrimination experienced by individuals with impairments (Hunt, 1966; UPIAS, 1976). Fundamentally, this disability movement argued that individuals were not disabled by their impairments but by the disabling barriers confronted in everyday society (Oliver, 2013; UPIAS, 1976).

Over time, the emergence of these opinions and the endless support of disability supporters have provided the foundations for the social model of disability (Oliver, 1981; 1990). Consequently, rejecting the medical model that had criticised the way disabled people were unable to play a ‘full role’ in society (Dewsbury *et al.*, 2004). As Oliver (1996, p. 22) confirms, ‘disability is something imposed on top of our impairments by the

way we are necessarily isolated and excluded from full participation in society'. However, Shakespeare and Watson (2001, p. 24) point out that the social model challenges to deconstruct the connection between impairment (the body) and disability (the social creation) in disagreement with the out-of-date view that disabled people are thought as 'medical tragedies'. Shakespeare and Watson's central argument also identifies that although there is no 'difference between disabled people and non-disabled people', those living with disabilities are an oppressed minority living in a disabling society (p. 24). The 'Social Model' values suggest that those with disabilities are excluded by needless societal barriers (Dewsbury *et al*., 2004). For instance, a blind student is disabled if their tutor does not provide course material in accessible digital formats to read with text-to-speech software. In this example, the 'problem' is not the blind student but the institution's lack of awareness in supporting and enabling the tutor to provide appropriate formats for access. As a result, it is the social model of disability that rejects the idea that the person's disability is a medical problem and solely their responsibility to provide solutions. In part, it is the role of society that needs to change and not individuals. However, there also needs to be an emphasis of change on political empowerment of disabled people as a 'force for good' to help remove barriers set by society.

Nowadays dyslexia is broadly acknowledged and identified in society through campaigns and advocacy. However, a problem for some individuals still exists, either they or their families must fight hard for dyslexia to be identified before they can challenge the society that has helped create the label (Riddick, 2001). One of the key issues with dyslexia is that it is a hidden disability with no immediate signs that it is an evident 'learning disability'. Thus, situations can occur where the individual is challenged or even denied that they have a recognisable disability (Riddick, 2001; Riddick, Wolfe, and

Lumsdon, 2002). The identification and labelling of dyslexia among adults are examined further in Chapter 3.

Although the social model of disability has been widely used to explain how disability has been structured by society, there is a need for action against the oppression of disabled individuals (Gabel and Peters, 2004). For some individuals with dyslexia, the difficulties faced in society can also present a range of disabling barriers. For example, a study by Macdonald (2009) identified that social class appeared to influence individuals' experiences of living with dyslexia. It recognised that individuals from a working-class background experienced high levels of disabling barriers in contrast with their middle-class equals. Whereas the middle-class individuals appeared to have environments more accommodating towards dyslexia due to their 'access to resources' and 'educational success'. Thus, it was the working-class individuals who were more vulnerable to discrimination and likely to be 'exaggerated by dyslexic disabling barriers', maybe because of the lack of opportunities presented to them by society. While this study gives a brief insight into how dyslexia can impact individuals in society, there is a need to focus on the disabling barriers and recognise individual impairments (Riddick, 2000) across all areas of society to fully extend inclusivity to all.

2.7.2. Medical Model of Disability

The very first experiences of individuals with dyslexia were thought of in the medical context with the longstanding view that the disorder is solely the individual's problem. The model concentrates on the biophysical differences and ignores the established problem that individuals' experience and impairments can vary. As Ho (2004) points out, the medical model advocates that disability is a 'natural' problem of the individual and is directly caused by their mental or physical impairments. It is argued that

the use of the medical model promotes the idea that individuals diagnosed with learning difficulties are 'abnormal' and regarded as inferior to those individuals who are not diagnosed (Ho, 2004). However, it can be viewed that the medical approach begins to deconstruct disability as a natural medical problem, requiring diagnosis and treatment where the individual is solely characterised by their disability, and the wider social, emotional and behavioural experiences are ignored (Carawan and Nalavany, 2010).

While many educational professionals see the term 'dyslexia' originating from a medical model of disability due to an emphasis on child factors and the exclusive category of children (Riddick, 2000), it can be explored that the use of medical label thinking in higher education is still commonly used and questioned (Holloway, 2001; Madriaga, 2007). For instance, the Universities and Colleges Admissions Service (UCAS, 2015) form utilises the 'diagnostic-focussed' question requiring students to categorise themselves with a specific impairment, noticeably aligning with the medical model of disability (Matthews, 2009). This kind of medical approach understands the self-identification of impairment as the disability being an 'individualised problem' (Matthews, 2009; Oliver, 1996). Thus, in the case of the UCAS application the focus for the student may be on their 'deficits' and seeing themselves as having 'something wrong with them', even though it may not be considered to have a medical basis (Boxall, Carson, and Docherty, 2004; Oliver, 1996).

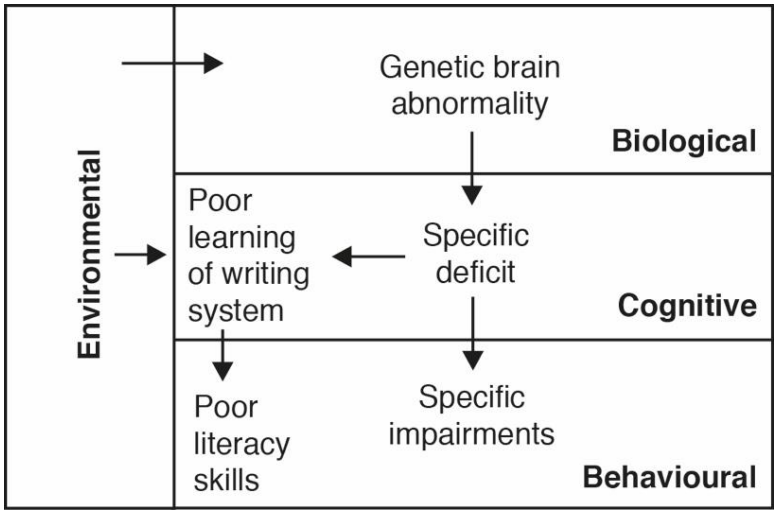
2.8. Morton and Frith: Three Stage Causal Model

Over the years there have been several attempts to define dyslexia and its causal links with a problem of reading (Snowling, 2006). From a substantial body of empirical research, the nature of dyslexia is now widely thought of as a disorder with several associated characteristics. Bishop (1997) points out that while dyslexia has behavioural

features, these are likely to change due to maturation with both social and environmental interactions. From a different theoretical perspective, Frith (1997) identifies dyslexia as a cultural phenomenon that has its main effect on literacy. The causal links from the brain need to be considered when understanding dyslexia.

The causal modelling framework developed by Morton and Frith (1995) provides a theoretical perspective to explain the causes of dyslexia across all levels. It acknowledges that there are various understandings towards dyslexia and identifies these within three main categories: biological, cognitive and behavioural. The framework model can also be applied to other developmental disorders. Figure 4 demonstrates the causal chain levels applied to dyslexia.

Figure 4. Causal modelling framework diagram applied to dyslexia (Morton and Frith, 1995; Frith, 1997).



A few years before the causal model framework was published Frith (1992) proposed for the links between the various levels of explanation to demonstrate the associations between biological causation, cognitive impairments and behaviours (i.e., poor literacy skills). The formation of the three-stage causal model reveals a comprehensive theory into

why some children fail to learn to read (Snowling, 2006, pp. 25-26). The causal model brings together established theories of developmental dyslexia and accepts the idea of a disorder in a multiple modelling framework.

Firstly, the biological level contained within this framework model identifies that the causes of dyslexia or other specific impairments could be due to genetic contributions and neuro-anatomical factors (Frith, 1999). Blakemore and Frith (2005) explain that developmental disorders are caused by subtle genetic programming faults affecting brain development; dyslexia is one of these developmental disorders and can have great consequences for cognitive development. While there is significant research on the physiological brain dysfunction in literacy tasks for individuals with dyslexia (e.g., Rumsey *et al.*, 1992; Shaywitz *et al.*, 1998), Frith (1999) argues that an explanation of the disorder should not be confined to the biological level. To understand dyslexia as a syndrome both the biological and environmental factors need to be considered with the influence of the cognitive and behaviour levels (Frith, 1995; 1999). Thus, 'the cognitive level is used as a bridge' in understanding the behavioural experiences and biological facts (Frith, 1997; 1999, p. 195). The prominent biological theories on the cerebellar deficit hypothesis (e.g., Nicolson and Fawcett, 1995; 1999; 2001a; 2008; Fawcett and Nicolson, 1999; 2008) and the magnocellular deficit theory (Stein, 2001; 2008; Stein and Talcott, 1999) are examined in Appendix A.

The cognitive level presented by Morton and Frith (1995, p. 358) refers to the 'functional description of the brain's activity' where 'affects and cognition occurs at the same level'. The causes of developmental dyslexia that belong to the cognitive level are associated with information-processing mechanisms although theories around cognition are still developing. The causal difficulties can include visual, auditory and temporal processing (Frith, 1999). Cognitive skills are closely associated with the behavioural level

as they cannot be observed directly. However, they can be assessed at the behavioural level from data obtained through literacy tests (Krol, Morton, and Bruyn, 2004). The difficulties caused by the cognitive deficits provide both a link to the biological and behavioural levels of the framework model. As Figure 4 illustrates, the environmental factors are also closely linked and can influence an individual's ability to process information. As Snowling (2006) and Clarke *et al.* (2014) explain, the frequency of specific reading difficulties depends upon external factors –both learning opportunities within the classroom and wider environmental elements can have an impact. While dyslexia has a genetic foundation (e.g., Finucci, 1978; Pennington and Olson, 2005), it does not mean that it is not susceptible to environmental interventions such as the development of reading comprehension skills (Snowling, 2006).

While several different cognitive deficits have been suggested as the causes of dyslexia, the dominant leading theory relates to the processing of speech sounds (phonemes) and written language (graphemes) (Bradley and Bryant, 1983; Frith, 1999; Snowling, 2006). Identifiable by Frith (1999, p. 194) as the leading 'cognitive level of explanation', the phonological deficit theory 'assumes that an abnormality in speech processing is the immediate cause of reading difficulties in dyslexia'. As Frith (1999) acknowledges, for an individual to be able to learn to read they must acquire the ability to decode letters (graphemes) and the sounds they represent (phonemes). Phonological skills remain essential in the capacity to map graphemes and phonemes to acquire the ability to understand alphabetic writing systems (Frith, 1999; Fälth *et al.*, 2013; Snowling, 2001; Vellutino *et al.*, 2004). From the phonological perspective, dyslexia is understood as a verbal deficit and regarded as part of a wider array of language disorders. This theory is supported by research from numerous studies that highlight deficient phonological decoding skills as characteristics of dyslexia (Lundberg, 2006; Shaywitz and Shaywitz,

2005; Snowling, 1996; Stanovich, 2000). As the English language is one of the more phonologically challenging languages, a child with weaknesses in phonological processing would lack the skills needed to achieve automatisation and would struggle to obtain basic literacy skills (Grigorenko, 2001). It is suggested that other European languages, such as Italian and Spanish, are much more phonologically transparent and therefore easier for children to learn to read and spell (Miles and Miles, 1999). That said, it is understood that many English-speaking children do eventually overcome their difficulties, but as adults, they may experience subtle difficulties with phonological perception that affect the development of adequate reading and writing skills (Snowling, 1996). For example, if a student's first language is more phonically regular (i.e., Italian) they may never have realised they are dyslexic until trying to learn English. Nonetheless, Durgunoğlu (2002, p. 189) points out that second language learners with dyslexia may have difficulties with 'phonological awareness, syntactic awareness, knowledge of genres and meaning-making strategies' in both their first and second language. In support of this perspective, Ball, Rainger, and Draffan (2005, p.26) suggest that the possibility of being dyslexic in one language and not in a second language is 'not that simple'. They argue that dyslexia is more complex than just reading and writing. For instance, if an individual has a short-term memory problem it will most likely remain no matter what language they are using.

The impact of a dyslexia diagnosis in higher education on an international student's second language can prove challenging. For instance, research by Mann, Ngor, and Wong (2013) identified that international students with dyslexia can discover that they are disadvantaged with having the disorder and the experience of studying at a higher level in a second language. The study also identified that students with dyslexia can have negative learning experiences and become anxious about their ability to learn; however, it was

highlighted that a diagnosis of dyslexia can provide students with the opportunity to achieve their academic potential. More broadly, there is also the need to consider the cultural aspects of teaching and learning as well as learning styles and factors associated with languages, such as transparency that can influence students' progress (Reid and Fawcett, 2004).

Other prominent cognitive theories of dyslexia include visual processing where there are specific deficits in the visual memory (Goulandris and Snowling, 1991; Skottun and Parke, 1999; Stein and Talcott, 1999; Stein, 2008). Referred to as 'visual stress', visual deficits occur across the wider population with an estimated 20 per cent experiencing problems. However, it is argued that this number could vary depending on the sample and criteria used (Jeanes *et al.*, 1997; Wilkins *et al.*, 1996). Irlen (1997) suggests that 12-14 per cent of the general population experience symptoms related to visual stress rising to 46 per cent for individuals diagnosed with dyslexics and other SpLDs. These occurrences of visual stress appear to be above the average rates of the prevalence of dyslexia where they are between 3-12 per cent (Schumacher *et al.*, 2007; Shaywitz *et al.*, 1998). These percentages highlight that the 'exact nature of the relationship between visual stress and dyslexia remains unclear' (Singleton and Trotter, 2005, p. 366).

The difficulties some dyslexics experience with visual stress problems can be understood as a concept called Meares-Irlen syndrome: 'a condition characterized by symptoms of visual stress and visual perceptual distortions' (Kriss and Evans, 2005, p. 350). It was identified in 1980 by Olive Meares and further explored by Helen Irlen in 1983, later becoming known as Meares-Irlen. An individual with Meares-Irlen syndrome or visual stress problems usually experiences generic symptoms such as headaches, sore or tired eyes. When reading, individuals would experience blurred moving images of

letters and words as well as sensitivity to extreme light (Kriss and Evans, 2005; Singleton and Henderson, 2007). Several research studies have explored the use of coloured overlays or lenses and identified the benefits to those experiencing symptoms associated with visual stress (e.g., Evans and Joseph, 2002; Kriss and Evans, 2005; Lightsone, Lightstone, and Wilkins, 1999; Singleton and Trotter, 2005; Wilkins *et al.*, 1996). Some research studies in the adult student population have identified the benefits with the use of coloured overlays. For instance, Grant (2004) reported a sample of 377 university students diagnosed with dyslexia, 42 per cent showed significant symptoms of visual stress with 34 per cent reporting visual stress symptoms. Further, a study by Singleton and Trotter (2005) claimed that adults who experienced high levels of visual stress were more likely to demonstrate progress in their reading rate with optimal colour if they were dyslexic –in contrast to not having the disorder. Thus, from this study, it can be questioned whether dyslexia and visual stress are entirely independent. If they were, all the participants with visual stress would have shown signs of benefiting from the use of colour overlays (Singleton and Henderson, 2007). However, a finding inconsistent with Singleton and Trotter (2005, p. 375) suggests that further research is needed 'on possible mechanisms of linkage between dyslexia and visual stress, including the magnocellular system as well as processes mechanisms of linkage between dyslexia and stress'. The debate between the causal connection between dyslexia and visual stress remains open for further research and how visual stress and dyslexia are defined and measured (Singleton and Henderson, 2007). Chapter 3 (section 3.16) adds a further discussion of colour overlays and typography with e-readers.

The final level contained in the causal modelling framework is the behavioural impact on developmental dyslexia. It is associated with the observations and facts about poor performance in reading and spelling exercises (Frederickson and Cline, 2015).

Although all three levels of the causal framework model are influenced by the environment, it is the behavioural level that is the most susceptible to this influence as 'behaviour is easily observable' (Helland, 2007, p. 28). The symptoms at the behavioural level, in the context of the manifestation of the phonological deficit, can be defined as impaired reading and spelling skills (Helland, 2007; Krol, Morton, and De Bruyn, 2004). Figure 5 by Snowling (2005) presents the manifestation of dyslexia across the lifespan. Helland (2007) adds that identifiable dyslexic behaviour (as outlined by Snowling, 2005, p. 28) can be 'both moderated and worsened by the influence of parents, school, friends and the subject's own self-esteem'. Although it is beneficial to define distinct behaviours of dyslexia, theoretical questions to 'subtypes' of dyslexia remain how each link to a different profile of skills (Nicolson, 2001).

Figure 5. Manifestations of dyslexia across lifespan (Snowling, 2005).

Pre-school	**Early school years**	**Middle school years**	**Adulthood**
• Delayed speech	• Poor memory for verbal instructions	• Subtle speech problems	• Poor verbal memory
• Immature sentence formation	• Difficulties with common sequences	• Word-finding difficulties	• Word-finding difficulties
• Poor expressive language relative to comprehension	• Poor letter knowledge	• Difficulty learning tables and number facts	• Slow reading
• Poor rhyming skills	• Poor phonological awareness	• Slow reading	• Slow speed of writing
• Little interest in or knowledge of letters	• Poor phonics (word-attack skills)	• Poor decoding skills when faced with new words	• Poor proofreading skills
	• Idiosyncratic spelling	• Phonetic spelling	• Difficulty committing ideas to paper
	• Problems with copying	• Slow at copying	• Poor organisation of written work

To understand and explain behaviours, the use of criteria for identification, measuring instruments and the appropriate use of the sampling strategy for variability can all play a role in defining developmental disorders. Frith (1999, p. 195) describes behavioural measures as being 'the outcome of the interaction of a great many factors'. These factors can be interpreted as what the tests measure (e.g., working memory, phoneme awareness) but also the attitude and attentiveness of the individual at the time of testing. Although researchers have been useful in identifying and testing possible causal factors through these measures, Heaton and Winterson (1996) argue that the numerous experiments conducted have clouded the view of the topic and effective action. They highlight that an array of 'semi-contradictory' causes of dyslexia are continually being examined to justify indicators and defend treatments, potentially obscuring the views of the practitioner and breaking down the reliability of dyslexia as a valid disorder.

One of the most fundamental challenges faced is to explain the diversity of dyslexia and how it manifests itself in different individuals. Thus, it is essential for cognitive theories to examine all elements of biological and behavioural research including any environmental or genetic influences.

2.9. Conclusion

Whenever reviewing or examining dyslexia three of the most prominent areas that are often touched on are the definitions of dyslexia, identification and diagnostic criteria, and the role intelligence plays in the assessment of dyslexia. This chapter has attempted to address these areas with a wide range of literature from across the spectrum of educational and scientific research, highlighting that dyslexia is a multifaceted and highly debated subject.

At the beginning of this chapter, the historical perspectives lay the foundations for the understanding that dyslexia and its associated forms of literacy difficulties are a type of brain impairment, often regarded as 'word blindness' and 'visual processing deficiencies'. What the historical perspective presents is a sense of meaning that the difficulties associated with dyslexia have been impacting individuals since the 1990s. There is a need to discover more about the disorder in providing ways of independent support using technology. The defining of dyslexia has evolved with definitions being defined by advocates, researchers and policymakers. While the exact wording and meaning of dyslexia can vary, all definitions acknowledge that it is a term associated with difficulties in the acquisition of language. It is also widely recognised that dyslexia presents itself with a range of other cognitive difficulties such as rapid naming, processing speed and working memory. Moreover, it is important to recognise that dyslexia is a life-long disorder and children identified with working memory problems will continue to experience these difficulties into adulthood, affecting performance in phonological modalities as well as central executive functions (Smith-Spark and Fisk, 2007). From the literature, short-term memory issues can be identified as a prominent factor to all SpLDs particularly within patterns of cognitive functioning (Jeffries and Everatt, 2004).

Although this chapter identified several advantages and disadvantages to the use of IQ assessments with reading relationships, the measure between intelligence and achievement is still used in diagnostic assessments across the education spectrum. A change in this approach could prove difficult or slow to move away from particularly with set criteria requirements from government, exam and education authorities. However, in the USA (as well as the UK) there has been a substantial shift towards the diagnosing of a specific reading disability. The Diagnostic and Statistical Manual of Mental Disorder (DSM-5, 2013) of the American Psychological Association (APA) has removed the

discrepancy between general cognitive ability and reading skills. Thus, it is now understood that all children with dyslexia have similar weak phonological skills regardless of intellectual ability (Lyon, Shaywitz, and Shaywitz, 2003).

The lengthy and complicated process of obtaining a dyslexia diagnosis involves several assessment procedures that the student is guided through before receiving appropriate support. While some students may find it overwhelming, others may be prepared from previous experiences and already have a range of compensatory strategies in place to aid their learning. Consequently, it is difficult to present a universal profile of an adult with dyslexia (Tanner, 2009) due to the underlying impairments of the disorder and how it manifests and changes as the individual ages. Thus, both the environment and compensatory strategies can have a significant influence (Frith, 1992; Snowling, 1987).

By exploring the perspective of both the social and medical model of disability, it has helped the thesis present a more personal and detailed view of the impact of disability on the individual in society. While the medical model has placed the individual at the centre of their disability between cause, symptom and treatment, the social model has been a movement of the people ensuring society removes barriers that limit choices for disabled individuals. Thus, disability legislation, better education and research have contributed to making society more inclusive of all forms of disability not just learning disabilities. Finally, Morton and Frith's (1995) theoretical model is one of the first attempts to bring together prominent theories of developmental dyslexia by connecting the biological, cognitive and behavioural levels with the influences of environmental factors to establish multiple frameworks. The real issue with one definitive definition of dyslexia or theory is that it does not define the disorder for clinical or educational practice. While theories offer distinctions for scientific researchers, they can lack clarity in language for the wider learning disability community.

The following final literature chapter examines more closely the broader understandings of dyslexia and disability, and research into the role of assistive learning technologies within the context of higher education.

Chapter 3: Literature Review

Perspectives of Disability and Support in Higher Education and the Cognitive Role of Assistive Learning Technologies

3.1. Chapter Overview

This chapter presents a review of research on two areas closely related to dyslexia and the present study. The first section explores the views of disability, dyslexia and support in higher education, as well as providing an insight into legislation, funding and the identification and labelling of dyslexia. The second section examines the wider background of ICT tools in higher education and the role of engaging students with dyslexia in their studies. Both sections conclude with a summary of the main themes reviewed highlighting the perspective of the individual with dyslexia.

Section One: Disability, Dyslexia and Support in Higher Education

3.2. Introduction

This first section addresses the broader perspectives of disability contexts and dyslexia, as well as providing substantial background information across three prominent subjects: disability in schools and higher education, identification and labelling, and dyslexia in higher education. While the focus of the study is on higher education and the educational experiences of assistive learning technologies for students with dyslexia, the

first subject, disability in education, briefly explores the broader context of schools providing support and screening for children. A more detailed section provides an outline of the history of disability rights legislation, the DSA and the funding available for schools and universities. The following topic explores the perception of dyslexia in higher education examining the prevalence and effect of the disorder across aspects of university life and the influence on the students' learning. The final topic considers the wider argument about whether labels or labelling an individuals' difference is necessary or whether it has a negative or positive impact on their disability. The section concludes by highlighting the importance of legislation, the impact of students' experiences at a university for state and private schools, the frequency of increases in dyslexia across higher education, as well as summarising the processes of identification and labelling of dyslexia.

3.3. Disability in Schools and the Development of Legislation

The origins and extent of SEN support in Great Britain date back to 1791 in Liverpool where Henry Dannett founded the School of Instruction for the Indigent Blind. Following interest in the School, where blind children and adults were trained in music and manual crafts, several other private schools followed (DES, 1978). Nearly a century later the Victorian definition of learning disabilities was introduced with the Idiots Act of 1886 providing an understanding of 'idiots' and 'imbeciles' from 'lunatics' (Idiots Act, 1887; Tomlinson, 1982). Appendix H presents an outline of events exploring the history of special education in Great Britain from the mid-eighteenth century to the mid-twentieth century (adapted from DES, 1978; Tomlinson, 1982).

Before legislation of the 1970s and 1990s requiring authorities and educational institutions to provide an inclusive learning experience, the 1944 Education Act (HMSO,

1944) was the first major government development recognising children's special education identifying education to be focused on age, aptitude and ability. An outline of key learning disability legislation and government reports since the 1940s is presented in Appendix I.

Following several major social welfare reforms during the UK's post-war period the 1978 Warnock Report, followed by the introduction of the 1981 Education Act, fundamentally transformed the concept of SEN (DES, 1978). By abolishing legislative categories such as 'handicap' it introduced the idea of a 'continuum of special educational needs' (Riddick, 2000, pp. 655-656), moving away from an individualised medical model of disability to a socially inclusive model for children (Pumfrey, 2008). The Warnock Framework introduced under the 1981 Education Act continued to provide legislative powers to individuals seeking clarity and protection against discrimination.

While the UK passed several prominent disability legislation since the 1990s, it did not go far enough in preventing wider discrimination in the workplace or higher education setting. For instance, the Chronically Sick and Disabled Persons Act (1970) ensured that disabled individuals received equal access to leisure and education facilities but failed to cover discrimination and involve disabled people in the creation of the law. After many years of campaigning by disability activists, the Disability Discrimination Act (1995) was introduced. It ensured that employers and service providers deliver appropriate adjustments to protect the rights of deaf and disabled individuals. The Disability Discrimination Act made progress in removing some discrimination, but many employment cases were rejected due to the individual not being identified as disabled under the Act (Gooding, 2000).

It was not until 2001 that the UK government passed legislation for Part 2 of the SENDA Act amending the Disability Discrimination Act 1995 to forbid all schools from

discriminating against disabled children. One of the primary emphases for SENDA was the removal of exemptions given to educational institutions in the Disability Discrimination Act of 1995. While the fundamental principles of SENDA (2001, p. 7) were to guarantee that 'all children's needs are met' with appropriate educational needs support and full access to education, it highlighted the need for reasonable adjustments. These adjustments vary from individual to individual but covered specialist equipment, expert support staff, the modification of teaching and learning materials or changes to teaching access and platforms. As a result of all educational institutions (schools, colleges, universities) being included in the Act, it ensured that the needs of individuals with disabilities were met throughout their pre- and post-16 education.

3.4. Disability in Higher Education and the Impact of Legislation

While there have been numerous studies concentrating on a range of disabilities in higher education for sometime (e.g., Ahead, 1994; Borland and James, 1999; Goode, 2007; Penn and Dudley, 1980; Ryan and Struhs, 2004; Watson, 2002), fewer studies have explored the sole focus of dyslexia. This is partly due to the advancement of disability legislation, and dyslexia understood as a relatively new phenomenon. This study is well positioned to explore these experiences around dyslexia and the impact of legislation and funding made available to students.

From 2000 the landscape of higher education has changed considerably with the introduction of disability legislation making it accessible to enable individuals with disabilities to access education (Lewis, 2002). A study by Tinklin and Hall (1999) identified five barriers to disabled students in higher education: the physical environment; access to information; entry to higher education; assumptions of 'normality'; and levels of awareness. Currently, disabled individuals represent between 3-12 per cent of the UK

population and a significant proportion of university students have disabilities. For instance, 5.5 per cent of Open University students state they have a disability (Cooper, 2006; Open University, 2016). 'Disability' is a broad term that covers a diverse range of conditions that can be both mental and physical. Seale (2006a, p. 12) adds that a disability is the 'extent to which performance of activities are limited'.

The creation of the Disability Discrimination Act of 1995 further enhanced disability laws and gave more disabled individuals protection from discrimination. While coverage of the Act did not include education provision, it did set a new legal obligation to Higher Education Funding Council England (HEFCE). It ensured the requirements of disabled individuals are considered, and state-funded universities publish disability statements on their provision for students' disabilities (Parker, 1997). Holloway (2001) points out that within a university there are three documents that refer openly to the university's legal requirement of provision for disabled students. These include:

- Disability statement –setting out current policy and provision with proposed future action;
- Teaching and learning strategy –directing departments to review the requirements for disabled students, and;
- Teaching and learning guidelines –ensuring that policy is implemented.

These three points are emphasised by the Quality Assurance Agency's (QAA) (2010, p. 4) code of practice guidelines for higher education institutions.

A few years later the government-sponsored the examination of higher education systems in the UK through the publication of the Dearing Report (National Committee of Inquiry into Higher Education, 1997). The Dearing Report recommended the widening

access of students from groups under-represented in higher education such as disadvantaged backgrounds and students with disabilities. Thus, the strategy was to provide financial supplements to HEFCE-funded institutions who recruited and retained students from underrepresented groups (Lewis, 2002). Between 1999 to 2001 tens of millions of pounds was allocated to higher education institutions, with an emphasis on additional funding for full-time undergraduates in receipt of the DSA. An overview of the DSA developments, funding and initiatives are presented in Appendix J.

The extension of SENDA in 2001 to higher education gave rise to substantial changes in the university sector by requiring provision for students with disabilities. The Act, which was later revised in 2005, made it illegal for institutions to discriminate against disabled students. Coming into force in September 2002, the Act amended part IV of the Disability Discrimination Act of 1995. It ensured that reasonable adjustments could be made to accommodate disabled students, for instance, providing resources available electronically for blind and dyslexic students (Gerrard, 2007). The question of what should be made available online is discussed by Cooper (2006) who argues the need for 'reasonable adjustment' and that the diverse requirements of the disabled student are foreseen instead of the educational institutions attempting to deal with these as they occur.

3.5. Funding and Support Available in Schools: State and Private

Since the 1970s there has been a substantial increase in the provisions outlined for pupils identified with SENs partly due to the publication of the Warnock Report in 1978 where special education provision was argued to be more extensive and integrated. The Report's recommendations and findings resulted in the creation of the 1981 Education Act and thus establishing the system of Statements of SEN. The 1981 Act made it a legal requirement for LEAs to assess children and understand the scale of their learning

difficulties. According to the National Literacy Trust (2011), approximately 60 per cent of SEN children are educated in a mainstream school with the support of external specialists. However, children with more severe disabilities are offered funded places at special schools, which are usually private. Today, LEAs are obliged to provide this funding, but recent government cuts have resulted in some students not receiving this support. Data from the DfES (2006) consistently show that the number of full-time pupils in special schools has decreased steadily. For instance, in 1979 131,000 pupils attended special schools, by 2005 this had fallen to 90,290. The reduction in pupils attending a special school could be in part due to policy and the government's view to educating those with disabilities in a mainstream school with SEN support (e.g., MacBeath *et al.*, 2005).

A recent reflection of today's costs for 2009-2010 is disclosed by the Department for Education (2011) that outline the total SEN expenditure as £5.2 billion. From this amount: £2.1 billion was assigned to mainstream schools, £1.6 billion was assigned to maintained special schools, and £612 million used to fund children with SEN statements at independent and non-maintained special schools.

For higher education students with disabilities, previous experiences of support provided at school will usually influence their opinions of disability practices offered by their university. These views will depend upon the type of school attended, either state or privately funded, and the broader support received before starting university. According to Ryan and Sibieta (2010), around 6-7 per cent of children in the UK attend private schools, otherwise known as independent schools. Compared to state schools, independent schools do not receive direct government funding, although some may have a charitable status that allows tax exemptions. Due to private/independent schools charging average annual fees of £10,100 for day pupils (Ryan and Sibieta, 2010), pupil to teacher ratio tends to be much lower than at state schools. The Independent Schools Council (ISC, 2017) estimates that

there are approximately 31,000 children with dyslexia at more than 1,100 independent schools in the UK. Each school offers a range of specialist provision for SEN and Disability (SEND), including specialist support from an educational psychologist, speech and language therapists, and one-to-one support.

While there are very few UK studies that explore special education with independent schools (e.g., Burden and Burdett, 2005), it can be argued that better resources, access to specialist support and a lower teacher to student ratio are an advantage in helping children with learning disabilities overcome their problems. A comparison study by Ndaji, Little, and Coe (2016) exploring academic achievement in schools identified state pupils significantly behind their privately educated peers, even when the social background and previous attainment is considered. The study compared performance through the pupils' primary school and GCSE level, discovering the private schools were ahead on every level. The researchers acknowledge that the findings should be 'viewed with caution' due to the measure of postcode-based deprivation data and the causal effects of attending an independent school could be an overestimate due to factors of the study not being considered. Although the study by Ndaji, Little, and Coe (2016) does not suggest that disabled children would benefit from an independent school, a government report by Rose (2009) highlights the need to develop high-quality interventions for children to support literacy. Interestingly, a study by Burden and Burdett (2005, p. 103) supports this view, and the independent specialist school under investigation had 'highly positive attitudes towards learning', and pupils were educated in an environment where the majority had 'highly positive attitudes towards learning' and independent control in learning outcomes. Thus, the support and access to special education in an adaptive and resourced environment such as an independent school could prove most beneficial. Due to small numbers of research studies exploring selective

school environments, it can be difficult to draw strong comparisons with state schools. Nonetheless, from the few studies that exist the emphasis is on the importance of mainstream schools becoming 'dyslexia friendly' and developing a 'truly inclusive ethos' (Burden and Burdett, 2005).

For children attending a state-funded primary or secondary school, there are several statutory regulations local authorities must provide to support and implement. For instance, local authorities delivering supported early education must ensure that they 'consider how best to use their resources to support the progress of children with SEN' (Department for Education (DfE), 2015, p. 90). It is estimated that 14.4 per cent of children in England (approximately 1.2 million) are identified as having SEN or disabilities (DfE, 2016). However, a recent survey by The Key (2016) of 1,100 school leaders found that 82 per cent of schools across England have insufficient funding in their budget to sufficiently provide for their pupils. The survey also suggests that 89 per cent of the recent cuts to local authorities were hampering the ability to manage students' needs. These statistics currently highlight a concerning pattern across SEN mainstream schools, primarily when they should be contributing to the development of SEN friendly policy and practice as well as exploring specific intervention programmes (Riddick, 2006).

3.6. Funding for Higher Education: Disabled Students' Allowance

Since the introduction of disability legislation and the focus of improving access to higher education for disabled students, preceding governments have continued to expand the support of the DSA in aiding students with both physical and learning disabilities. It is the growth in the range of support and provisions across institutions that have also contributed in making it more affordable and appealing for students to attend higher education programmes (Pino and Mortari, 2014).

The existence of support and funding for dyslexia before the Education Act of 1995 in schools and higher education institutions was virtually non-existent. The introduction of legislation in the mid-1990s and beyond can be partly attributed to 20-30 years of scientific research exploring language processing disorders that are now recognised as a primary feature of dyslexia (e.g., Jorm, 1979; Jorm and Share, 1983; Vellutino, 1979; Wagner and Torgesen, 1987). Students with learning difficulties, educated before the introduction of legislation and the awareness of learning disorders, would have had limited opportunities to access support and provisions at school to achieve the requirements needed for entry into a higher education institution.

During the 1990s there was a 'muddled and patchy mixture of paternalism and self-advocacy' operating in the UK with some LEAs financing dyslexia assessments and others shying away from the idea (Riddick, Farmer, and Sterling, 1997, p. 17). Also, the majority of British universities and colleges continued to offer little or no support to disabled students. In a review of education for disabled individuals, Barnes (1991) discovered that many of the British higher education institutions were inaccessible with many reluctant and unable to provide the appropriate accommodations to make learning accessible for all students. Due to legislation changes, many institutions were forced to accommodate disabled students. The number of students receiving the allowance has steadily increased. Since the academic year 2000/01, only 1.5 per cent of UK undergraduate students received the DSA, by 2014/15 this number had increased to 7 per cent (HESA, 2014).

Originally introduced in 1989, (dating back to 1974 in small local funding initiatives) the DSA was established with a small grant from the UK government creating the National Federation of Access Centres, initially aiding 500 students with physical and sensory difficulties. Following the publication of the Dearing Report in 1997, means

testing for the DSA was abolished in 1998/1999 and extended to include part-time and postgraduate students in 2000/2001 (Harrison *et al.*, 2009). Initially administered by UK LEAs, it was transferred in 2009 to Student Finance England (Beauchamp-Pryor, 2012) where it provides disabled students (including those with long-term health and mental health conditions, and SpLDs) with funding to cover disability-related costs or expenses.

Currently, there are four allowances covering different areas that disabled students can access: specialist equipment; non-medical; general expenditure; and travel costs (DSA, 2017). Students eligible for the DSA would need to provide evidence of a medical statement and diagnostic report as well as providing evidence of studying an undergraduate or postgraduate course lasting at least one year. It is available to both full-time and part-time students including distance students. The 2017/18 rates for the allowance are as follows (DSA, 2017):

Full-time undergraduate students can be funded up to:

- Specialist equipment allowance - £5,358 for the entire course
- Non-medical helper allowance - £21,305 a year
- General allowance - £1,790 a year

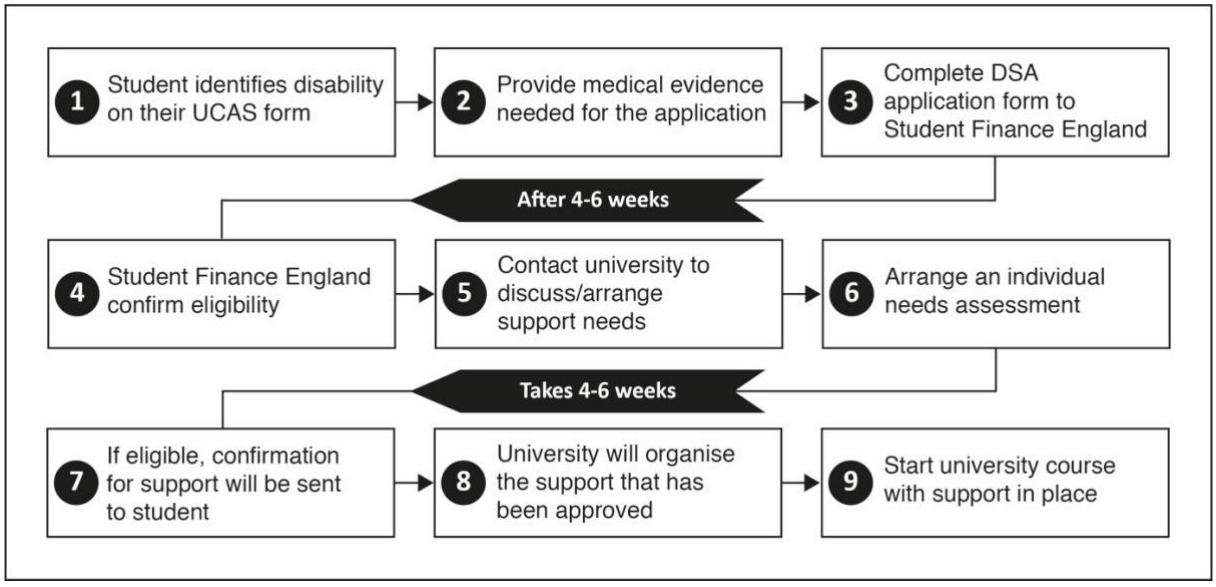
Part-time undergraduate students can be funded up to:

- Specialist equipment allowance - £5,358 for the entire course
- Non-medical helper allowance - £15,978 a year
- General allowance - £1,432 a year

Postgraduates can be funded with a single allowance of £10,652 a year.

According to DfE (2015), applications for the DSA should be made as soon as the Student Finance England application service opens. Although this can vary from year-to-year, it is usually six months before the student is expected to start their university course. For some students with dyslexia, the process involved in completing the DSA form can prove difficult. Norton (2007) who conducted a small-scale study discovering the difficulties students faced when applying for the DSA, identified the main issues experienced were 'filling in the forms and having to read everything'. Another student added that '… a lot of students might not actually bother with it because it is so hard to fill in'. Norton also points out that several of the students also arrive at university with 'their own personal life experiences' of dyslexia that can have a negative influence on their ability to accept the disorder and complete the DSA form. An overview of the DSA process and the stages involved for students to receive their support, provision and technologies are presented in Figure 6.

Figure 6. DSA process of student support and diagnosis (Adapted from Ulster University, 2016; Jamieson and Morgan, 2008).



Following a government review in 2014, David Willetts, Minister for Universities and Science, published a Ministerial Statement on changes to the DSA (DSA, 2014). These included modernising the current system and ensuring that the limited funding is targeted at those in most need of help. Described by some institutions as a 'rebalancing of responsibility', universities are now accountable (from 2015/16) for funding parts of disability-related support that were previously funded by the DSAs. Higher education institutions are now required to provide inclusive practice to ensure that courses, delivery and assessment are accessible to all students, as well as providing both practical and financial support for services such as note takers and proof-reading. Taylor *et al.* (2016, p. 369) suggest that these changes are an indication of the government's intention to reduce expenditure on disabled students by 'effectively withdrawing support for students with mild or moderate levels of disability, and the transferring the cost of supporting such students to universities'.

Moreover, the funding for the purchase of standard computers, printers and scanners are no longer provided, only higher specification or higher cost computers 'where a student needs one by virtue of their disability' will the DSA cover costs (DSA, 2014). Since the proposal and introduction of these new changes, disability charities, Student Union's and the wider higher education community affected have campaigned, arguing it will have a major bearing on the support provided to students at university. A recent case study by Taylor *et al.* (2016) explored the 'transformation required' for university services at a large post-1992 university to identify the proposed changes to the DSA. The study highlighted several changes to the way support and provision is made available and accessible for disabled students. These included: a review of university policy into the funding and process of dyslexia assessments; organisation of local and central provision of assistive computer hardware and software; inclusive learning and assessment materials

to reduce the need for notetakers such as lecture capture; and centralising the organisation of special examination provisions. Although these changes were implemented within a short period since the DSA recommendations were proposed, further research is needed to explore the deeper impact of the reforms within institutions over a longer period as well as exploring students' views both before and after.

Before government reforms of the DSA, several studies investigating student experiences and the impact of the allowance in higher education have been well explored (e.g., Goode, 2007; Holloway, 2001; Kirwan and Leather, 2011; Mortimore, 2013; Riddell and Weedon, 2006; Tinklin and Hall, 1999). The more recent studies after 2009 share similarities to this study as the funding structure of the DSA is provided by Student Finance England. It is currently unknown how the new DSA funding structure will impact higher education and disabled students' experiences. However, this study focused on those experiences before the government reforms on universities.

For some time, the DSA has provided many disabled students with access to technologies enabling them to support their studies. Although some students may already have a diagnosis when applying for the DSA, for many it is the first time they are assessed with a disability (Goode, 2007). Compared to their peers, disabled students' experience several assessment procedures (i.e., diagnostic and needs assessment) before receiving any support or provision. This can prove to be 'costly in terms of time, money and emotional work' Hopkins (2011, p. 9), as well as stressful when delays are experienced (Holloway, 2001). Riddell and Weedon (2014, p. 43) acknowledge that the formal diagnosis process of dyslexia can be 'lengthy' and the support of software packages can be delayed 'until the second year of the course'. While there are a number of issues with the DSA, there are further problems associated with the university and the student coming to terms with their disability. Some of these were highlighted in a report for HEFCE and

HEFCW published by Harrison *et al.* (2009). The report identified problems of 'delay and poor communication affecting the meeting of individual support needs' (p. xiii). It proposed that universities need to reduce delays in processes and target information to all students, not just groups whose needs are more visible from the start. Moreover, further work is required within teaching and learning as both practical and attitudinal barriers remain despite improvements in this area.

3.7. Needs Assessment: Disabled Students' Allowance

As part of the DSA, the needs assessment is a one-to-one meeting between the student and assessor at either an educational institution or approved independent assessment centre. The meeting aims to explore different types of technologies with the purpose of understanding the students' support needs. Draffan, Evans, and Blenkhorn (2007) point out that the support needs of dyslexics vary between individuals and can be quite complicated. Draffan, Evans, and Blenkhorn also add that a substantial number of students receiving the DSA are identified with dyslexia when starting their university course, compared to the majority of other disabled students with hearing, physical and visual impairments –whose needs are identified earlier.

Before the needs assessment, the assessor will read the student's diagnostic report provided by the educational psychologist or registered diagnosis tutor. It is an opportunity for the student to explore and discuss what support and provisions they need to get the most from their time at university. Due to students being faced with several face-to-face assessments, Jamieson and Morgan (2008) acknowledge that it can cause some students to feel overwhelmed and confused between the 'diagnostic assessment' and 'needs assessment'. It is estimated that a needs assessment takes between one and a half to two hours with the student shown several examples of assistive learning technologies to

support their studies. These technologies can include both hardware and software, although Draffan, Evans, and Blenkhorn (2007, p. 115) explain that there is 'no standard combination of hardware and software given to students'. It is also noted by Draffan, Evans, and Blenkhorn that the maximum 'a typical' dyslexic student receives is a scanner, recording device, mind mapping and text-to-speech software. It is estimated that it can take between 4-6 weeks before students receive confirmation that their claim for support has been approved. A further two to four weeks is anticipated before the technology is delivered to the student. In addition to recommendations, the needs assessment also allows the assessor to suggest proposals for possible exam arrangements and reasonable adjustments such as recording lectures and receiving advanced copies of lecture notes (Jamieson and Morgan, 2008).

The selection and review of technologies during the needs assessment process should be a two-way process between the student and assessor. Price (2006, p. 36) supports the view that 'technology needs should be a multi-professional process, not a linear, sequential procedure' that is frequently the case. It is also suggested by Price that specialist assessors and dyslexia tutors should work together with technology specialists to ensure 'effective technological scaffolds' are developed for each student, so 'a dyslexic cognitive profile can be matched to effective and efficient solutions'. However, it can be identified that there are two significant factors that can impact a student's perspective of engaging with the technologies once they receive it. Firstly, while it is widely assumed that students are 'tech-savvy' and proficient in interacting with all forms of technology, it should not be assumed. Draffan, Evans, and Blenkhorn (2007) assert that those students trained in using the specialist technologies tend to have a good perception of training, but a majority of students remain untrained partly due to their perceptions of IT competence. Assessors and access centres should not assume that 'students with mild disabilities will

learn to use the tools independently' or 'continue to use it across time and conditions' (Wissick and Gardner, 2008, p. 87). A case study by Eld (2008) highlighted the need for further training opportunities for students, suggesting that assistive technologies should be introduced before recommendations or reports being made. Another significant factor to influence students' perceptions of engaging with the technology is the selection of inappropriate technology provision during the needs assessment. Stacey (1998) describes this position as equally negative as receiving no provision. It raises important questions about students' involvement in the selection of technologies to support their disability, particularly when students abandon or do not respond to using technologies that have been given to them. If factors of training and student involvement in the selection of technology are not addressed, some students will discontinue to engage and possibly abandon any future use of assistive learning technologies.

3.8. Higher Education: Students with Dyslexia

From 2008 there have been two distinct groups of dyslexic students entering the university system. The first group are those assessed with dyslexia after starting university and are offered interventional support. The second group are those diagnosed recently while at school, with some receiving specialist support (Jamieson and Morgan, 2008). These students will have a clear idea of their entitlement to financial support and will have benefited from special examination arrangements during their GCSEs and A-Levels.

For many students with disabilities, starting university can be a daunting and intimidating experience. In some cases, it will be a time of uncertainty, readjusting to a new and self-disciplined environment accepting academic and social responsibilities (Lowe and Cook, 2003). It can be argued that all students experience feelings and emotions during their first months at university. But for those students with dyslexia, they

may display higher levels of stress and anxiety, mainly when presented with tasks or activities involving literacy (Carroll and Iles, 2006). A study by Riddick *et al.* (1999) exploring the associations between anxiety and undergraduates identified that students with dyslexia displayed higher levels of anxiety and feelings of incompetence in their academic work compared to the control group. Although students reported lower anxiety levels compared to their time at school, the overall experience in higher education was more 'sympathetic' regarding attitude and support, despite identifying as 'doing less well academically than their peers' (p. 238). Nevertheless, depending on whether the student is mature or just out of school, some will develop personal coping strategies for supporting and managing their difficulties (Thomson, 2008). A UK government report published by Goswami (2008) identified the need for the early identification of learning difficulties combined with focused interventions to prevent problems developing and to create benefits for the individual and society. These interventions may be with technologies, study skills or specialist tuition. Thus, students identified with learning difficulties should be provided with the relevant support and provisions, regardless of how they arrived in higher education. However, in several studies (e.g., Hadjikakou and Hrtas, 2008; Madriaga, 2007; Morgan, 2001; Riddell and Weedon, 2006) researchers have also highlighted how academic staff are sometimes rude or dismissive towards students with dyslexia. Mortimore and Crozier (2006, p. 238) suggest that in many cases, academic staff will be uninformed of a student's diagnosis and 'even when they are aware of it, their marking may be guided by the belief that, whatever the student's difficulties the effective production of written work is an essential component of 'graduateness''. For some tutors, they may never have encountered teaching a student with dyslexia or even understand the disorder. Thus, pre-existing teaching practices and materials may not be appropriate or even accessible. An analysis of research data by Riddell and Weedon (2006) from an

ESRC funded study into 'Disabled Students and Multiple Policy Innovations in Higher Education', highlighted that pre-92 university lecturers did not make suitable adjustments such as access to lecture notes in an electronic format. More widely acknowledged by lecturers from the study was the distrust of using the label 'dyslexia' to warrant reasonable adjustments for assessment, particularly as some feared that the category could be used as a 'smokescreen for lazy students' (p. 70). However, Riddell and Weedon (2006, p. 70) suggest that dyslexia is becoming more 'actively embraced by a growing number of students in higher education', but among lecturers, there is scepticism about some middle-class students using dyslexia 'as a means of securing additional resources and allowances'. The claim middle-class families and individuals are actively seeking a dyslexia diagnosis is suggested by Gillies (2005). Moreover, analysis of the HESA statistics also points towards students with dyslexia being more likely to be middle class (Riddell, Tinklin, and Wilson, 2005). Further research is needed to explore the 'middle-class dyslexia phenomena' in higher education and identify if there is a social influence within the student community or a familial effect towards a diagnosis.

Today, dyslexia is one of the largest forms of disability in higher education with growing numbers of students obtaining a diagnosis for the first time when starting their studies (Watson, 2002). For the academic year 1994-1995, the profile of undergraduate students with a disability was 3.5 per cent of the first-year student population, with 1.5 per cent recognising themselves with dyslexia (HESA, 1996). An analysis of HESA statistical information for the academic year 1999-2000 by Riddell, Wilson, and Tinklin (2002) found that disabled students were more likely to be white males aged between 19-24 years, with the largest group of disabled students being dyslexic and most likely to be white, middle-class and male. The HESA statistics are compiled through students' self-disclosure on their UCAS form and do not necessarily mean a formal diagnosis has been

undertaken. Postgraduate students with dyslexia are not represented in HESA statistics as they do not complete a UCAS form and may not be questioned about their disability status on entry (Riddell, Tinklin, and Wilson, 2005a). For the 2015-2016 academic year, the number of students with dyslexia (including SpLDs) was reported to be 5.6 per cent (HESA, 2016). An overview of HESA statistics and categories of disability for first-year undergraduates from 1994 to 2016 is presented in Appendix K. The HESA statistics point towards higher education becoming increasingly more accessible to students with dyslexia and other disabilities since the late 1990s, with large numbers of students self-identifying themselves with a disability (Bacon and Bennett, 2013; Jordan, McGladdery, and Dyer, 2014). The increases in students with dyslexia and other forms of disabilities across higher education can be partly due to the UK government's widening participation agenda. The objective was to achieve 50 per cent of 18-30-year-olds to attend a higher education institution by 2010 (Perkin and Croft, 2007). Although this target was briefly achieved in 2013/14 with 49 per cent of young people attending a higher education institute (DfE, 2016a), the National Working Party on Dyslexia in Higher Education by Singleton *et al.* (1999, p. 15) argues that the increase in dyslexia within universities can be attributed to several factors. These include: widening access for mature students; early identification and provision for school children with dyslexia; improved academic support; widening participation from legislation and policies; and increased financial support for students through the DSA. Riddell and Weedon (2014, p.40) make the connection that due to the 'financial incentive to disclosure, the proportion of disabled students in UK higher education institutions over the past decade has almost doubled'. It is also suggested by Hopkins (2011) that the recent growth in dyslexia numbers could be connected to universities making increased diagnoses or individuals disclosing a disability to receive support services instead of any wider improvements to access. However, it

remains open for debate whether the increasing number of students with dyslexia is due to improved incentives for disclosure, widening access or a more inclusive environment. While this study does not attempt to explore the reasons why more students with dyslexia are attending university or their perceptions of disclosing their disability, it aims to discover a general understanding of the personal experiences at university.

3.9. Support for Students with Dyslexia

Since the introduction of legislation, universities have invested time and financial resources ensuring support and provisions for disabled students are up-to-date with government policies and practices. While the DSA has provided universities with additional funding to support disabled students, more direct measures from the government have been introduced to improve access. For instance, the Quality Assurance Agency's (QAA) 'Code of Practice for Students with Disabilities' stipulates 21 precepts of good practice for academic quality and standards that institutions must follow (QAA, 2010, p. 2; Riddell and Weedon, 2006). The first precept of the QAA (2010, p. 4) clearly defines that 'appropriate provision' should not be described as 'additional' by institutions, instead 'a core element of the overall service that an institution makes available'. The disability office is a key example of this 'core element' of services within universities. It provides a continual level of support and provision where students with dyslexia, and other forms of disabilities, can receive access to diagnosis assessments, tutors, literacy support, technologies and accommodations for examinations (Jordan, McGladdery, and Dyer, 2014). Instead, Ball, Rainger, and Draffan (2005, p. 68) describe these services as 'systems of support' where students have access to technical support and regular consultations to help monitor the progress of their university careers. However, Riddell and Weedon (2006) suggest that the range of support provided for students within these

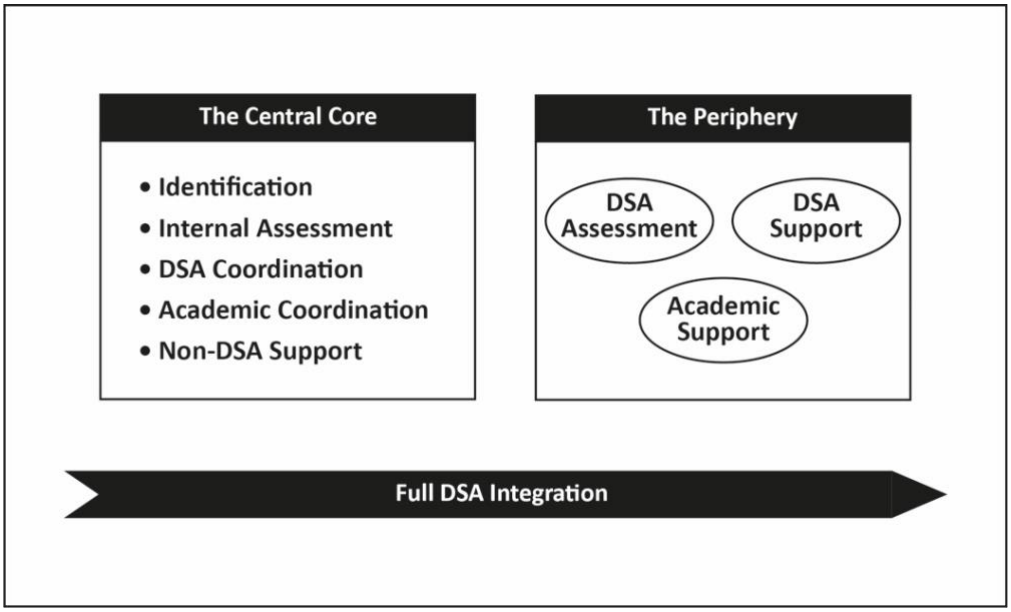
disability services can vary considerably from pre-1992 and post-1992 universities. While the government intended to create greater uniformity between institutions when they abolished the binary system in 1992 (when polytechnics and some colleges were awarded university status), Riddell and Weedon (2006) argue that it has created key differences between traditional and new universities concerning the provision of learning support. Thus, it could be argued that new universities were focused towards teaching and developing a range of learning support services that attracted a more diverse student population (Wolfendale and Corbett, 1996). Whereas the more traditional universities had to create more focused learning support services for the needs of a growing and new diverse student audience (Riddell and Weedon, 2006).

A HEFCE report by Rodger *et al.* (2015, pp. 17-24) examining support for higher education students with SpLDs across 25 institutions developed three general model classifications (core and periphery, hub and spoke, and stratification of student need) where the generic SpLD structure of support is experienced and delivered. These delivery models are categorised as:

i. The *Core and Periphery (functional support)*

This model refers to two elements. The 'core' refers to the centralised SpLD support that is coordinated for the institution and centrally operated as a disability office. The 'periphery' identifies several SpLD support services that are external and delivered by staff outside the institution while being funded by the DSA. An example of 'core' services provided by institutions could be an internal diagnosis assessment or the organisation of extra time in examinations. Figure 7 presents an overview of the core and periphery model.

Figure 7. The core and periphery operational structure model (Rodger *et al.*, 2015, p. 18).



A survey by Singleton and Aisbitt (2001) on the available support services within higher education for students with dyslexia identified several influences that could delay effective provision. These included: the variability in provision available across institutions for students with dyslexia; lack of qualified and experienced tutors to understand dyslexia; limited understanding of problems associated with assessment and identification of dyslexia in addition to the consequences for learning among staff; and continuation of centralised services instead of support at a departmental level. In a systematic review of research on the inclusion of dyslexia in higher education, Pino and Mortari (2014) identified that some students found it psychologically difficult to disclose their dyslexia with many forfeiting the opportunity to accept support and provisions. Students previous experiences of difficulties during their early school years may be the reason why some decided not to disclose their dyslexia due to fear of being embarrassed or stigmatised. However, for some students that openly acknowledged their dyslexia, it

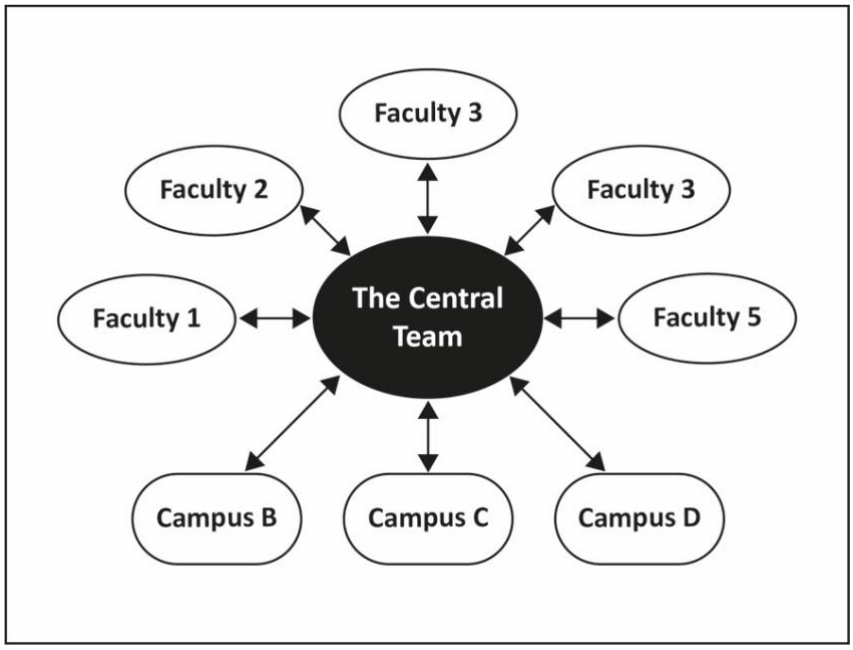
can be a positive experience, although there are instances where students can receive negative attitudes towards their disabilities (see Griffin and Pollak, 2009).

One of the main elements of the 'periphery' support provided to students is study skills support in the form of a dyslexia tutor. While many institutions provide in-house face-to-face support through a tutor or mentor, numerous institutions offer the same level of support through external tutors. A dyslexia tutor can help students with their literacy as well as develop memory and organisational strategies to improve academic work (Jamieson and Morgan, 2008).

ii. *The Hub and Spoke (locational)*

Identifiable as the generic support model, it centres on the connection between the central disability office and the main points of support delivered across the institution, including academic faculties and satellite campuses (Rodger *et al.*, 2015, pp. 22-23). As shown in Figure 8, each faculty is responsive to the reasonable adjustments outlined by the disability office where a member of the team is responsible for the support and provision provided to students. Rodger *et al.* argue that one of the biggest challenges is advising and implementing support to a variety of academic departments with different structures and cultures where there is no direct responsibility from the disability office.

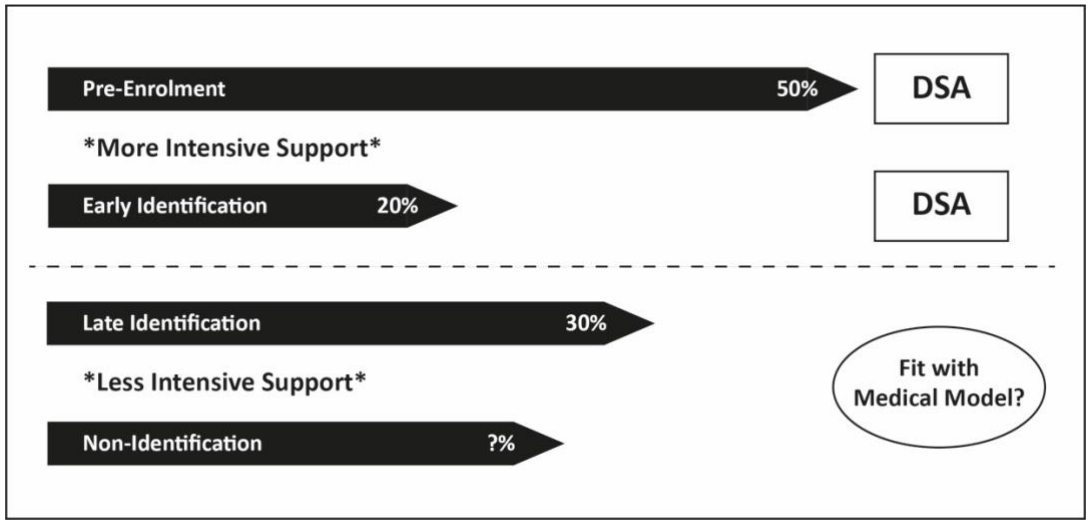
Figure 8. The Hub and Spoke model demonstrating the centralised SpLD support team with the relationship between faculties and other campuses (Rodger *et al.*, 2015, p. 22).



iii. *Stratification of Student Need*

The final generic model by Rodger *et al.* (2015) reports the heterogeneity of SpLD students where each has unique needs and signs of a learning disability in many forms. Rodger *et al.* emphasise that the diverse needs have implications for both the operating structure and type of support delivered by institutions. Rodger *et al.* suggests there are four distinct categories of student need, as shown in Figure 9. The identification of dyslexia is discussed further in the following section (3.10).

Figure 9. The Stratification of Student Need model addressing the heterogeneity of SpLD students (Rodger *et al.*, 2015, p. 23).



(a) *Pre-Enrolment*

Students who contact the disability office team from the start of their studies are the easiest group to support because they have been formally assessed with a learning disability (Roger *et al.*, 2015). For many students with learning disabilities, embarking upon university life can be an anxious time. Thus, it is essential that the information provided to students for the pre-arrival period is accurate and timely. For instance, the Equality Challenge Unit (2010, p. 22) suggest institutions to consider the organisation of pre-enrolment weekends for disabled students that include introductions to disability support staff and campus tours. However, Solomon (2013, pp. 83-85) suggests several approaches are needed to ensure students and institutions work together from initial correspondence to identify any possible issues. These initial proposals include: access to uncomplicated pre-arrival, arrival and induction to study information; specialist staff that can assist in the weeks before the start of the

academic year; managing expectations of what students should expect to experience; and building friendship on arrival.

(b) *Early Identification*

Some students starting university will request a dyslexia assessment during their first or second term of study. However, due to an increasing number of students approaching the disability office for an assessment, several universities have deployed screening strategies to provide a reliable indication that an individual is dyslexic. Although screening does not establish a diagnosis because of the limited information submitted, it can be administered without a professional diagnostic qualification (Casale, 2006). It has been documented by Singleton *et al.* (1999) that 70 per cent of UK universities provide an initial dyslexia screening.

(c) *Late Identification*

Students identified with a SpLD towards the end of their first, second or third year of university will probably have been coping with their disability until experiencing a difficult period caused by an exam or dissertation (Rodger *et al.*, 2015). This difficult experience would have prompted them to seek appropriate help or support. However, Rook and Miles (1999, p. 9) explain that some students diagnosed with dyslexia relatively late in life it can provide an insight into why they had 'underestimated their academic abilities'.

(d) *Non-Identification*

Small numbers of students will take the decision not to identify or recognise they have a problem. This decision would have been made when asked to declare their disability on the UCAS form or institutional application. Tinklin and Hall (1999) explain that some students decide not to declare their disabilities as they fear it will disadvantage them in some way. There is also the view among some students with disabilities that although they are entitled to support, they prefer not to receive it as they do not want to be seen different from their peers.

3.10. Identification and Labelling of Dyslexia

In the context of society, being identified with a label is an essential requirement for obtaining relevant support which can be helpful. Riddick (2000) describes labelling as a unitary construct that can be explained as something neither good nor bad. However, there are many characteristics of a label with both negative and positive consequences.

For a dyslexic student, a label can be used to enable an understanding of their difficulty to receive appropriate support. Reid and Kirk (2005, p. 6) point out that 'acquiring support should not be the goal of a label but rather a signpost'. The type of support they receive should not depend on their disability but their characteristics and needs. What is important outside the label is the contextual information of each student identified with a learning disability, not only their problems but also their experiences at school and their learning strategies.

Although dyslexia is characterised by difficulties in reading, a student might present the intelligence and motivation needed for successful reading (Shaywitz and Shaywitz, 2005). The element of motivation is essential if the student is to overcome their identification of dyslexia. It would not only allow them to succeed, but it would also

present a clear and definitive understanding of what being identified as dyslexia represents. The dyslexia label is multifaceted and understanding its identification, associated support and the wider acknowledgement of it in society can affect students in many ways. Macdonald (2009) argues that the stigma of a learning disability is only formed when a label is attached. His research identified that specific indicators connected to learning disabilities are stigmatised rather than the attachment of a label. Not only is a label effective for the student to understand their difficulties but it also offers increased support in certain groups with many dyslexic individuals seeing it as a socially valid label (Riddick, 2000).

According to Gallagher (1976), one of the positive outcomes of a label is the diagnosis, appropriate treatment and adjustment to the environment. For example, from learning strategies, students can support their difficulties associated with dyslexia that can have a progressive effect on their academic performance (Beane, 1982). However, following the identification of the dyslexia label, some students may experience self-esteem issues with their academic studies (Taylor, Hulme, and Welsh, 2010). Riddick (2000) and Riddick, Farmer, and Sterling (1997) argue that it is not the label that influences self-esteem but the general interpretation of the difficulties experienced that may or may not come with an identifiable label.

One of the main issues students with dyslexia may face is the stigma they will experience at university. From this, students can experience stress, confusion and begin to understand that their difficulties are complex. Riddick (2000) confirms that labelling is multifaceted and argues two points. Firstly, that labelling can lead to stigmatisation, giving individuals negative hopes. Secondly, everyone has a distinct and unique profile of educational needs which cannot be fully established if the identity of a particular label has already been assured. Indeed, the use of the label confirms a diagnosis and instils self-

confidence in the individual. Further, research by Macdonald (2010) identifies that although students have experienced stigma relating to their dyslexia label, they also describe diagnosis as positive. Their diagnosis enabled them to transfer their identities from a negative label to a positive identity based on difference.

3.11. Conclusion

This section has discovered the development of legislation in both schools and higher education, and how it has contributed to a more equal and inclusive environment for individuals with disabilities. At the beginning of this section, the UK's first significant disability legislation in the 1970s was introduced, emphasising the continual persistence made by disability activists fighting to ensure new laws protect the rights of deaf and disabled individuals. Following years of campaigning, the Disability Discrimination Act was made law in 1995 and ensured greater protection for disabled individuals both in education and in the workplace. Since then, legislation has continued to progress with the late 1990s bringing about several major reforms regarding funding and greater opportunities for individuals to receive appropriate levels of care in the state education system. While SENDA (2001) and subsequently the Equality Act (2010) were brought into law, higher education institutions have faced continued pressure to ensure students with disabilities experience an inclusive teaching environment, treated equally to their non-disabled peers with reasonable adjustments.

The government's introduction of disability legislation also brought about considerable funding for widening access, recommended by the Dearing Report in 1997, providing institutions with funds to students from disadvantaged backgrounds and with disabilities. Thus, numbers from these under-represented groups started to increase. In addition to the general student population increasing in numbers across higher education,

the proportion of dyslexic and disabled students has grown substantially too. In 1994/95, only 15 per cent of students declaring a disability were dyslexic, by 2015/16 this had increased nearly threefold to 43 per cent (HESA, 1995; 2016), with widening access, improved support and provisions among the reasons for an increase in numbers (Singleton *et al.*, 1999). Thus, the number of students receiving the DSA has also increased, with 7 per cent of students in 2014/15 in receipt, an increase of 5.5 per cent since 2000/01. As highlighted in this section, the DSA is not without issues (e.g., Goode, 2007; Harrison *et al.*, 2009) and several studies also suggest that the process in receiving appropriate support and provisions in universities is time-consuming and disorganised (e.g., Riddell and Weedon, 2006).

For some students, the section emphasises that their previous experiences at school could greatly impact their views on support and provisions provided by their university, as well as how they manage their studies. In particular, pupils that attended private schools would most likely have received better educational resources, such as specialist support and appropriate interventions at an early age, so would be best prepared to study independently and not necessarily need more severe interventions when they arrive at university (Burden and Burdett, 2005). Whereas state school pupils might not necessarily receive the appropriate support or resources needed and thus may not be aware of their disability or difficulties even when they arrive at university. Some studies suggest this may be the case (e.g., Ndaji, Little, and Coe, 2016), although further research is needed to explore this phenomenon.

Further, the discussion of support provided to students with dyslexia also emphasises the variation in the range of support practised and delivered. In particular, the variation in systems of support where researchers such as Wolfendale and Corbett (1996) highlighted differences in disability services for pre-1992 and post-1992 universities.

However, since the introduction of more recent legislation and widening support being introduced, these distinct differences between old and new universities have somewhat narrowed. Several examples of the types of support available in higher education has been identified through three general model classifications (core and periphery, hub and spoke, and stratification of student need) by Rodger *et al.* (2015, pp. 17-24) who uses these to define the range of support institutions provide, as well as recognising the heterogeneity of students' SpLD needs.

Finally, the discussion of labelling and identity has highlighted numerous discussions around students' issues and positive uses of the label dyslexic. For example, Macdonald (2009) indicated that the positive side to labelling is student ownership; however, Reid and Kirk (2005) reveal that obtaining support should not be the sole use of a label but a direction for personal development. Nonetheless, this study proposes to use the term *dyslexic* or *student with dyslexia* for these reasons. For instance, the label is likely to be used within a positive and professional environment (i.e., disability office, university). More so that it will also be the appropriate environment for students to understand and make a fair judgement of the use of their label.

Section Two: Cognitive Role of Assistive Learning Technologies

3.12. Introduction

This final literature review section addresses the literature examining assistive learning technologies, the broader background of ICT tools in higher education and how students with dyslexia engage in their studies. Firstly, the section attempts to define 'assistive learning technologies' and how the general term 'assistive technology' is closely associated. Centred around the focus of education and learning, a brief overview of the historical perspective of assistive and adaptive technologies will outline the three

prominent developments: foundation, establishment, and empowerment periods. The following topic draws on existing research in the field of disabilities, dyslexia and technologies by examining students' needs when selecting and using assistive learning technologies to enable and enhance their studies. The final topics review the wider purpose of assistive learning technologies bringing independence and structure to students' educational experiences. These include subtopics covering voice recognition, text-to-speech and visual organisation through mind mapping, each examining the cognitive processes involved when students engage in different contexts to enhance their learning. A review of more recent literature is summarised on the provision of electronic alternatives for reading, focusing on several research studies that explore the use of typography, letter spacing and colour overlays. The section concludes by emphasising the educational role assistive learning technologies can play in supporting students with dyslexia, in addition to highlighting the importance technologies can help in removing barriers.

3.13. Defining Assistive Learning Technologies: What do we mean?

When considering the term 'assistive learning technologies' or the general term 'assistive technologies', it is important to examine and explain what is meant. For instance, in the USA the Individuals with Disabilities Education Act (IDEA, 2004, Sec. 602) defines the term 'assistive technology' as 'any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities'. The former charity, the Foundation for Assistive Technology (FAST, now defunct) defined assistive technology as: 'any product or service designed to enable independence for disabled and older people' (FAST, 2014). The former UK government agency, Becta (British

Educational Communications and Technology Agency, 2003), which supported technology use in schools, defined assistive technology as: 'the software and technology which helps people with disabilities and special needs to overcome the additional barriers they face to communication and learning'. While Abbott (2007, p.6) explains that the term assistive technology has a 'long and honourable history', suffering in part from a variety of 'understandings as to its meanings', the collection of definitions from charities and agencies can help play a role in educating society and professions to bring discussion and debate to the forefront of a relatively new and developing field of social disability inclusion.

According to the World Health Organisation (WHO, 2015), there are various definitions of assistive technology and within their community of work define it as an 'umbrella term'. It is focused on both assistive products, such as technologies, adapted instruments and related services, which include referrals and assessments. Although a purposeful definition of the WHO's scope of work, it is a broad description encompassing both medical and educational perspectives. Watts, O'Brian, and Wojcik (2004, p.43) point out that assistive technology has long been associated with an individual's rehabilitation, but has recently merged into a subfield of educational technology where practice and research have started to 'explain the meaning, legal requirements, and service delivery practices of assistive technology consideration'. One detailed definition by Raskind and Higgins (1998, p. 27) suggests that: 'In some instances the technology may assist, argument, or supplement task performance in a given area of disability, while in others it may be used to circumvent or "by-pass" (not remediate) specific deficits entirely'. The varying uses of technologies can often influence and determine the terminology used to differentiate between them (McKnight and Davies, 2012). Lewis (1993, p.7) attempts to

explain the varying definitions of assistive technology by outlining the purposes for how they are used, conceptualised through the ABC model:

(i) Augmenting an individual's strength, so their abilities make up for the effects of any disabilities;
(ii) Bypassing entirely; or
(iii) Providing a different method of performing a task, so an individual's disabilities are compensated.

From Lewis's attempt to clarify the purposes of assistive technologies, it can be identified that there are two forms of 'special education technology', remedial and compensatory. Both creating 'an equalising force –that is, a way to circumvent disabilities and allow access to the activities that nondisabled people take for granted' (p. 8). Thus, the education professions and technology providers must have a strong sense of understanding the differences between both compensatory and remedial technologies, ensuring their students are utilising the correct technological interventions intended for their purpose (Raskind and Scott, 1993). McKnight and Davies (2012) explain that remedial technologies are suggested to be used by individuals to help 'fix' a problem, such as a student using software to enhance a skill they are missing or in need of improvement. Remedial, or developmental education, often referred to in schools due to the negative connotations associated with 'remedial education' (Habley, Bloom, and Robbins, 2012, p. 256), may use software designed to improve poor phonic skills or address gaps in children's core competencies. On the other hand, compensatory technologies are to help students accommodate their disabilities while decreasing the effects (Lewis, 1993). These can include software programmes such as text-to-speech that

can assist students who have difficulty reading and word prediction to aid students' writing. As briefly highlighted earlier by Raskind and Scott (1993), one of the issues in the suitability of provisions is the challenging evaluation in the assistive technology consideration process. For example, Edyburn (2006, p. 22) proposes a 'remediation vs compensation' equation where support teams consider what percentage grade should be devoted to interventions depending upon the individual's situation. For instance, a child requiring reading intervention may use 30 per cent of their time on remediation such as breaking down tasks into smaller parts, re-teaching skills and using different teaching strategies. The remaining 70 per cent could be devoted to a compensatory approach where text-to-speech software could enable an alternative way of accessing information and help improve vocabulary. The balance between both remediation and compensatory interventions are crucial and careful thought must be given to the individual so they can achieve their full potential.

Another way of viewing or organising assistive technology is presented by Abbott (2007) who suggests classifying into three types by their usages, focussed around learning: (i) technology to train or rehearse; (ii) technology to assist learning; and (iii) technology to enable learning. This definition of assistive technologies helps understand the purpose of how enabling learning technologies can help bridge the gap between abilities and the demands of the education environment to compensate for an individual's specific deficits. Thus, this thesis focuses on the educational perceptions of supportive technologies with dyslexia (sometimes combined with other SpLDs) and uses a relatively new term 'assistive learning technologies', exploring both the enabling and cognitive literacy perspectives that remedial or compensatory assistive learning technologies can be identified. In their research, McKnight and Davies (2012, p. 159) are among the first researchers to propose the separation of the 'more general field of assistive technologies

from the field of assistive learning technologies, or those which are mainly intended to support learners'. In this present study, the term 'assistive learning technologies' will be used as an alternative to the term 'assistive technologies'. This is because the term assistive technology covers a wide range of technology, and this study focuses on examining only those technologies that enable access to learning.

3.13.1. A Brief Historical Perspective on Assistive Technologies

The field of assistive technologies has developed substantially since the early 1990s, the advancement in software, computers and adaptive aids have brought substantial advantages of independence and enablement to many individuals. However, over the last 150 years, assistive technologies have played an important part assisting in maintaining, improving and increasing the function of those with disabilities. The historical developments around assistive technologies, according to Bryant and Bryant (2003) can be divided into three classifications of time periods: (i) The Foundation Period covering events before 1900; (ii) The Establishment Period from 1900 to 1972; and (iii) The Empowerment Period covering from 1973 to the present.

From the Foundation Period, it is initially thought that the first forms of assistive technology devices came into existence as soon as humans needed to create tools to compensate for practical limitations caused by disabilities or impairments (Wendt and Lloyd, 2011). As outlined in the previous chapter (section 2.2), the progression and development of disability legislation led to the foundation of disability services in the 1800s and helped establish a need for innovative individuals and organisations to create technological devices to help enhance human abilities. For instance, in 1874 one of the earliest forms of hearing aids was invented, known as the Audiophone Bone Conduction Amplifier. By the end of that century in 1898, it had been developed into a more

transportable hearing device referred to as the Akouphone. The first electrical amplifying device for individuals with hearing impairments. Another significant development for blind individuals was the invention of the first Braille typewriter in 1892 by Frank Hall.

The Establishment Period from 1900 to 1972 is identified as this label due to the time in which disability disciplines were established as distinct entities (Bryant and Bryant, 2003). Throughout this period, there were significant advances in policies, legislation and government processes that brought about change for individuals with disabilities. Wendt and Lloyd (2011, p. 11) add that during this time devices and procedures were established to support individuals with disabilities 'in using their strengths to compensate for their functional limitations'. While the impact of war initially influenced developments during this period, one key technological advance that affected blind individuals was the radio which was distributed to blind people by the American Foundation for the Blind in 1928. Several years later as the general population slowly started to become more aware of technology, Thomas Edison invented the phonograph –a device for the use of talking books for the blind. As the century progressed towards the second half, prominent developments in the microprocessor led to increased functionality of assistive technology devices. For instance, in 1968 the first English text-to-speech system was developed by Electrotechnical Laboratory in Japan.

Lastly, the Empowerment Period from 1972 to present marked the beginning of critical legislation (both across the USA and UK) that acknowledged disability rights as a civil rights issue, providing empowerment to life issues such as education, housing and employment (Bryant and Bryant, 2003). From the 1970s onwards, the computer era brought many sci-fi inventions into reality and saw vast innovations in assistive technology developed. In 1977 the Adaptive Firmware Card (AFC) was invented which enabled individuals with disabilities to control the computer with a single-switch or an

alternative keyboard, offering access to computer-based learning and productivity tools. Other devices that aided individuals with literacy difficulties included the invention of the Kurzweil reading machine in 1976 that used Omni-font Optical Character Recognition (OCR) and a flatbed scanner. In 1992, this progressed to computer operating systems including speech synthesisers, enabling individuals with reading disabilities or visual impairments to access written material on their computers.

Today, the Empowerment Period remains focused on new disability-related legislation continuing to be passed, and the development of new assistive technologies becoming more affordable and prevalent in people's everyday lives. It is estimated that there are nearly 40,000 assistive technology products available (Marianjoy Medical Library, 2015) for an individual with a disability to use. However, Edyburn (2001) points out that the methods of identifying, assessing and choosing assistive technology devices can be time-consuming, and widely dependent on specialist support and knowledge. While the research of this thesis does not evaluate or examine specific assistive software, it does attempt to identify the experiences and processes of using these technologies for students with dyslexia.

3.14. Assistive Learning Technologies: What are students' needs?

The importance students with dyslexia place on the use of assistive learning technologies are often related to the way tools can support their independence as learners (Seale, 2006a). By aiding students' needs and abilities, various assistive technology support checklists have been created to identify if students can complete tasks independently and understand what access accommodations they might need. For example, the Wisconsin Assistive Technology Initiative (WATI, 2004) checklist for assessing school students' needs. However, since the late 1990s, the Internet has made it

more accessible for students with dyslexia to access learning and evaluate their own needs directly. Thus, online learning can be regarded as a powerful means of enhancing students' independent learning experiences for both physical and learning disabilities (Wissick and Gardener, 2008).

Arguably, the assistive learning technologies that are available today allow students to create adequate computer environments. Specialist software and hardware configurations can include text-to-speech, speech recognition and mind mapping software, all of which help organise ideas and encourage the creative use of technologies, which in turn, could inform pedagogy and ICT teaching practices (Draffan, 2003; Price, 2006). However, as Draffan (2003) explains, problems can arise from online learning materials when they have not been designed to allow the user to adapt or configure with the software (discussed further in section 3.16). It is important that the student is placed at the very centre of the learning process so that they can influence and modify the necessary changes needed for their studies (Phipps and Kelly, 2006).

The Vygotskian idea of scaffolding sees the guidance and participation at the centre of the learning experience. This is already accepted in the teaching of adult learners, and the thought of a means of assisting is no longer original or suitable (Tharp and Gallimore, 1991; Price, 2006). However, Price (2006) argues that the leading pedagogy in special education has not changed, relying upon a Vygotskian methodology to develop teaching and learning. Thus, the development of academics' awareness and understanding of one's thought processes through scaffolded teaching, modelling, structured learning and personalisation of learning outcomes have been actively supported (Vygotsky, 1978; Price, 2006). The use and understanding of assistive learning technologies could be seen as a technological scaffold (Price, 2006). A study by Price (2006) investigated the impact of dyslexia on the writing process in higher education, it reported on 3 dyslexic students'

experiences with the use of assistive learning technologies and the use of scaffolding techniques. Price analysed discrete elements of students' writing processes: collecting information; planning; drafting; editing; and proofreading. The study revealed that students' use of these technologies, such as mind-mapping software, supported their cognitive style of writing and the speech recognition software supported independent and critical reading skills. Thus, highlighting the crucial role technologies play in the cognitive learning process of the learner and how students can use them in their studies. For instance, the use of a Virtual Learning Environment (VLE) allowed one student to manage sizeable blocks of information and manipulate sections electronically to save time and reduce inaccuracies in spelling. However, in a qualitative study by Gerrard (2007), several of the students with dyslexia did not like using the online discussion boards because their disability is only disclosed to their lecturer and not to their peer group, who can also see everything they write:

> I have quite severe dyslexia and having to write my ideas and thoughts down for other people to see was a bit of a nightmare and I really felt that my condition was being advertised to everyone else on the course, so I stopped contributing. (Student quoted in Gerrard, 2007, p. 203).

Interestingly, the use of speech-to-text, grammar and spell checkers, and predictive text software would have benefited this student. The use of strategies, such as coloured acetates, colour coded notes on screen and individualised colour backgrounds may also have helped reduced visual stress when reading and organising sentences.

The 3 students who participated in the research by Price (2006) were fortunate to have access to assistive learning technologies to support and emphasise their learning needs. However, the insufficient availability of assistive learning technologies can make students with dyslexia question the value and importance of the educational institution,

thus, examining the role technologies have with disabilities (Seale, 2006a). The problem students face when not having direct access to specialist equipment (before applying for the DSA) can mean that they receive software that is unsuitable to their way of learning. Students need access to assistive learning technologies before applying for the DSA so that they can be confident of the technologies they need to support their learning. Research by Silver-Pacuilla (2006) also suggests that in the long-term, supported access to assistive learning technologies can also help to strengthen skills, increase computer literacy and reinforce self-determination to succeed. However, many higher education institutions are still unaware of the importance and use of assistive learning technologies with disabilities (Vickerman and Blundel, 2010). The role of the DSA and Access Centre's is somewhat distant from the institutional experience of the student and tutor. As soon as the student becomes involved in discussing their technology requirements, the institution is removed from the process. When the student has received their technologies, the institution has no information or report what the student is using. Thus, students and institutions understanding on the role of assistive learning technologies can be varied and not consistent with teaching and learning.

3.15. Structuring the Environment with Assistive Learning Technologies

Since the introduction of multimedia technologies in education, it has offered students with dyslexia and the broader disabled community the opportunity to extend their learning experience to levels beyond limitations (Sloan, Stratford, and Gregor, 2006; Wissick and Gardener, 2008). Thus, allowing students to demonstrate and stimulate concepts over different disciplines, utilising their auditory and visual senses to process the written word. The use and development of assistive learning technologies, in many ways, share similarities with multimedia tools, such as audio recordings, photographs and

animated interactive diagrams. These similarities are elements that lead students to take a multi-sensory perspective and allow them to adopt an experiential learning experience of completing tasks successfully (Dale and Taylor, 2001, pp. 997-998).

One of the earliest forms of multi-sensory learning was proposed by Gillingham and Stillman in 1936, publishing the first teaching technique developed purposely to assist reading for children with dyslexia (Lawrence, 2009). According to Thomson (1990, p. 208), 'Multi-sensory learning involves the integration of visual, auditory, tactile or kinaesthetic modes, as in associating letters with sounds in writing'. Based on literacy development, several studies (e.g., Hairston *et al.*, 2005; Kast *et al.*, 2007; Dimitriadi, 2001) have identified that multi-sensory use with visual and auditory prompts can enhance literacy performance in children with dyslexia and non-dyslexic children. Moreover, when the combined methods of sensory enablement and engagement are characterised by several modes of activity, it can be identified as multi-modal. Vue *et al.* (2015, p. 3) recognise multi-modal tools as 'supports to engage, scaffold, and model the multi-step strategies essential for students to build writing skills'. Multi-modal tools refer to several technologies that combine features associated with distinctive modalities, such as image, audio and text, i.e., text-to-speech. A study by Chmiliar and Anton (2015) exploring the role of the iPad® as an assistive technology device reported that the multi-modal functionality supported students with disabilities in studying and learning. However, Griffin and Pollak (2009) argue that universities should be making use of multi-modal technologies as they can benefit students with and without disabilities.

The variety of assistive learning technologies that are available to support students' comprehension and organisational skills are increasing and becoming more sophisticated, particularly with the use of Apps on mobile devices. The correct understanding of selecting technology to aid comprehension and organisational difficulties is to examine

and identify what types of problems students are experiencing. As Draffan, Evans, and Blenkhorn (2007) explain, the support needs of students with dyslexia vary considerably, and it can be complex in providing the relevant assistive hardware and software for their needs. From the student's needs assessment and evaluation, there are many considerations to discuss; these might be their preferred choice or the assessor's recommendation of assistive software and hardware. This process will aim to guide the student through the requirements and specification for using assistive learning technologies and strategies for cognitive functions, such as note taking, time management, organisation, proofreading, examinations and assessment. Smythe (2010) explores the idea of cognitive functions further, outlining technologies within the realm of dyslexia support, performing five separate roles. The idea is also contrasted by Price (2006), investigating writing strategies by higher education students with dyslexia. The cognitive functions of composition and assistive learning technologies use can be identified as:

1. Capture information; gathering digital material through online resources, electronic devices, lecture capture and Learning Management Systems (LMS)

2. Analyse information; planning and organising before, and during written production

3. Store information; drafting and translating written work

4. Synthesize information; finalising and editing written work

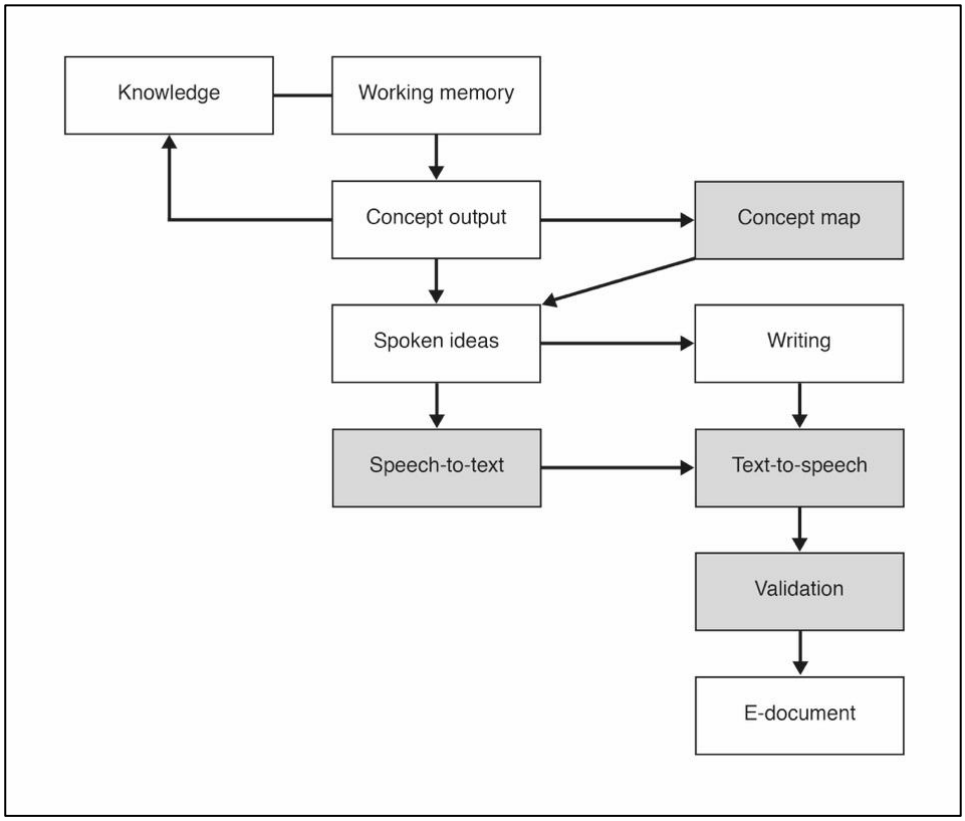
5. Output results; proofreading and producing a final copy.

(Smythe, 2010, p. 37; Price, 2006, p. 23)

The cognitive functions outline the role students apply knowledge and course requirements with their preferred use of assistive learning technologies. However, despite the cognitive functions describing a working example, the issue remains as to how the student approaches the use of software and the technological scaffold, which is operated at different levels to provide support in weaknesses such as organising contextual categories (Price, 2006). It is understood that the term scaffold is a Vygotskian metaphor for teacher or technological support where the learner attempts literacy assignments that could not be attained without assistance or provisions (SEDL, 2012). An American study by Rapp (2005) at Landmark College, highlighted the practical approach of scaffolding. It was noted that one student who used the scaffold approach to help make functional connections with the word, text and writing patterns, found the use of a text-to-speech reader extremely helpful for longer reading as it gave them more confidence and saved time (Engstrom, 2005). If assistive learning technologies are used in a structured and purposeful way, it can support students to interact with content and help them to develop independent knowledge and skills (Rapp, 2005). Smythe's (2010, p. 69) concept of mapping assistive learning technologies to the writing process, as shown in Figure 10, helps reflect the central relationships between the technologies and the users' processes involved in writing. As summarised in Appendix A (section 2), these methods acknowledge the cognitive transfer of knowledge from separate areas of the brain (working memory, executive functioning) to enable the individual to organise and create an ideas output. Usually in the form of a mind map or outline of notes, enabling the individual to capture their thoughts so they can refer and listen back via text-to-speech software. Once stored and organised in the individuals' phonological loop system (Kelly and Philips, 2016), the individual is then able to process into a written format using a word processor –for assistance with spelling and grammar. The use of predictive-typing

software could also benefit some dyslexics with the writing process (Gregor *et al.*, 2003). The purpose of text-to-speech software could then be used to proofread what has been written by highlighting where words are missing or in reversal error (e.g., from/form), thus helping to increase independence (Rose, 2009).

Figure 10. Mapping assistive learning technologies to the writing process (Smythe, 2010, p. 68).



On many occasions, assistive learning technologies act as a role of a cognitive partner (e.g., Mull and Sitlington, 2003; Puckett, 2006; Price, 2006; Sloan, Stratford, and Gregor, 2006). In this role, it is essential that both the learning content is accessible and instructing the student independently (Rose and Meyer, 2000). Together, accessible and instructional elements need to perform equal roles in the use of technologies to be

successful. Essentially, the institution also has a purpose of ensuring students receive adequate training and advice with their technologies. A research study by Draffan, Evans, and Blenkhorn (2007) examined the use of assistive learning technologies by dyslexic students, emphasising technology provision is variable between students and disciplines. However, a significant number of students who received a recording device, such as a Dictaphone, text-to-speech and mind mapping software, as well as a computer system, did not choose to receive training. By opting out of training, the students did not take advantage of their equipment. It could be argued the biggest issue with software training is the lack of variability and adaptability in how it is delivered. Singleton, Horne, and Simmons (2009, p. 149) suggest that it is the responsibility of the training provider to ensure that the delivery of training is made available in 'alternative ways' and the 'provision of learning materials in alternative formats'. Potentially, students are not receiving the benefits of using their software and do not understand the options for supporting their difficulties. In an ideal world, the software would be designed to be instantly functional and operational to the student, reducing the need for expensive and time-consuming training. The following sections (from section 3.15.1 to 3.15.3) take a closer look at categories of assistive learning technology software that are widely used by students to aid their learning difficulties and cognitive processes.

3.15.1. Voice Recognition Software

Voice recognition, speech recognition or speech-to-text enables a user to turn the spoken word into text through a microphone which is then recognised by the computer software. The use of voice recognition has been accessed by individuals with severe learning difficulties and physical limitations in operating a computer since the early 1990s (Fichten *et al.*, 2003). During this time, researchers (e.g., De la Paz, 1999; Meisel, 1993)

and teachers began to see the advantages of using it for their students with learning disabilities. However, engagement with the software was not without its issues, as (Wetzel, 1996) explains, 'the technology holds promise for students with learning disabilities when it is refined to allow less difficulty in using it' (p. 371). Since the 1990s, voice recognition software has advanced significantly enabling users to activate commands without intensive training, making writing tasks easier for individuals with dyslexia. While keyboards can still place a huge burden on individuals' memory for processing syntax, if integrated correctly (Cavalier and Ferretti, 1996) voice recognition software can help remove this burden and enhance the performance of individuals with learning disabilities (MacArthur, 1996). Smythe (2010, p. 78) summarises the technology as providing two aspects, writing composition and proofreading: 'The technology provides dyslexic users with the freedom to write what they like, and can put the text into any document either directly… The speech-to-text also allows the software to read back what has been written, providing the first level of proofreading'. Today, the most popular known example of speech-to-text dictation is Nuance's® Dragon® software, available for both the desktop computer and mobile device, and provided to students with dyslexia from the DSA.

Voice recognition can bring many advantages for individuals with literacy difficulties, for instance, a student with dyslexia and deficient writing ability with adequate oral language would be able to support their studies a lot easier (Engstrom, 2005). A review of research by Wald and Bain (2008, p. 446) exploring the possible benefits of voice recognition software with disabled students, discovered that it could assist with managing online digital multimedia resources, automatic access to synchronised lecture notes and captioning of speech. In another detailed review of the literature on voice recognition software and standard dictation to support learning

difficulties, De la Paz (1999) suggests that some individuals may benefit from developing improved writing. Although, De La Paz recommends that users receive scaffolded guidance from trained educators as they begin to use the software and develop a detailed plan before attempting to use. The need for speech-to-text training was highlighted in a survey of assistive technology for students with dyslexia by Draffan, Evans, and Blenkhorn (2007). It revealed that speech technology had the highest proportion of positive and negative comments that could be determined by the characteristics of the student, such as their patience in training and learning to use the software.

Other studies have concentrated on student measures to identify the success of voice recognition software. In one study, exploring the compensatory effectiveness of text-to-speech recognition on written composition performance, Higgins and Raskind (1995) investigated the use of Dragon Dictate® with students diagnosed with learning disabilities. The analysis of students' essays suggested that speech recognition software encouraged the use of longer words (7 or more letters) and students achieved higher scores using the technology, with scores not far behind the non-disabled students. A further study by Raskind and Higgins (1999) also exploring the use of Dragon Dictate® to enhance basic reading skills discovered that students with learning disabilities presented significant improvement than the control group. Overall, the researchers concluded that the voice recognition software improved phonological processing –enhancing the grapheme-phoneme correspondence, necessary for word recognition, spelling and reading ability.

3.15.2. Text-to-Speech Software

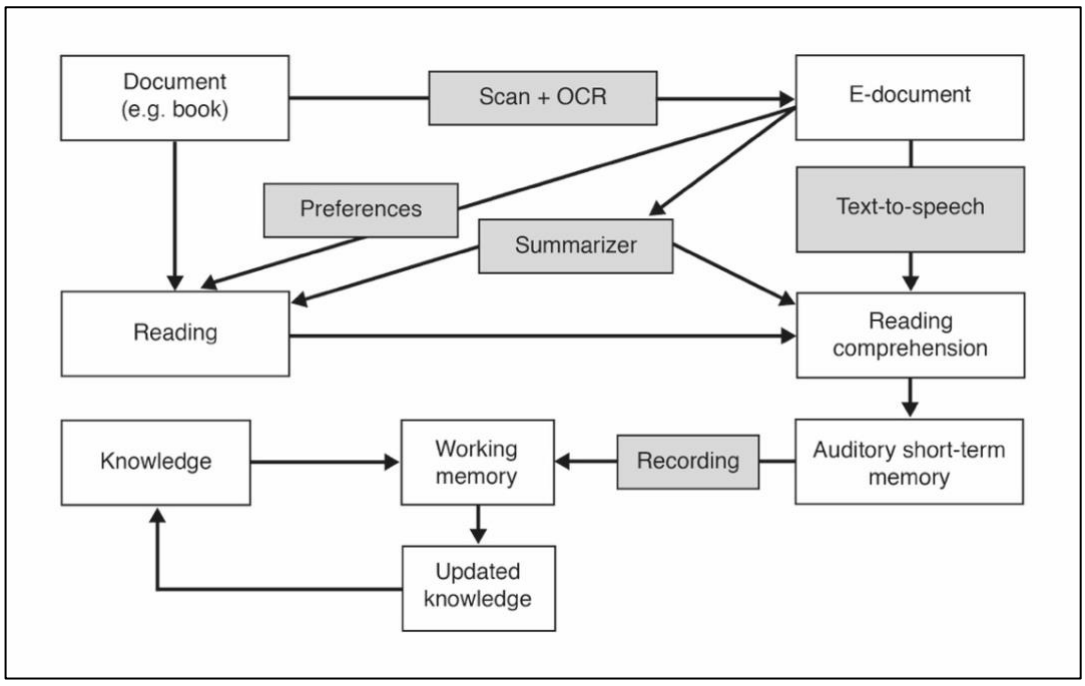
Text-to-speech, or speech synthesis technology allows an individual with digital information in an electronic format to access it through an auditory means. Digital text (e.g., letter, number, word phrase or sentence) on either a computer or electronic device,

such as an e-reader or tablet, is voiced by either a computer-based synthetic voice or by a human voice (Kennedy, 2003). Since the introduction of text-to-speech, individuals with a visual, physical, developmental or learning disability, often phased 'print disability', have been able to digitise printed material and listen to it (Wolfe and Lee, 2007). In recent years, the biggest issue reported with text-to-speech is the computerised synthetic voices which users often describe as unnatural and strange (e.g., MacArthur and Haynes, 1995). However, over recent years, research and development has significantly improved synthetic voices. In 2012, CereProc and Jisc TechDis (now defunct) collaborated to produce two text-to-speech voices, Jack and Jess, to encourage the use of speech software among learners in the UK education system. There are increasing numbers of text-to-speech software available via the Internet, as either Freeware or Shareware where users can try before purchasing (Berkeley and Lindstrom, 2011). Users can also download text-to-speech apps for mobile devices for a relatively small payment, or free and buy add-ons for further enhancement. However, computer operating systems (Microsoft® and Apple®) and mobile devices (iOS™ and Android™) now have speech technologies built-in.

According to (Smythe, 2010), the principle techniques of text-to-speech is linking parts of speech together, for example, individual phones, diphones and half-phones as well as using pre-recorded speech. This connection of speech sounds means that the software can create new and unfamiliar words, so it does not need to have an extensive dictionary. Several text-to-speech commercial software programmes operate in this way, such as ClaroRead™ from Claro Software and Read&Write™ by Texthelp™, and are widely provided to higher education students through the DSA. In a review of assistive technology provided by the DSA, Draffan, Evans, and Blenkhorn (2007) identified that the majority of students reported being supplied with Read&Write™ and ClaroRead™

software (n=363), and a table top OCR scanner (n=347) that could be integrated to convert printed pages into a digital format. Overall, students' positive experiences were three times that of the negative ones. However, there was some discussion regarding the usefulness of text-to-speech when integrated with a scanner, as students with moderately severe reading difficulties found this to be particularly distracting. Interestingly, Figure 11 by Smythe (2010, p. 68) presents the association between the factors involved in the reading process and how the assistive learning technologies may enable access to its contents through both an auditory process (text-to-speech), or adaptation of digital text (colour overlays for text –discussed further in section 3.16) following an OCR scan. The graphic representation of the reading process allows education practitioners to evaluate if their teaching material is accessible and understand how learners can engage through different approaches and techniques.

Figure 11. Mapping assistive learning technologies to the reading process (Smythe, 2010, p. 68).



While the understanding of dyslexics' ability to decode, track and comprehend language has been widely debated, existing theories, outlined in Chapter 2 and Appendix A, argue that one of the primary foundations of reading disabilities is the inability to decode written text fluently (Wood *et al.*, 2017). Given the variability in individuals' underlying cognitive deficits, text-to-speech and text digitisers can not only benefit those with language impairments but also those without (e.g., Kim *et al.*, 2006). Nevertheless, it is important to remain cautious in assuming text-to-speech will support all struggling readers. For instance, text-to-speech may not be useful in supporting all differences in individuals and could affect their experience of the software (Wood *et al.*, 2017). In a review of literature from 1985-2009 on Computer-Assisted Instruction (CAI –a self-learning technique, usually offline/online, involving interaction of the student with programmed instructional materials) to enhance reading comprehension in struggling readers, Stetter and Hughes (2010, p. 9) concluded that it had the 'potential to help students with disabilities improve their understanding of text'. However, Setter and Hughes emphasised that studies (e.g., MacArthur and Haynes, 1995) with synthesised speech and its effect on reading comprehension have been indecisive. The quality of the speech and the ability to use the built-in support were identified as problems with CAI.

Integrated within the text-to-speech software (i.e., Read&Write™, ClaroRead™ and Kurzweil™) is dynamic highlighting, a feature that colours each word or phrase when the text is being read, making it easier for the 'readers to stay in sync with the spoken text' (Silver-Pacuilla, 2006, p. 100). In one study, Hecker *et al*. (2002) explored the benefits of assistive reading software for 20 students with attention disorders at Landmark College in the USA, discovering that it enabled the majority to read faster so they could complete their reading assignments in less time. Mostly, the software-assisted students to reduce their distractibility to read, aided by the synchronisation between the highlighted and

spoken words, resulting in less stress and fatigue when used for longer periods of time. In two more recent research studies, Stodden *et al.* (2012) and Wood *et al.* (2017) explored text-to-speech related tools to improve reading comprehension for struggling American student readers, reporting a statistically significant increase in reading skills. Moreover, Stodden *et al*. discovered significantly improved reading scores in both its pilot studies and suggested that this improvement was due to students' exposure to more text and incidental vocabulary learning through using the text-to-speech software' (p.359). These studies demonstrate the importance of text-to-speech and other types of assistive learning technologies enabling users to improve reading. Further studies are needed to explore the diverse range of contexts where individuals with a reading disability use a variety of text-to-speech software packages. In addition to examining reading disability profiles as language ability can be heterogeneous (Stetter and Hughes, 2010; Wood *et al.*, 2017).

3.15.3. Visual Organisation with Mind Mapping

The first understandings of mind mapping were developed by Tony Buzan in 1970 after he evaluated research on the psychology of learning and remembering (Mento, Martinelli, and Jones, 1999). According to Buzan and Buzan (2006, p. 55):

> The mind map is an expression of radiant thinking and is therefore a natural function of the human mind. It is a powerful graphic technique which provides a universal key to unlocking the potential of the brain. The mind map can be applied to every aspect of life where improved learning and clearer thinking will enhance human performance.

Sometimes referred to as 'brainstorming', it was popularised by Alex Osborn in 1953 from the publication of his book, *Applied Imagination*. However, towards the end of the

twentieth century, it was deemed politically incorrect to individuals with epilepsy and was replaced with more suitable terms such as ‘thought-showers’ and ‘mind dump’.

The term ‘Mind Maps™’ was registered by the Buzan Organisation in 1990 in the USA and UK. The use of the term is widely associated with that of concept mapping, developed by Joseph Novak in 1972 to help science students understand and make connections between concepts of energy and conservation (Novak, 1990). Novak (1985) argues that concept mapping plays a significant role in the educational activities of his course and aided students to take control of their own ‘meaning making’. Novak and Cañas (2007, p. 29) define concept maps as:

> …graphical tools for organizing and representing relationships between concepts indicated by a connecting line linking two concepts… Concepts and propositions are usually organized hierarchically, from the most general, most inclusive to most specific.

Both terms, ‘mind map’ and ‘concept map’ can be defined as being a process of visual representation of ideas and their relationships. Smythe (2010) argues that the main difference between these two terms is the mind map contains one central idea where other thoughts are established, while the concept map indicates the relationships and does not require a core. Smythe concludes that ‘a mind map may be seen as a concept map that radiates from a single idea’ (p. 85). However, Chiou (2008) suggests that a concept map can act as a network structure to assist learning and understanding, helping the student to develop the capacity to learn independently. Either way, this thesis identifies both terms as providing a visual process for the organisation and representation of ideas.

For students with dyslexia, the creation of ideas in an organised visual format using mind mapping software, such as Inspiration® or MindView™, can help play a vital role in enabling and assisting with the cognitive aspects of writing (Engstrom, 2005;

Mortimore, 2008; Puckett, 2006). Students can also create mind maps through a practical level of engagement with paper and pens, or for group work with a whiteboard/flipchart. The former being an advantage for some students as it allows a larger working space. Whereas a computer screen often requires swapping between pages and layers, increasing visual memory, which is not always suitable for some students with dyslexia (Smythe, 2010). However, computerised versions of mind maps can enable students to begin combining their ideas into an accessible and organised digital format, as well as using colour coding, merging content and hyperlinking to other files before starting to write (Pino and Mortari, 2014).

Often referred to as a visual organisation learning strategy to aid revision or organisation, mind mapping can also be defined as a meta-cognitive strategy, empowering the student to take control of their learning in a 'highly meaningful fashion' and to learn independently (Jegede, Alaiyemola, and Okebukola, 1990, p. 952). In an analysis of assistive technology provision by Draffan, Evans, and Blenkhorn (2007), 350 higher education students with dyslexia reported receiving mind mapping software. However, in a follow-up survey, 23 per cent of students described it exceeding expectations with 9 per cent acknowledging that it failed to meet their needs. While this study provides an insight into the personal reflections of students' use of the software, it emphasises nearly a quarter of students are engaging to support their dyslexia in some way. If used effectively in various disciplines, mind mapping can not only improve a student's ability to learn but help integrate new knowledge with what they already know, enforcing comprehension (Chiou, 2008). Thus, it is important to ensure that the appropriate strategies are taught with using mind maps to enable students to support the writing process.

One of the biggest problems students with dyslexia experience is decoding the appropriate text structure and outlining relevant information (Graham *et al*., 1992).

However, several studies have demonstrated that students' use of mind maps for academic writing can help with improved recall of ideas (e.g., Draheim, 1983; Hughes *et al*., 2011) and increased levels of organisation (e.g., Holland, Holland, and Davies, 2004; Price, 2006). In one study, Sturm and Rankin-Erickson (2002) explored the effects of two methods of mind mapping, hand-drawn and computer-aided for essay writing, for students with learning disabilities. While students in both the hand and computer mind mapping conditions showed an improvement in writing, those that used the computer-aided mind mapping were more confident about writing and seeing themselves as writers. Sturm and Rankin-Erickson suggest that the students wrote more and better when using the mind maps to organise their ideas, although they point out that it did not increase the complexity of their sentence structures.

Across higher education, mind mapping has also been considered an effective learning strategy to enable and engage students with learning disabilities. Nevertheless, there have been several studies (e.g., Budd, 2004; Yen, Lee, and Chen, 2012) exploring mind mapping to support non-disabled students' academic achievements and their preference for visual forms of organisation.

3.16. Provision of Electronic Alternatives

For many university students with dyslexia, they have learnt to become reliant on the use of computers and the Internet. A study by Fichten *et al.* (2003), exploring the use of computers by Canadian Higher Education students with SpLDs, revealed that 41 per cent required some form of specialist technology or adaptation to use computers effectively. The difficulty facing higher education institutions is to ensure that all learning is physically and technologically accessible to all types of disabilities. When the personal computer is enhanced and adapted with assistive learning technologies, such as text-to-

speech and built-in accessibility features within the operating systems, it can be a liberating and exciting feeling for the student (Williams, Jamali, and Nicholas, 2006).

For students, the idea of challenging universities and tutors on issues such as accessibility and usability is a concern. Many disability issues within universities are not always questioned; however, disabled students need support from the curriculum level to adapt programme materials presented to them by their tutors (Gerrard, 2007). As Draffan (2003) explains, the creation of accessible e-learning materials requires support and commitment from disability experts and academics of all disciplines at the university. The question that arises is how tutors manage the requirement and responsibility of providing accessible learning material online and in class. Tutors need to be trained in preparing accessible materials and have access to ICT support staff who can take on a support role. However, several studies (e.g., Cornett-DeVito and Worley, 2005; Diraä *et al.,* 2009; Sweener *et al*., 2002) have shown that some tutors were refusing to provide lecture notes in electronic format to students with dyslexia, asserting it would give them an unfair advantage over those students without a statemented disability. For many students, with and without a learning disability, providing alternative formats for course materials can help enhance their higher education experience. For example, text alternatives for spoken PowerPoint lecture notes, or a simpler version of a text-only format for multimedia presentations online (Seale, 2006a, p. 61). In one study, Blankfield and Martin (2002) examined 12 students with disabilities studying on a six-week access course to higher education. They found that publishing the lecture notes on PowerPoint presentation files on the VLE in advance of the face-to-face session was recognised as being helpful to all students, including those without learning difficulties. The relatively easy addition of materials accessible online meant that students could make more relevant and meaningful notes, supporting their preferred style of understanding. Leyser and Greenberger (2008)

argue that tutors' knowledge towards different types of disabilities could be one of the reasons why some are lacking the willingness to make accommodations.

The question of what should be made available to students is discussed by Gerrard (2007, p. 200), who argues the need for 'reasonable adjustment'. The Code of Practice Post-16 (Disability Rights Commission (DRC), 2007) provides clear examples of what is regarded as a reasonable adjustment. Mostly, educational institutions are required to listen to disabled students and find out what they need. If such discussions are held with disabled students at an early stage in their studies, there is a better chance of reaching the best result for both the student and university:

> An education provider's duty to make reasonable adjustments is an anticipatory duty owed to disabled people and students at large. It does not only arise when an individual disabled student presents himself to the education provider (DRC, 2007, p. 64).

For the provision of online learning materials, it is essential that students are provided with adequate time to access and read their notes before lectures start. A four-year case study by Taylor, Duffy, and England (2009), exploring the use of general technologies on higher education students with dyslexia, discovered that the VLE could help assist the students' learning through the provision of lecture notes in advance, avoiding the need to take detailed notes during lectures. While no reference was made to assistive learning technologies used, the study highlighted the need for technology provisions from the DSA to be made available before the beginning of the academic year and for institutions to be aware that individual adjustments are not the same for every student with dyslexia.

Existing studies exploring the use of typography, letter spacing and graphics in literacy materials for children with reading difficulties have shown to motivate their choice of reading, following through into improving literacy development (e.g., Reynolds

and Walker, 2004; Thiessen and Dyson, 2010; Walker and Reynolds, 2002). Thus, for university students receiving lecture and course notes it is essential that they receive this material in digital format so they can adapt and enhance for a suitable reading preference. It is reported in guidelines from the Royal National Institute for the Blind (RNIB) and BDA, as well as being noted by several researchers (e.g., Evett and Brown, 2005; Ball, Rainger, and Draffan, 2005; Lockley, 2001), that sans-serif fonts (e.g., Arial, Comic-Sans, Helvetica) should be used in size 12 or above with line spacing set at 1.5 or double. In a study by Rello and Baeza-Yates (2013), eye-tracking software was used to investigate the effect of font type on reading speed with dyslexics. The researchers discovered that sans-serif fonts, specifically Helvetica, Courier, Arial and Verdana, influenced increasing individual reading performance. Additionally, one font specifically designed for dyslexia, OpenDys, was found to not lead to faster reading, with students significantly preferring Verdana or Helvetica fonts. While it is acknowledged that fonts can have an influence on dyslexics' reading, Marinus *et al.* (2016) point out that dyslexia designed fonts, such as OpenDys and Dyslexie or even sans serif fonts in general, are effective for reading by individuals with dyslexia, not due to their specially designed letters but their spacing settings.

Further research on the use of electronic formats for reading has highlighted that the use of digital content, such as ebooks and PDFs on mobile devices (tablets, smartphones, e-readers) can help support individuals with dyslexia to read faster. In one study, Schneps *et al.* (2013a) explored the effectiveness of reading with e-readers compared to print among high school students with dyslexia. The researchers found that the use of an e-reader type device significantly improved reading speed and comprehension, specifically due to shorter lines. However, a study by Margolin *et al.* (2013) examining the impact of technologies on reading comprehension with young adults with no learning disabilities,

compared different methods of text presentation using paper, computers and e-readers. They discovered that text displayed in electronic forms did not demonstrate a difference in comprehension compared to paper. Although Margolin *et al.* suggest that if a difference did exist it would be expected to be small or controlled by a variable that readers could easily compensate, such as familiarity, comfort or competency with technology. Moreover, another feature to reading with digital text is the adaptability of changing the colour of the screen/text to a preferred style of the reader, thus helping to reduce contrast sensitivity and improve reading speed. Current assistive software such as ClaroView™ and Read&Write™ can enable individuals to change the colour and contrast sensitivity of their computer screens. A study by Kriss and Evans (2005) investigating the effectiveness of coloured overlays with dyslexic teenagers revealed that their overall reading speed significantly improved compared to the non-dyslexic control group. These findings could propose that coloured overlays are useful for neutralising contrast sensitivity for dyslexic readers. A further study by Machan and Aleixo (2016) exploring e-readers as an alternative to coloured overlays for dyslexic teenage readers, also discovered that coloured overlays and e-readers are similarly effective interventions for individuals with dyslexia.

While further research studies (also, Ahlroos and Hahto, 2012; Schiavo and Buson, 2014; Schneps *et al.*, 2013) explore the benefits of the presentation of text through colour overlays or e-reading devices for dyslexics, it can be argued that they enable efficient learning and improve access to reading. Nonetheless, further research and longitudinal investigations are needed to explore the long-term effects of technologies on reading comprehension with dyslexics, specifically to emphasise their compensatory benefits within different contexts.

3.17. Conclusion

This final section has explored the educational role of access, engagement and enhancement of assistive learning technologies that aim to enable independence and break down disabling barriers. It has also attempted to explore the advances in technologies and how they have brought benefits to those students with dyslexia, empowering them to support their own needs, as well as identify their difficulties.

At the start of this section it examined the long-standing definitions of assistive technology and how charities, governments and researchers have come to define them. Initially described by McKnight and Davies (2012), this section also explored and proposed the term ‘assistive learning technologies’, emphasising that the study is centred around technologies enabling access to education. Thus, this definition helps provide a distinction of its purpose. Additionally, the discussion and association of compensatory and remedial technologies with special education technologies help present clarity and understanding of the correct use of technological interventions required to support students.

By presenting a brief historical perspective of assistive technologies, outlining the three key periods, Foundation, Establishment and Empowerment, it identified the continued role technologies have played in supporting those with disabilities. In addition to making connections to the previous section where legislation has helped contribute to a move from medical to social model of technology. From this view, the section explored the wider access to online learning and how it has helped enhance the broader learning experiences for those students with learning disabilities. Emphasising the significance of establishing a personalised and accessible environment where the student can engage with their technologies at each stage, a view emphasised by Price (2006).

The discussion of assistive learning technologies providing enhancement through a multi-sensory role is identified as an experiential learning strategy students often adopt when engaging with their studies. The ability to present and enhance the textual information in alternative formats, such as audio and visual with technologies, has been proposed by several researchers (e.g., Bozic, 1997; Dale and Taylor, 2001; Sloan, Stratford, and Gregor, 2006) as a solution to students with learning disabilities. However, what is often the difficulty, particularly for students unaware of technology support applications is choosing the assistive hardware and software suitable for their needs. Institutions and DSA access centres do not always recommend or support technologies that are appropriate for students' needs.

One of the significant focuses from this section is understanding the cognitive functions, such as note-taking, organisation, writing and proofreading with the composition of assistive learning technologies. Smythe (2010) makes the connection between representing the use of assistive learning technologies with both the writing and reading processes, demonstrated through the scaffold approach of making functional connections with specific assistive software. The widely accepted use of assistive learning technologies among students with dyslexia to enable cognitive processes was identified as voice recognition, text-to-speech and mind mapping software. While several studies highlighted the benefits assistive learning technologies could bring to students with learning disabilities (e.g., Raskind and Higgins, 1999 –voice recognition; Stodden *et al.*, 2012 –text-to-speech; Sturm and Rankin-Erickson, 2002 –mind mapping), De la Paz (1999) recommends that users receive instructional techniques that can guide them towards a stronger understanding of the software and enable them to establish a plan before attempting to use. The most significant issues faced by students when using these

technologies is the lack of training and guidance when integrating with cognitive functions.

Lastly, the discussion of the provision of electronic alternatives emphasised the importance of universities and tutors providing accessible learning materials (i.e. course notes) for students to adapt and engage with their assistive learning technologies. Not only has research found it to be beneficial for students with dyslexia, but Blankfield and Martin (2002) revealed that it could also help non-dyslexic students support their preferred style of learning. The all-inclusive benefits of electronic formats also presented researchers (e.g., Kriss and Evans, 2005; Schneps *et al.*, 2013) with further opportunities to explore the presentation of text on e-reading devices, alternating fonts and using coloured overlays to discover how it could improve reading speed and comprehension.

Although this section has presented an insight into the cognitive roles of assistive learning technologies from the standpoint of dyslexia, it is also important to note the emerging landscape of new technologies being developed. These new developments repeatedly outpace the independent research needed to examine the effectiveness and interaction with twenty-first-century learners with learning disabilities. Thus, this study is well placed to explore this phenomenon. The following chapter introduces the research design that examines the specific data collection and analysis procedures.

Chapter 4: Methodology

4.1. Introduction

This chapter outlines the research design of the study, providing the rationale for its methodology, including the multiple case study approach. The chapter also discusses the specific data collection and analysis procedures. It concludes by presenting the areas of access, issues of the reliability, validity, generalisability, ethics and limitations in the study's methodology.

4.1.1 Overview

The overarching research question of the thesis was:

> What are the experiences of university students diagnosed with dyslexia as they use assistive learning technologies for their studies?

The sub-research questions were identified as follows:

1. How can students' personal and educational backgrounds enable them to use assistive learning technologies in their studies?

2. What disability support and provisions do universities provide to their students?

3. What educational roles do assistive learning technologies play in the writing process for students?

Question 1 and 2 was answered through data obtained during a series of interviews, and question 3 was answered through data from the interviews, diary log and the narrative task analysis.

The collection of data to answer the three research questions was completed through the following three elements:

1. Diary log with students from Redwood University and Owen University (see section 4.4.1 and Appendix B);

2. Semi-structured interviews with students and university staff from Redwood University and Owen University (see section 4.4.2 and Appendix C); and

3. Narrative task analysis with students from Redwood University and Owen University (see section 4.4.3 and Appendix D).

4.2. Research Strategy

The objective of this study is to understand the experiences of students with dyslexia as they use assistive learning technologies to support their studies. It was decided from an early stage that this study would adopt a predominantly qualitative research approach in terms of the kinds of data collected and the kind of analysis to be carried out, as this would make it possible to study individuals in their natural settings, aiming to make sense of, and understand, the experiences that the individuals bring to them (Denzin

and Lincoln, 2003; Miles and Huberman, 1994). A qualitative approach was adopted to achieve a 'deeper' understanding of the social phenomenon, but it makes it possible to explore an individual's life experiences through reliable methods (Silverman, 2005). Nonetheless, the value of the data relies on the competency of how the analysis is conducted (Miles and Huberman, 1994).

Previous research studies investigating experiences of dyslexia (e.g., Carter and Sellman, 2013; Dale and Taylor, 2001; Illingworth, 2005; Madigan, 2007; Osterholm, Nash, and Kritsonis, 2007) and the research aims and objectives of this study indicate the appropriateness of conducting the research from a grounded theory perspective. As Cameron and Nunkoosing (2012) confirm, grounded theory involves the identification of categories from the data, through a process of coding, comparison of data and theoretical sampling, and consistently reflecting on and asking questions of the data. Initially, grounded theory starts by collecting data upon which to develop a theoretical analysis framework and discovering the participants' viewpoint on the research questions (Charmaz, 2009). The process of developing a research framework helps link the purpose, theory and research questions in defining an appropriate research design strategy. Defined by Corbin and Strauss (2008), grounded theory is a method for building theory from data, developed by Glaser and Strauss in 1967. It is used to think about and study social structures, and can be identified as having two primary characteristics: (i) the persistent evaluation of data with emerging categories, or 'the systematic choice and study of several comparison groups' (Glaser and Strauss, 1967, p. 9); and (ii) the theoretical sampling of different groups to increase the similarities with the connection and variation of information, or 'the process of collecting data for comparative analysis' (Corbin and Strauss, 2008; Creswell, 2009; Glaser and Strauss, 1967, p. 9).

Additionally, my personal experiences and the audience for the study also point to the appropriateness of using grounded theory. The implementation of a grounded theory strategy in this research was selected for three main reasons. Firstly, the need for flexibility in the in-depth and open exploratory approach to the research questions and selection of participants. It is generally understood in social science research that qualitative studies are typically exploratory and more theory-generating rather than testing. Thus, it was important and necessary to structure the research questions to allow for the flexibility to explore the issues being researched as thoroughly as possible (Corbin and Strauss, 2008). Although Glaser and Strauss (1967) originally proposed that the research questions must 'emerge' through the data, I believe it is a process of stating the research questions broadly and in a language, that 'reflects a problem-centred perspective' to those with experiences of dyslexia and technology (Birks and Mills, 2011, p. 22).

The second reason for using a grounded theory strategy was to discover and conceptualise the underlying social patterns and structures of how assistive learning technologies help influence the learning experiences of students with dyslexia. Thus, it was important that the students lived experiences of dyslexia and technology were captured to discover the meanings they placed on their 'perceptions, assumptions, prejudgments, presuppositions' (Van Manen, 1977) and linking these to the social world around them. However, Miles and Huberman (1994) argue that the strengths of the data rest centrally on the method in which the analysis has been completed, a process of selecting, focusing, simplifying, conceptualising and transforming the data. Grounded theory does not suddenly appear; it is a detailed process that is developed and combined by the researcher with the appropriate application of the important grounded theory methods (Birks and Mills, 2011).

The final reason is that with the wider implications for the future use of assistive learning technologies, the categorisation and interpretation of data through identifying analytic associations will help contribute to a framework of learning strategies for institutions. The use of grounded theory methods helped allow for the increase in flexibility and a wider focus on the data collected, with ways of reaching the research participants and gaining their trust. By establishing an understanding relationship with my participants, I could respect them and ensure I recognised their lives from their perspective (Charmaz, 2009). Working within the field of learning technology, I could evaluate the link between my initial research interests and the emerging data. My initial ideas and concerns were not forced upon the data but helped to define it (Charmaz, 2009). The exposure of qualitative inquiry from grounded theory methods helped advance the legitimacy of the research.

4.2.1. Case Study Research Design

It was decided from an early stage, after reviewing literature of case studies into dyslexia, technology and education (e.g., Cooper, 2006; Gerrard, 2007; Kirwan and Leather, 2011; Middleton, 2009; Mortimore, 2013; Ramus *et al.*, 2003) as well as considering the limitations of the study, that a case study design would be appropriate for examining students' experiences of assistive learning technologies within two universities. From the 1990s to 2010, there have been many research studies on the subject of dyslexia and learning difficulties. Nonetheless, very few of these studies have investigated dyslexic individuals' personal reflections, perspectives or even accounts of living, working, studying or using technology with dyslexia (Riddick, Farmer, and Sterling, 1997). A case study was selected in order to capture an in-depth understanding of a selection of dyslexic adult learners' uses of technology and how their universities

provided disability support and provisions. According to Kenny and Grotelueschen (1984), case study design can be used to identify and define phenomena and secondly, they contribute to the development of theory. Kenny and Grotelueschen (1984) also identify that case studies can provide a detailed and holistic narrative of the phenomenon that has been studied, as well as contributing multiple perspectives where a non-technical language is used. Moreover, case studies allow researchers to achieve several aims, such as providing a description, testing theory or generating theory (Eisenhardt, 1989).

A qualitative case study approach not only allows me to build a real-life learning experience of how technologies shape the lives of students diagnosed with dyslexia, but it allows me to put it into context with their educational backgrounds and experiences. Ghesquiere, Maes, and Vandenberghe (2004) identify that within the world of SEN, such as Wolcott's (1973) study, *The Man in the Principal's Office*, case studies have enabled researchers, teachers and even parents, to unravel the complexity of teaching practices, assess the success of inclusive education and understand the cognitive effects of inclusion on students. According to Stake (1995) and Yin (2003), case study designs are closely associated with a constructivist paradigm, a process in which we construct knowledge and meaning from our experiences of investigation, and where new theory can be built. Constructivism is developed through the foundation of a social construction of reality from experiences (Searle, 1995). One of the key advantages of the philosophical underpinnings of constructivism is the interlinked collaboration between the researcher and the participant in communicating their opinions to each other (Crabtree and Miller, 1999). However, according to Flyvbjerg (2006), within the community of social science, misunderstandings remain over whether case studies are beneficial in making generalisations about how areas of society work. Moreover, it is important to note that small amounts of qualitative research can contribute to falsifying a generalisation and the

researcher needs to recognise the requirement to include variability with observations and contexts (Stake, 2010).

The implementation of case studies at two UK institutions (Owen University and Redwood University) not only allowed me to include variability in my research but also explore differences within and between the cases. During the analysis phase, Yin (2003, p. 32) points out that comparisons are identified in the data and, from these, theories are considered and developed, as 'the main vehicle for generalising the results of the case study'. Thus, it was imperative that the institutional case studies were chosen wisely so that I could contrast the results with each other and examine the more varied forms of teaching and learning at each institution.

Finally, conducting a case study can involve a range of data collection methods which can include anything from direct observation to document analysis and interviews, as these allow the researcher multiple access to a variety of data from within various social contexts (Woodside, 2010). This study's use of multiple data collection methods and procedures helped improve the process of capturing how assistive learning technologies play a part in students' learning experiences.

4.2.2. Case Study Sample Selection

Sampling is a crucial process of the case selection and is essential for later analysis, particularly as qualitative researchers work with small samples of participants and study them in depth (Miles and Huberman, 1994). According to Miles and Huberman (1994), there are two processes in sampling, although these processes can sometimes involve different techniques and operate in different orders. The first process is to set boundaries, outlining the features of case studies and setting the criteria for time and methods, linking these to the research questions. Secondly, operating concurrently with the first process is

to construct a framework to support the processes of the study, helping to uncover and confirm the quality of data to be collected. This study adheres to these two processes; firstly, the selection of two higher education institutions, Owen University and Redwood University, sets the boundary for conducting multiple qualitative data collection methods. The time frame set for data collection was over a period of two academic terms (approximately sixteen weeks) with data being collected in parallel at both institutions. Secondly, the development of a research framework was established to identify the qualitative methodological approaches and link the purpose, theory and research questions in defining an appropriate research design strategy (Robson, 2002).

An outline of the two higher education institutions selected are outlined below:

i. Owen University is a pseudonym institution identifying a modern university established in 1992 in the UK. In total, the university has 28,000 students studying across all modes of study.

ii. Redwood University is also a pseudonym institution identifying a traditional university with a history of academic teaching in the UK. The university has approximately 21,000 students, including undergraduate and postgraduate.

4.3. Data Collection

Data collection methods selected for this study included semi-structured interviews both with students and university staff (academic and professional) at the two universities over a period of two academic terms. Additional qualitative methods were also used to collect a range of data from students, which included a diary log, to record students' experience of assistive learning technologies, and narrative task analysis, for students to talk through their use and experience of assistive learning technologies. These data collection methods are discussed in more detail below. Students and university staff also

voluntarily submitted documents relating to assessment reports, university access provisions, as well as photographs relating to student revision strategies. The advantages to deploying a varying range of qualitative methods are to gain a deeper insight into the research focus and attempt to understand, 'or to interpret, the phenomena in terms of the meanings people bring to them' (Denzin and Lincoln, 2003, p. 5). The outline of my data collection processes is discussed and outlined in more detail below.

4.3.1. Sample Selection

The process of sample selection is not only crucial for analysis later in the study, but it made it possible to select participants suitable for further investigation (Miles and Huberman, 1994). As Given (2008, p. 169) proposes, thorough selection of research participants 'with different outcomes can provide case-based comparisons that can illuminate factors in the real domain of prime importance'. Thus, for the selection of research participants, 'purposeful' sampling or criterion-based selection was used. From within the theoretical framework, convenience sampling was used, a subtype where the sample was 'based on the location and availability' of students diagnosed with dyslexia (Merriam, 1998, p. 63).

Qualitative inquiry is usually a process of focusing in depth and looking into manageable studies that are selected purposefully (Merriam, 1998; Patton, 1990). This approach, as Miles and Huberman (1994) describe, is where qualitative studies are not entirely specified in advance but can develop once the data collection begins. Additionally, Miles and Huberman (1994, p. 27) also suggest that this process of development and refinement is often referred to 'conceptually-driven sequential sampling', or 'theoretical sampling' –predefined or emerging as you progress with your research (Glaser and Strauss, 1967). Essentially, it is important that sampling not only

involves the choices we make when selecting participants, but considers the 'settings, events and social processes' (Miles Huberman, 1994, p. 30).

Additionally, the number of sample participants for any qualitative study is argued by Patton (1990) to have no set rules. He also points out that sample size depends on several decisions. For example, what you want to find out from the research; reasons for conducting the inquiry; what sample size will have credibility; and what can be achieved with the time and resources available.

Participants selected included students and university staff (academic and professional) at the two universities. The research sample criteria for students was based on three rules. Firstly, students had to be studying for a degree or accredited university programme, such as an undergraduate, postgraduate or PhD. Part-time students were also welcome to take part and provided the study with an insight into their personal experiences with a combined involvement of technology at a professional level. The study was not extended to include visiting students as I did not want students' UK experiences merged with their home institution. Secondly, it was necessary to include students studying a wide range of subjects as this would provide information-rich cases from which I could begin to understand how students' use of assistive learning technologies impacted their learning across all disciplines (Patton, 1990). Finally, and most importantly, students had to have been formally diagnosed with developmental dyslexia by an educational psychologist to participate in the study and not the acquired condition due to injury or accident. It is worth noting that formal diagnosis of dyslexia involves standardised psychological tests with observation and a clinical decision (McLoughlin, Fitzgibbon, and Young, 1994). It was decided early in the study, and from the pilot study, that it would not be possible for me to identify and verify SpLDs through diagnostic reports or assessments. Thus, it was necessary that the process for recruiting students was

aided by the university's disability office and their database of students with SpLDs. All students identified with dyslexia were initially contacted via e-mail by a member of staff in their university's disability office (a copy of the e-mail sent to students can be found in Appendix E). A research website (http://research.dyslexicsonline.com) was created so that students could find further information about the study, my background as a researcher and a more detailed outline of what was involved in participating, as well as documents and forms to aid the research process.

Due to data protection and confidentiality reasons, I was not able to make direct contact with any student unless they contacted me or agreed to the disability office sharing their personal data. Once students had received the e-mail from their disability office, they contacted me directly by e-mail and outlined their willingness to take part in the study. Some students even voluntarily provided information on the technologies they used and the subject(s) they were studying. Although the majority of students that contacted me to take part in the study met the criteria, there was a handful who were not able to participate because of the timing of exams and the demands of their lessons and personal lives. Also, a handful of students that did meet the criteria to participate in the study did initially make contact via e-mail but later did not respond to subsequent correspondence, so naturally they were eliminated from the study. Additionally, it was also imperative that the study included students who were in the process of receiving the DSA for assistive learning technologies. This selection enabled me to identify their need for technology and support and the ways in which the wider university provisions were at that time supporting their studies. It also allowed me to contrast students' experiences of using technologies and those who anticipated using it.

Each student who participated in the study received a reward. A gift voucher incentive of £15 was given on completion of the final task and a letter of completion. The

main reasons for offering students an incentive for taking part in the research study were to ensure they completed all the necessary components of the data collection process and so I could receive a good response rate of students wanting to participate. A doctoral research study by Michail (2010) investigating dyslexic students' experiences in higher education highlighted the difficulty of attracting students without any form of incentive or reimbursement of costs for participating in a series of interviews and tasks.

In total, using purposive sampling, 41 students took part in the study, with 21 from Redwood University and 20 from Owen University. Overall, there was an equal mix of male (51%) and female (49%) students from undergraduate and postgraduate programmes, with the majority studying full-time and their ages ranging from 18 to 55.

In choosing academic and professional staff at both universities, it was decided to use convenience sampling to target disability offices and support networks working with students. The criteria for selection of academic and professional staff was based on one principle, that they worked or were involved in supporting dyslexic students and supporting their well-being while at university. University staff were initially identified by their involvement with students and asked to take part. Other members of staff were invited by their colleagues and with the identification of support roles from the student participants in this study. It was not my intention to use a 'snowball technique', whereby university staff would refer other staff members thought to be beneficial to the study. However, where this occurred, the referees were able to provide me with an insight into disability support and provisions supplied to students.

In total, from both university groups, 10 members of staff took part in the study with 3 working at Redwood University and 7 at Owen University. From my personal experiences of learning disabilities and my connections at both universities, I had an insight into who to approach and ask to participate in my study. University staff who took

part in the study participated in a semi-structured interview consisting of six open-ended questions (available in Appendix C). At both universities, these included staff working directly in disability support services. However, Owen University had some staff working as student support link tutors, as well as working in teaching roles as senior lecturers. This support link role is voluntary and seen by many members of staff as self-advocacy. Either they identified a need within their discipline, or they had personal experiences of learning disabilities.

4.3.2. Pilot Study

Before conducting the formal data collection, a mixed-methods pilot study was conducted to evaluate the validity of the methodology and the outcome of the research subject. This pilot study investigated how 7 undergraduate students used assistive learning technologies to help with their studies and how the integration of technologies into their daily lives contributed to independent learning strategies. The pilot study was conducted at a modern university and included five Learning Support Co-ordinators and two Dyslexia Support Tutors. By extending the study to include academic and support staff, qualitative data could be collected on the difficulties faced by students diagnosed with dyslexia.

For the student participants, the mixed-method pilot study analysed their educational experiences of using assistive learning technologies and followed a systematic approach for completing the four elements of the data collection process. For each student participant, the four elements included: three accessible online surveys, a student diary log, a semi-structured interview and cognitive task analysis using assistive learning technologies. The second part of the pilot study investigated the role of academic support, within the modern university, for students with dyslexia. This investigation followed a

qualitative methodology, conducting semi-structured interviews with academic and support staff involved with dyslexic students. This was achieved using accessible online surveys, website and software, and structuring the research exercises, so the student participant knew what to expect. Only when each student had completed each research exercise were they able to move on to the next stage.

By testing the reliability of the four-stage student data collection, I could assess the research questions, the process of collection of data, research methods (i.e. question design, cognitive task analysis) and the participant completion online. Originally, I proposed that students would use the cognitive task analysis to capture how they used their computers and assistive learning technologies without providing a narration of what they were doing. The intention was to capture their usage on a computer for 30-45 minutes with the data capture software operating in the background. However, some students did not have any ongoing assignments to work on. Instead, they provided me with narrated videos (5-7 minutes in length), talking through their use of technologies, including assistive learning technologies, and their experiences of learning. This provided the study with a concise, clear and visual representation of how the students were using technologies to shape their learning experiences. The outcome of the pilot study influenced the development and design of the full-scale study to become a manageable, in-depth qualitative investigation of the educational role of assistive learning technologies at a traditional UK university.

Following a review of the pilot study, it was agreed that the mixed-methods design originally proposed might create problems regarding time and integrating different approaches. Additionally, the use of the quantitative student online surveys would not provide the quality of material important for close investigation of student experiences. It was decided that the study would prioritise actual content with students through in-depth

interviews and student diaries. The use of the cognitive task analysis continued to be used; however, it was simplified to ask students to talk through their use of assistive learning technologies and their experiences while using screen capture software. This element of data collection was called the narrative task analysis, and student guidance notes were simplified (see Appendix D).

Evidence from the pilot study indicated that student use of assistive learning technologies for literacy varies across different disciplines and subjects studied. Nonetheless, what was of interest to this study, was how students personalised and adjusted the software to their individual situations and experiences. Beyond the level of using software to perform satisfactory tasks, students invested time and energy into understanding their requirements and adapted the software to their preferred learning strategies. To understand further, students were asked to talk through their actions of completing standardised assignments and their learning experiences at university.

4.4. Research Framework

The research framework underpins the methodological approaches used during the data collection process and links the purpose, theory and research questions in defining the research strategy. For the research framework to effectively gather data relevant to the research questions and objectives, three different qualitative data collection methods were used, with the pilot study testing the validity of the design.

The process for data collection involved two groups of participants: students and university staff. For students, the study began with the student diary log, followed by the semi-structured interviews and narrative task analysis. The collection of data for university staff consisted of semi-structured interviews. The following sections outline and discuss these elements in more detail.

4.4.1. Student Diary Log

Diaries and personal journals can be used 'as tools of data collections and as data', capturing 'mundane activities and experiences otherwise inaccessible by researchers' (Given, 2008, p. 764). Several researchers, such as Dale and Taylor (2001) and Taylor *et al*. (2010), have used diaries and journals to collect personal reflections from participants and it has proved to be very informative, contributing to the wider analysis of emerging categories. The data from the student diaries helped shape the study to reflect students' personal experiences from within different educational contexts and investigated areas I could not personally explore. The use of diary logs in my research has had numerous advantages in data gathering. These have included: reaching out to dyslexic students, access to which could sometimes be challenging; supporting the recording of private and personal experiences; and accessing students' experiences in their own words without research intrusion (Given, 2008). These student diary logs were helpful in providing me with detailed and timely data that highlighted students' experiences of using assistive learning technologies.

To give perspective on the diary log, when I first met with a student I explained the process of data collection, what was involved and the elements to be completed. The purpose of the diary log was to record students' experiences of assistive learning technologies (including internet tools, mobile phone applications and university learning systems) that helped with their studies or personal work, over a period of one academic week. The students were provided with downloadable digital files or printed copies of the diary log. A copy of the student diary form can be found in Appendix B. Each student was required to enter the date and time they started a task or exercise, what technology they used to support each task or exercise and how it supported them. This entry helped identify how the availability of assistive and learning technologies helped students with

their studies. The final two entries specified the context of where they used the technologies and if they experienced any difficulties when supporting their learning. The data acquired from students' diaries enabled me to construct more tailored questions for the semi-structured interviews.

When students had completed their forms, they either e-mailed the form back to me or handed it to me in person. Only two students questioned the suitability of the writing task in the diary form. Nonetheless, I was prepared for this, given that many dyslexic students have problems organising their time and taking notes. Thus, it was acceptable for the student to record their response as an audio log using their mobile phone; audio files were then shared via e-mail and transcribed.

Although there were some elements of redundant data, it was interesting to understand how each student had completed their diary and the methods of technologies they had used. The data displayed students' experience of using assistive learning technologies within different contexts and highlighted a range of proficiency levels with the use of their technologies. Their planning processes and the many 'work-around' solutions they developed when using assistive learning software were all apparent from their diaries. Obviously, some diaries were more detailed than others, but it gave a true insight into how assistive learning technologies contributed to their learning experiences at university.

For the analysis of data, the use of grounded theory provided the diary logs with a methodological groundwork for identifying categories from the data (Bryant and Charmaz, 2010). The analysis of the diary logs included a three-stage process: stage one understood the data and the quality of the data; stage two focused on the analysis of the data with research questions that need answering; and stage three related to how the relevant data was categorised into themes or patterns.

4.4.2. In-Depth, Semi-Structured and Recorded Interviews

Following the successful completion of the diary log and understanding students' reflections on using technologies, in-depth semi-structured interviews were conducted with 41 students from both universities. This data collection process was a two-way connection. As Mishler (1986) explains, semi-structured interviews are a practice of discourse between the researcher and the person being interviewed. The use of semi-structured interviews was selected, so the study focused on students' experiences of assistive learning technologies and to discover how this supports their learning. A semi-structured approach was adopted due to the nature of the subject and audience. This allowed me to ensure the predetermined questions were not used in a pre-set order (Robson, 2002).

These interviews proved beneficial in obtaining student experiences in using technologies and their educational backgrounds. The interviews lasted, on average, between 60 to 90 minutes. Each student participant received a copy of the interview questions at least three days before the research interview taking place, allowing time for the students to consider their responses.

Ten open-ended interview questions were used, split under three subject headings: background information, assistive learning technologies and university support. I started the interviews with asking the students to talk me through their background on dyslexia: when they were diagnosed, what support and provisions they received at school and university, and if this had influenced their use of technologies at university. From their responses and the use of open-ended questions, the flexibility to encourage co-operation in understanding any unexplained or anticipated answers helped present an authentic perspective of the research problem. As Roulston (2008, p. 582) explains, the benefit of open-ended questions is that they enable the research participant to decide how they

‘orient to the research topic’ and ‘to choose the terms with which to construct their descriptions and highlight the topics that are meaningful to them’. Throughout my interviews, I was aware to ensure that the questions were open enough to allow data to emerge from the students and for them to feel relaxed (Charmaz, 2009). Initially, some students were quiet and a little shy so it was my role to make them feel comfortable and ease them into the questions by allowing them to introduce themselves, and talk about what degree they were studying. Some students were vague in talking about their school experiences with dyslexia, compared to other students. Thus, I had to be mindful that some of their school experiences might have been stressful and not particularly pleasant to recall. For instance, in one interview I had to stop and pause the interview because I could see one student becoming upset. After a short break, the student was fine to continue, but this instance made me even more aware of the sensitivity dyslexia can be in someone’s life. Thus, I became more skilled as the interviews progressed and learnt to draw out the students’ personal experiences while they remained at ease. Throughout some of the interviews, there was a pattern of some students talking about a range of topics and issues. Although this was interesting, it was sometimes off topic and not the focus of the study. However, the use of probing questions was useful, and these were included in the interviews at suitable places to keep the focus of the study centralised on the research theme (Patton, 1990). For example, in one interview a series of probes was used to get the student to expand further on a response about ‘teacher support for technology at school’ because technology is relevant to the study. The most effective method I found involved writing down key words and phrases from the students’ answers, and when they had finished their reply I asked them to elaborate further: ‘Did using technology at school help contribute towards using technology now? At university?’. At first, a handful of students were quite reluctant to be open towards talking about their support, provisions and issues

at university, commenting: ‘does this go back to anyone?’, ‘Is it just you?’. This was an interesting perspective given how open they were towards their disability at the beginning of the interview. Although these students were made aware that their responses were confidential and anonymous at the beginning of the interview, I did have to reassure them their responses were private, and all quotes used would be unidentified. Towards the end of the interview, I gave students the opportunity to add any further comments that they felt might benefit my study. Not all of the students took this opportunity to summarise their experiences, but those that did expressed several issues and comments that they thought were personal and important for them. These included provisions at university, labelling of dyslexia as a disability and being diagnosed early with dyslexia through support from family.

In addition to the student interviews, I conducted in-depth semi-structured interviews with ten academic and professional staff at both universities (a copy of the semi-structured interview questions can be found in Appendix C). The objective was to interview university staff who were directly involved in supporting students with disabilities and associated with the disability support services. The interview questions centred on the experiences and opinions of academics in teaching and supporting dyslexics students over the academic year. For professional members of staff, working in libraries and disability support departments, interview questions were focused on the support and provisions provided by the universities and the diagnosis of dyslexia.

4.4.3. Narrative Task Analysis

The final element of the student data collection process involved students talking through their use and experience of using assistive and learning technologies on their computers to complete their assignments or set tasks. Students completed a variety of

tasks including essays, writing reflective evaluations, presentations and even in-depth analysis of their use of technologies. The purpose was to capture the way a student used assistive and learning technologies and the strategies used to make decisions, or even solve problems (Crandal, Klein, and Hoffman, 2006). The aim was to capture the students' computer screens, using cloud-based capture software, to understand and analyse their experiences. One of the advantages of capturing the live use of technologies was that it placed the student in control of demonstrating their strategies, difficulties and technologies, in an environment where they felt comfortable. Although there was no set time limit on the length of their analysis, I did advise that students aim for 5-15 minutes in length. Some students went beyond this and recorded their in-depth analysis for 20 minutes. The idea of setting open-ended tasks and not goal-directed tasks for students was preferred since I did not want to place unrealistic expectations on students' abilities, as this would not present a true perspective of their experiences.

At first, a handful of students did experience a few issues with using the screen capture software, even though I had created an accessible online guide for them to follow, available through my research website. To avoid these issues, it was decided that after completing each interview I would guide each student in using the software for their task. Each student was given a cloud licence to use the software online and to download their file. Once the student had recorded their narrative, they arranged to meet with me and provide a digital file ready for me to analyse. The critical part of the narrative task analysis was about understanding the process of structuring data and identifying what the data meant (Crandal, Klein, and Hoffman, 2006). Thus, the process of systematic data helped present a qualitative approach, including textual descriptions of the students' narration and workflow models. These workflow models are a series of processes and

stages that have been identified from the students' reflections and methods needed to complete their task or assignment.

Students' narrative task files were transcribed and analysed using grounded theory (see section 4.5), identifying emerging themes from the data. It is important that the data developed an analysis protocol and included the elements of a coding scheme to seek patterns and interpret the data (Cox, 2007). Additionally, the data helped identify the students' assignment process and highlight new knowledge on students' processes and experiences of learning while using assistive learning technologies with their studies.

4.5. Data Transcription

The final role within my data collection process, before analysis, was transcribing the research interviews. Davidson (2009, p. 37) claims that the shared views of transcription as a method can be identified as 'theoretical, selective, interpretive, and representational', with researchers approaching transcription to understand the world. From the collection of my research data, transcription became a necessary practice to reflect and understand the theory, as well as helping to structure it (Du Bois, 1991). All my semi-structured interviews and task analysis files were transcribed in their entirety using basic transcription notation conventions. It was important for me, as a researcher, to be as accurate as possible, including capturing grammatical errors, verbal emphasis, hesitation and when a sentence ended in laughter (Rugg and Petre, 2007). The majority of the student diary logs were already in text format, but those that were completed by hand or audio were transcribed in their entirety too. I believe that all these elements help present and prepare a true perspective on the subject and issues being researched. McLellan, MacQueen, and Neidig (2003, p. 64) argue that transcription guidelines help prepare researchers to 'systematically organise and then analyse textual data, regardless of

the analytical techniques and tools used'. Nonetheless, it is important that these guidelines do not constrain the data collected but allow the researcher to 'accommodate an iterative process' (p. 64). All of my data files were transcribed and were consistent with Mergenthaler and Stinson's (1992) seven principles for developing transcription rules. These principles include: to 'preserve the morphologic naturalness of transcription', ensuring words and punctuation are near identical to the speech presentation of the participants and consistent with the written text; and 'the transcript should be an exact reproduction', generating a word-for-word account with very little loss of information from the data (Mergenthaler and Stinson, 1992, p. 129). Patton (1990) also argues that the appropriate data to acquire when transcribing is a full transcription, even if this is time-consuming, as this is the most desirable to obtain.

4.6. Data Analysis Framework

Through the collection of data and the creation of research questions, the process of a data analysis framework was identified. The process of analysis is understood to be repeated cycles of two significant stages: firstly, managing the data and, secondly, understanding the data through expressive or explanatory interpretations (Ritchie and Lewis, 2003). This framework model was developed to help support the in-depth analysis of data using grounded theory. As Ritchie and Lewis (2003, p. 220) explain, the framework, referred to as the 'thematic framework' because it is the fundamental component of the research process, used to categorise and systematise data with 'key themes, concepts and emergent categories'. However, Charmaz (2009) argues that the theoretical framework is key in holding together your research argument and using it to explain the meaning of your original concepts. From within this study, the theoretical analysis and the development of category concepts highlight the experiences of students

diagnosed with dyslexia as they use assistive learning technologies to support their studies.

Although Patton (1980, p. 306) argues that 'patterns, themes, and categories of analysis come from the data; they emerge out of the data rather than being imposed on them prior to data collection and analysis'. I believe that these patterns, themes and categories do not necessarily develop on their own. It is a process that drives the interpretation of what the researcher wishes to find out, through the development of a theoretical framework. Thus, the first process in the identification of forming categories for a framework was achieved through keyword classification of the research questions and the research interview questions. This allowed the research data to be collated and to let the research problem influence the coding categories. Birks and Mills (2011) argue that because grounded theory looks to create theory from the data and not from pre-existing views of the subject being studied, generally a theoretical framework is not used to aid the research. Nonetheless, Corbin and Strauss (2008) suggest that theoretical frameworks do have some relevance and can help support the interpretation of findings. They also argue that a researcher should continue to be open 'to new ideas and concepts and be willing to let go if he or she discovers that "imported" concepts do not fit the data' (p. 40). I was mindful of remaining open to new ideas and concepts in all elements of my data. Ensuring that my theoretical framework was not applied too early in the data analytic process, as this could risk losing some detailed elements from the emerging data (Ritchie and Lewis, 2003).

The use of grounded theory provided the data with a methodological groundwork for identifying the data and discovering the theoretical possibilities (Bryant and Charmaz, 2010). Thus, it presented me with the flexible guidelines to direct my study and with the opportunity to think freely and openly (Charmaz, 2009). Moreover, it gave me the

responsibility to develop a strategy for the process of category building. It was considered that the category building would not be influenced by the literature review as this might have allowed for my opinion and other researchers' ideas to influence the categorisation. Nonetheless, as a researcher, it was important for me to acknowledge the link between my initial research interests and the ideas emerging from the research questions: 'grounded theorists evaluate the fit between their initial research interests and their emerging data… we do not force preconceived ideas and theories directly upon our data' (Charmaz, 2009, p. 17).

4.6.1. Grounded Theory

The use of grounded theory and the flexibility of the data analysis framework provide a guideline for the organisation of categories and subcategories. It is essential that as the theory develops, new categories emerge and it becomes apparent that relationships within the data can change. Glaser and Strauss (1967, p. 70) confirm that as theory changes and forms, we can understand which 'categories require the most and least complete saturation, and which ones can be dropped'. It is a process that is 'multi-layered' and driven by the idea that 'sociological concepts should be organic', where data is continually collected and analysed to discover new conceptual information (Wasserman, Clair, and Wilson, 2009, p. 358).

By using grounded theory and an inductive approach for generating codes from the data (Strauss and Corbin, 1998; Glaser and Strauss, 1967), this study critically analysed the research interview transcripts, identifying themes and categories related to the research questions and data analysis framework. Initially, the use of open coding helped identify and interpret the possible emerging categories within the data transcripts. From this, the categories identified were then formed and linked together, in a process known as

axial coding. This is the practice of relating the codes, including categories and properties, through an arrangement of inductive and deductive thinking. As Birks and Mills (2011) explain, this intermediate level of coding is firstly used to develop complete individual categories by connecting sub-categories and thus expanding the array of properties and dimensions; and secondly, by linking the categories together. Through the analysis of data, I could continually examine and search the data for concepts and themes that would help provide an insightful description of 'what's going on' in the inquiry (Srivastava and Hopwood, 2009, p. 77). The process of inductive analysis allows the 'patterns, themes, and categories of analysis' to emerge from the data instead of being forced before commencing data analysis and collection (Patton, 1980, p. 306). It is driven by what the researcher wants to discover while allowing the theoretical framework and individual perspectives to interpret what the data is telling the researcher (Srivastava and Hopwood, 2009).

Finally, the use of selection coding was to focus on one aspect of the core category, providing a conceptual framework and theoretical understanding (Robson, 2002; Goulding, 2002). Although when starting the analysis theories can be seen as irrelevant or unconnected, as they emerge it can become clear that they help form the central theoretical framework, contributing to defining the emerging theory, as Glaser and Strauss (1967, p. 40) confirm:

> In the beginning, one's hypotheses may seem unrelated, but as categories and properties emerge, develop in abstraction, and become related, their accumulating interrelations from an integrated central theoretical framework – the core of the emerging theory. The core becomes a theoretical guide to the further collection and analysis of data.

The process of data analysis was conducted using a qualitative data analysis programme NVivo, to manage data, ideas and query questions relevant to the research. The leading preference for using NVivo was that it allowed me to be in control of the data analysis with an array of tools, such as matrix searches, visual representations and detailed memos. According to Glaser and Strauss (1967), keeping notes and memos is an essential part of grounded theory for the method of conceptual development. From the perspective of NVivo, Bringer, Johnston, and Brackenridge (2004) describe the advantage of using NVivo for memos and an audit trail, as it allows for various active links and attaches these within the data, thus enabling me to maintain a record of the development of the project.

Figure 12. Constructing a grounded theory framework through the analysis and comparison of data (adapted from Barden, 2011, p. 80).



1) Open Coding Analysis

Using NVivo, open coding identifies emerging ideas, creating free nodes within the programme that are quick and spontaneous. As defined by Bazeley (2009), a node provides storage areas in NVivo for references to coded text, providing evidence for what

is known or confirmation of one concept or category. The use of coding provides an association between collecting the data and developing the emerging theory to rationalise the data (Charmaz, 2009). The logic of initial coding in this study allowed for the identification of problematic opinions and, as such, the following questions were asked: What is the situation? What is going on? What categories are suggested by the data? What is the data a study of? (Glaser, 1978; Charmaz, 2009).

From the analysis of the transcribed data, 177 different concepts were associated with the research questions. These concepts were analysed in more depth, relating to the transcript and the identification of themes within the concepts. The next process of axial coding involved assembling the data in new ways, after open coding (Robson, 2002).

2) Axial Coding Analysis

The analysis of the transcript to form concepts and categories is the process of interpreting the data and discovering the theoretical possibilities. Through analysis of the research questions, examining the experiences of assistive learning technologies with dyslexic students, I began to understand the relationships identified and the creation of categories from the data. Using the methods of constant comparison, making links and asking questions, relationships within the data were identified and formed. Analysed from the transcripts through open coding, the original 177 concepts were associated with 57 possible categories. The development of the coding system was achieved through making connections between the categories and subcategories. Through organising concepts into coding hierarchies, otherwise known as trees, I identified various patterns of association. As defined by Bazeley (2009), the tree nodes in NVivo help create order out of randomness, moving from a general category to a specific category. The sorting and

connecting of existing and new nodes into a branching system of tree nodes helped reflect the overall structure of my data.

3) Selective Coding Analysis

The final process in the coding of data involved the integration of the existing categories into the axial coding model. As defined by Glaser (1978), the process of selective coding follows a method of conceptualising the established codes that are related to each other and the hypothesis. By reflecting on the overarching ideas running through the newly developed coding system, it became apparent as to how to identify patterns between the groups of nodes. From the process of developing and categorising the existing themes, I could identify the broader educational experiences of assistive learning technologies on students with dyslexia, how they integrated these technologies into their studies, and the disability provisions made available. This analysis of data and the creation of overarching core categories lead to the connection of associated subcategories, where common patterns and occurrences were grouped. It is from the data that the coding categories and subcategories are organised into meaningful clusters (Hsiu-Fang and Shannon, 2005). According to Bazeley (2009), categories are also described as 'concepts' but are ones that 'stand for phenomena'. These categories can be labelled and organised in various ways, although it varies on the properties of the concept that are being considered. The following findings chapters identify the relationship between categories and subcategories based on the analysis and association of data, presenting a greater understanding of the phenomena.

4.7. Validity and Generalisability

Carrying out the procedure of qualitative validity allowed me to check the accuracy of the research data. The qualitative reliability of the study assesses whether I am consistent throughout the study and with other researchers (Creswell, 2009). Moreover, Bryman (2008) argues that reliability and validity are related, as validity presumes reliability. Thus, if the measure is not reliable, then it cannot be valid. To ensure the reliability of my research study I employed several strategies. Firstly, I ensured the transcripts were checked for obvious mistakes. This was a slow process but ensured that the data was accurate and contained true responses from the participants. Additionally, I engaged the use of an external researcher to review a random selection of my transcripts against my themes and existing categories. This was achieved by the researcher categorising a random selection of interview data files, highlighting a series of emerging categories and then comparing these with my process of conceptualising the data. This allowed me to assess the reliability of my own categorising decisions. Moreover, it ensured and verified, that I remained independent of my data and that I analysed it through various processes without showing any bias. Secondly, in addition to the external researcher, during the process of categorising the data into codes, I ensured that there was no movement in the meaning of codes. This was achieved by constantly comparing the data with codes and by initialising memos in a paper format about the codes and definitions.

4.7.1. Limitations and Reflexivity - The Position of the Researcher

From the beginning of this thesis, and at various parts throughout, I have acknowledged my role as a researcher with dyslexia. By exploring the educational experiences of technologies with students diagnosed with dyslexia, it has helped shape the

position and depth of this research. Interestingly, Olney and Brockelman (2003, p. 49) describe 'coming out of the disability closet' as a personal choice that could have 'serious repercussions for the individual regarding relationships and opportunities'. Thus, for me as a researcher acknowledging my dyslexia to students with the same disorder, it could be claimed to potentially have a positive effect on my collection of data, both from external researchers and the participants. However, Macdonald (2009), who is also dyslexic and researching the sociological perspectives of dyslexia, argues that if we exclude disabled individuals from social research, it allows the medical profession to strengthen their 'personal tragedy ideology'. Another point to consider is the impact of my bias towards the research and ensuring that I did not try to influence the results. However, Vernon (1997) points out that no research is without bias, emphasising the involvement of our life experiences:

> The closer our subject matter to our own life and experience the more we can expect our own beliefs about the world to enter into and shape our work, to influence the very questions we pose and the interpretations we generate from our findings (p. 178).

By being 'open and out' about my dyslexia and recognising my individual biases towards the lack of support and provision I received at school, I could appeal to an audience that would feel comfortable and relaxed when being presented with interview questions and tasks. Perhaps one of the advantages of being a researcher with dyslexia exploring the disorder was the ability to make an initial connection with the students when recruiting them for the study. For instance, although I did not see it as my role or even possible for me to verify each student with a formal identification of dyslexia, I was able to judge independently, and in my mind confirm, that each participant was, in fact, genuine by talking with them about their dyslexia prior to the interview. By simply

acknowledging my own dyslexia and the need to discover more about how technologies can support the disorder, I could establish a connection of honesty and trust, as well as remaining transparent about the reasons for my interest in the study. Interestingly, Riddick (2000) points out that by understanding the impairments associated with a hidden disability such as dyslexia, a researcher would have an idea and willingness of what appropriate evidence to look for.

One aspect that could be described as having both a positive and negative effect on my data is identified from my own experiences with dyslexia during the interviews. Due to the students being aware of my dyslexia, it sometimes meant there were elements of *transference* during some of the interviews: a process where past experiences and relationships can affect people's perceptions of individuals we meet (Wilson, 2002). Although it was essential to try and remain neutral throughout my data-collection process, during some of the interviews a handful of students would revert the questions I presented and ask about my own experiences on the subject. It was my desire and interest in the research topic to develop a rapport with my student participants. Thus, I would avoid discussing any personal opinions or beliefs about the subject until they had completed their interviews and tasks. In this instance, it could be argued that by disclosing my dyslexia it is seen as having a negative effect on my research, due to the focus being moved away from the research participants. However, I argue that researchers with learning disabilities (e.g., Denhart, 2008; Macdonald, 2009), have expert and inside experiences of their difficulties to explore deeper into the conducting of their research. From my perspective, I was able to connect with the students, obtaining useful and relevant data about their experiences, while using my knowledge to search deeper into the broader problems only dyslexic learners experience. For instance, the data collection method asking students to screen capture their use of technologies was created so I could

explore deeper into identifying their cognitive work patterns and how they made connections with different types of software. By understanding the difficulties faced by students with dyslexia, from my own insight of dealing with the disorder, I understood the importance of capturing students' processes with technology and investigating these aspects.

The focus of dyslexic researchers investigating the disorder are in the minority within academia (Stacey, 1997), with only a handful of known researchers with dyslexia studying the disorder from different disciplines: Dr. Hazel Denhart, education perspective; Dr. Stephen Macdonald, sociological perspective; and Professor Matthew Schneps, scientific perspective. Thus, it is essential that these minority group of researchers persevere in exploring the issues surrounding dyslexia and continue to acknowledge their own perspectives to enhance the depth of research further.

Furthermore, away from the effects of my dyslexia on the study, the use of qualitative case studies in the study provides the data for rich, detailed descriptions of the phenomena, although it does generate some limitations. Despite this study only examining two universities of variable sample sizes, they only represent a small proportion of students in UK universities with a learning disability and thus, limit the generalisation of the research study. Additionally, this study captured the experiences and opinions of students who were diagnosed with dyslexia at various times throughout their education. It brings together an array of students' understandings and feelings towards their learning experiences at university. The concluding chapter presents a more detailed insight into the overall limitations, focusing on the sampling and methodology of this study.

4.8. Access, Consent and Ethical Considerations

4.8.1. Access to Owen University and Redwood University

From my personal contacts in disability support offices at both universities, I gained access to their services so I could recruit students that were diagnosed with dyslexia and university staff. By explaining my research study and the reasons why I was conducting my research in this area, I could gain their support and interest. Each disability support office understood the importance of the support provided to students and thought the study would give insight into the services they offered. Also, they had limited qualitative in-depth evidence to suggest the support they offered was of value to the students. Although I got permission from Owen University that I could invite students to participate in my study via their email groups, it became a little more complicated at Redwood University. Following a meeting with their disability support office, it was felt that the process of promoting my study via their email database might infringe data protection laws as I was singling out 'only dyslexic students'. While I did not see this as being an issue, since there were no problems with contacting students from Owen University, I respected their concerns and worked with Redwood University in gaining their support to recruit student participants. This involved working with the Data Protection and Legal Services departments at the university, ensuring the correct information and wording of the e-mail message was approved before it was sent to students. Both universities' disability offices, departments and academic faculties gave me support and access in recruiting students and staff and were helpful in arranging appointments throughout the research process. After the analysis and completion of my thesis, I will work to synthesise my findings from each institutional case study to present an insight into the disability support and provisions of each university, and specifically around students' integration of assistive learning technologies.

4.8.2. Consent from Study Participants

From conducting the collection of data, I followed a detailed process in recruiting participants, gathering and organising data and informing participants of their involvement by using accessible online consent forms. All online communication forms were tracked and managed through a password-protected database; only participants who had completed the ethical consent form could proceed to the data-collection stage. Upon first meeting the students, I informed them of the stages of data collection and reminded them that they had the option to withdraw from the study at any point during the data collection process. Fortunately, this did not happen, and I only had to adjust meeting locations and times for a handful of participants. I also developed an online research site, (available at http://research.dyslexicsonline.com) so students could download the research outline, interview questions, data collection forms and details about signing the online consent from. Contact information for my institution, its research ethics committee and my research supervisor were made available to all participants via the online research web site.

4.8.3. Ethical Considerations

The consideration of ethical issues regarding individuals with learning disabilities has been widely discussed and debated in many research studies (Beacham and Atly, 2006; Mattson, Fischbein, and Roll-Pettersson, 2010). Without question, it is essential that the research study protects the interests of all participants, while developing trust and ensuring no misconduct or impropriety is reflected on their university (Israel and Hay, 2006). Throughout the research process, I respected the privacy, rights and welfare of each student and, where necessary, directed students to the relevant institutional support offices if they required additional help.

Finally, it was my responsibility to ensure that all the data collected was transcribed and handled ethically. To ensure this, the coding and data analysis was completed with participants' names anonymised, and I kept all data files and notes in a secure and confidential location. All participants received a transcribed copy of the interview a week after it took place. This allowed the student to check what they had said was accurate and so they could approve their interview for accuracy. As a researcher, it was my role and responsibility to understand the ethical concerns in writing and communicating the research findings, considering the use of language or words that may identify a disability or participant group (Creswell, 2009). As Mattson, Fischbein, and Roll-Pettersson (2010) point out, through the transcription of data, consent must be given for the use of sensitive material and the confidentiality of the participants must not be compromised. Essentially, the study has constructed anonymous case studies of student reflections at two institutions, respecting personal privacy using face-to-face interviews and personal perspectives. To comply with university research standards, my study received approval from the University of Oxford, Central University Research Ethics Committee (CUREC).

4.9. Conclusion

In this chapter, the rationale for the research questions, qualitative strategy and the research framework, underpinning the methodological approaches for the collection of data, have been examined and justified. By implementing a case study research design, focusing on participants at two very different institutions, I could gain an in-depth insight into students' educational backgrounds and experiences, while understanding the context of their views from interviewing disability staff. The selection of student participants with dyslexia is also emphasised in this chapter, as it highlights the importance of a formal diagnosis being an essential requirement for participation in the study.

One of the strengths of the methodology is the combination of multiple data collection methods involving diary logs, semi-structured interviews and the narrative task analysis. It brings together a combination of data to provide a clearer understanding of students' educational experiences of assistive learning technologies and evidence of theories and hypotheses. Through the construction of a grounded theory framework, I have not only been able to manage all components of the research analysis but explore emergent theories through a series of analysis: open coding, axial coding, and selective coding.

While I have acknowledged my own personal interests, connections and prejudices within this chapter, overall, I can identify that my individual experiences of dyslexia have enabled me to construct an in-depth and systematic investigation of students' reflective understandings of dyslexia.

The next two chapters present the findings from Redwood University and Owen University

Chapter 5: Findings

Redwood University

5.1. Overview

The purpose of this chapter is to present the findings into the experiences of university students diagnosed with dyslexia as they use assistive learning technologies for writing. This chapter examines the findings from the sample of the Redwood University participants. For the presentation of data, these findings guide the reader through a collective narrative of students' journeys from childhood to university. The findings present the significant themes of how students have navigated and empowered themselves to acknowledge their dyslexia, receive a range of support and provisions, thus enabling them to use their learning strategies with assistive learning technologies to aid their studies. These findings are presented in three sections responding to the structure of the study's research questions, comprising the identification of support, awareness of technology provision and the integration of assistive learning technologies to aid writing:

(i) **Section 5.2. Students' Backgrounds Enabling the Use of Assistive Learning Technologies**, explores the experiences through school to university, reporting how personal, learning and educational backgrounds have enabled the use of assistive learning technologies in their studies. The section links to early school experiences, social and family influences, as well as the development of personal learning strategies.

(ii) **Section 5.3. Disability Support and Provisions**, reports on the students' discovery of support and provisions, presenting their experiences through university at three prominent stages: foundation, awareness, and post-diagnosis. For the student, it is an important process in establishing and surrounding themselves with the appropriate support and environment.

(iii) **Section 5.4. Multi-Modal Uses of Technologies**, reports on how students have integrated assistive and learning technologies into their studies, with the prominent themes, multi-modal uses of technologies and visual organisation and processing, highlighting students' cognitive processes.

Before introducing these key findings, an outline of the participants involved in the study is presented below. Exploring their key characteristics, as well as the ages students were diagnosed with dyslexia.

5.1.1. The Participants

The study at Redwood University consisted of 21 adult students, 10 male and 11 female. From this case study, 16 students were identified as British home students, 2 from within the European Union (EU) and 3 international students. In addition to the students, 3 staff participants working in disability support also took part in the study. The students were made up of 15 undergraduates and 6 postgraduates. All students were studying full-time for their degrees in a range of subjects, including arts and humanities, medical sciences, social sciences, and mathematical, physical and life sciences. Recruiting from a large collection of students across all disciplines of the university helped reflect a good representation of the dyslexic student population and ensure the data was rich in personal

perspectives. In total, 13 students were funded by the DSA, 2 were in the process of applying, 3 were directly funded by the university because they were not eligible for government support and the remaining 3 did not apply. The varying funding positions will be discussed in more detail in this chapter and highlight the different states of funding to support each students' disability, as well as the influence it had on their time at university. The table in Appendix F provides a summary of the main characteristics of the student participants and outline of their profiles.

5.1.2. Setting the Scene: Age Diagnosed with Dyslexia

One of the criteria for the selection of students was to be formally diagnosed with dyslexia at some point in their lives, either at school, privately or university. The age that the students were diagnosed with dyslexia varied depending on their backgrounds. From the group of students, their average age was 23.1 years, ranging from 18 to 49 years. In contrast, the average age range of diagnosis was 16 years. The examination of the students' backgrounds and personal reflections helps give further context and insight into the differences of diagnosis age and personal age. As Goodman, Schlossberg, and Anderson (2006) confirm, the individual characteristics of age, ethnicity, gender and socio-economic status can help impact the personal perspectives of life.

Nearly half of the students (n=10), Adam, Amy, Gavin, John, Laura, Peter, Richard, Sophia, Tim and Tom were diagnosed with dyslexia while they were still at school, before the age of 16 years. Interestingly, Peter, Richard and Tim, the only European students in the group, were diagnosed before they had completed their first stage of schooling, before the age of 11 years. Again, nearly half the students (n=9), Chloe, Emily, Emma, Jane, Liam, Robin, Rory, Ryan and Stephen were diagnosed while they were at university through the disability support office.

Examining the data presented in Table 1 (see Appendix F), there appears to be no obvious pattern emerging between the students' age of diagnosis, personal age and the type of school they attended. From the analysis, some students were fortunate to be identified early with their difficulties. Adam, John, Laura, Peter and Richard were the youngest to all be diagnosed with dyslexia between the ages of 6-9 years, with the majority being diagnosed because of their family's interest or connection with dyslexia. As Richard explained: 'My whole family is dyslexic, so they were quite keen to get a dyslexia diagnosis relatively early'. John also described that he was tested because of his mom's professional interest with dyslexia: 'I think my first official diagnosis was in primary school, but it's always been on the cards because my mum is a specialist teacher, so picked it up very early'. Adam also recalled the time his mother who took him to get tested: 'I remember going with my mother to a dyslexia assessment, which given my age seemed quite aggressive actually. I found out probably when I was about 8 or 9'. Interestingly, Adam is one of the older students in the group but was fortunate to have been diagnosed early: '…when I look back, I think crikey, this would have been late 70's. It's a long time ago'. Although identified early, it did not mean Adam's school years were made easier: 'It was horrible for me, school. In English lessons, you were expected to read aloud so obviously for someone like me that was incredibly difficult because I couldn't read very well at all'. It is suspected that in the 70s very little was known in state schools about dyslexia, so identifying and supporting individuals with a learning disability would have been rare and there would have been no legal obligation for the school to intervene.

Furthermore, those students also identified with dyslexia at a young age can give thanks to their teachers and school for recognising their difficulties. Peter confirmed: 'I

did my education in France, so it's the equivalent of the UK, so being 6 years old, so I think it was started with tutors telling my parents that I probably had dyslexia and then I went to see a specialist, and it was confirmed that I had dyslexia'. Tim explained his experience from a European perspective when he was diagnosed with dyslexia between 10-11 years: 'I got the referral from my school to be assessed with dyslexia, and then that went back and forward for a while, but then by year 10/11 years they had the diagnosis in place'. One student, Gavin, who was not officially diagnosed until he was 11, explained: 'I went to a private school, and they had a dedicated learning support officer there… Her job was to essentially help students with spelling problems, so we had a spelling club that we all went to. I was probably aged about 7, 8, 9 I went to spelling club and aged 11 I went to have an official diagnosis of dyslexia'. Gavin's dedicated support at school helped until there was a greater need for a diagnosis before his exams: 'Extra time in all my exams from the age of 11 onwards, so I had extra time throughout my entrance exams and secondary school…'. As Gavin points out, the support officer played an important role in this: 'Because our school had a learning support officer they were very keen on sort of getting everything they could for the students'. It is identified from these students'

Laura's Story

Struggling at school, Laura explained that her teachers made her repeat year two again. After moving schools, she was placed in year four, and her new teachers considered the reasons why she needed to repeat year two. Finally, at 8 years old Laura was identified with dyslexia, and through school became aware of its limitation on her ability to achieve her full potential.

Throughout secondary school, Laura did everything she could to hide her dyslexia, 'laughing if off' if she spelt something wrong or mispronounced a word. During most of her time at school, Laura found herself not experiencing many problems, apart from spelling. However, as she started to specialise in her GCSE subjects, difficulties around essay writing and examinations started to present themselves. Being encouraged by her teacher who pushed for extra help in exams, Laura received permission to use a laptop computer because of her poor handwriting.

Laura's passion for learning emerged as she was able to focus her learning on her favourite subjects, becoming keen on the idea of studying at a top university: 'I got the idea in year 12… I think that sort of correlated to when I just learnt to accept it and just go with it!'

reflections that their personal and demographic characteristics played a part in how they cope and are diagnosed with dyslexia.

As mentioned earlier, nearly half the students were diagnosed with dyslexia when they were at university. Chloe, Emma, Jane, Liam and Rory all identified that they experienced considerable difficulty at school with reading and writing, despite not being identified with dyslexia until university. Rory explained: 'I never really thought I was dyslexic. I just thought I was bad at reading and bad at writing essays'. However, Emma also highlighted that she was not aware of any problems: 'The only thing that really strikes me what I remember is the reading out aloud in class and not excelling particularly well when I was with a teacher that was very strict on the orthodox ways of studying… of learning'. Chloe, who was also diagnosed at the beginning of her degree recalled her difficulties at school: 'The writing was a big issue where it was getting to like a year before going to secondary [school] I still couldn't write that well. People were just telling me [it was] because I was left-handed'. While the students displayed a good deal of literacy-based problems, their diagnosis went undiscovered until they started their degrees. An insufficiency of assessment could be attributed to the absence of awareness about dyslexia when they were at school. Hannah who was 18 when she was diagnosed suggested that her school was to blame: 'If I'd gone to a better school or something I think it would have been picked up on because I think I was openly struggling at school, dyslexia wasn't a thing that was talked about at school'. She also pointed out: 'I always thought there was something different about the way I learnt. I was always conscious of that. So, it's kind of like I didn't know I was dyslexic, it just wasn't official and I was still always convincing people that I had a problem'. One of the issues identifying dyslexia is that there are no biological markers, and diagnosis relies on reports and analysis of the individual's behaviour (Blakemore and Frith, 2005). Diagnosing dyslexia or a

developmental disorder can be a time-consuming and expensive process for schools, as well as a complicated issue of identifying from an isolated difficulty.

5.2. Students' Backgrounds Enabling the Use of Assistive Learning Technologies

This first section outlines several themes from the data, discussing and attempting to answer part 1 of the research question: 'how can students' personal and educational backgrounds enable them to use assistive learning technologies in their studies?'. To begin answering the research question, this section takes the reader through a collective narrative of the students' journeys from school to university, exploring their early understandings and perspectives that played a role in defining their dyslexia and helping to aid their use of assistive learning technologies with their studies. It is important to acknowledge that some of the students' accounts of their school days might also be coloured by hindsight.

5.2.1. Early School Experiences with Dyslexia

For many of the students growing up, struggling to learn to read and write, they would never have imagined being diagnosed with dyslexia. However, this accounted for just over half the students (n=11) in the group where the majority were diagnosed beyond their school years. Thus, the difficulties they experienced meant approaching learning through different strategies and adopting new ways of processing information. For the remaining other half of the students in the case group (n=10), they were formally diagnosed with dyslexia before finishing school, with 8 of these being diagnosed at primary school. From these 8 students, only 2 indicated that they attended a private school, with the remaining 6 students educated at a state school.

Although the students who were diagnosed during their early school years could not recall every detail, their personal accounts revealed that the provision and support each received was not equal or consistent. For instance, those students diagnosed at a private primary school reported that they received a range of support including 'remedial teaching', 'extra lessons' or a 'specialist education officer'. Also, one student, Gavin, reported that his school experiences were 'pretty good' and 'there was always a person on site to help me out'. However, the 6 students that were diagnosed when they were attending a state primary school reported mixed responses. For instance, students Adam and John who were diagnosed privately while at school pointed out that it was their mother's decision to get them assessed. Although one of the first individuals to be diagnosed in the 1970s, Adam explained that he never received any additional support at school and that 'the whole school experience was not very pleasant'. He also recalled that one day while he was in his 'remedial set' at school his teacher said, 'the aim of the school was to "turn people out that would go and work in the dockyard…" So, they weren't particularly

Tim's School Experiences

Tim received confirmation of his dyslexia while at school in Norway aged between 10-11 years. Educated in a state school, Tim added that it was an independent system that provided different types of equipment for all kinds of disabilities. He explained that it is now 'much more sort of haphazard whether you're getting all the equipment you need'. Nonetheless, Tim recalled that his parents played an important role in pushing hard to obtain the correct support and ensuring the school was involved.

Describing his school experiences as not 'problematic', Tim identified that there were challenges and frustrations with writing and spelling, as well as issues around memory that affected his ability to understand the written language. Throughout his early primary school years, he described receiving extra tutoring lessons every week with more intense courses. However, towards the end of primary school and throughout secondary school, Tim started to receive less tutoring due to a lack of resources and his ability to support his own needs through different learning strategies and the use of a computer for his homework.

At secondary school, to help with his writing in exams, Tim recalled receiving extra time and the use of a computer: 'Obviously, I felt that I would do much better when I had the computer, so in that way, it was an advantage for me'.

Acknowledging that his father and other members of his family are dyslexic, Tim explained that he follows their ethos of 'hardworking' and 'studying' to achieve his goals.

aiming very high! In the education states across the whole school, not just people like me'. But John, whose mother was a specialist teacher and picked up his dyslexia very early, decided to refuse a support teacher as he did not want to be stigmatised. Arguing that he did not want to be seen as one of the 'very low ability kids' and 'it was more of a defensive sort of thing, everyone knew I was dyslexic, but I didn't like to show people the weaknesses, the actual writing'. The other students that were diagnosed in their early school years described receiving some minimal remedial teaching and spelling lessons, while the majority indicated that their school 'wouldn't offer extra help or anything'. Another student, Sophia, reported that because she received extra support during her primary school years, she was automatically placed on the special needs register in secondary school. That placement, however, did not result in her receiving any suitable support. Sophia described her experience: 'I was placed with a whole load of kids that weren't academically capable, and they just wanted to muck and mess around, so I kind of didn't go to any of the extra lessons. I think they kind of gradually realised that I wasn't really interested in it so… they kind of cut me off and realised that I wasn't as needing as some of the other people, so I wasn't top priority'. Another student pointed out that his 'remedial teaching' in primary school had helped him catch up with his peers in the first year of high school and it had stayed that way ever since. Moreover, those students that were all identified with dyslexia in their early school years, both state and private, highlighted that they experienced considerable difficulties with

Ryan's Early Experiences

Not diagnosed until his second year of university, Ryan described his first problems becoming evident when he was very young with difficulties speaking. Throughout primary school, Ryan recalled broader problems with grammar, spelling, writing and a more inconsistent approach to learning. While some of his teachers were aware, they did not see it as a 'major issue' and worthy of justifying a dyslexia assessment.

Identifying himself as one of the brightest in the school, Ryan said: 'I guess teachers were reluctant to pick up or like criticise me too much on the issues I was having at school because the work was relatively good'.

reading. The students reported that they tried to 'avoid reading most of the time' and would try to never read out in front of their class as they knew they would be 'seen as slow'. The support and intervention, or their resolve to succeed, following these early years would have been essential in allowing the individual to overcome their difficulties and learn new strategies for reading.

In contrast to the other half of the case group that were diagnosed during their early years at school, the majority of the second half (n=11) were diagnosed with dyslexia while they were studying at university. For those students that were diagnosed later in life, they shared very similar challenging school experiences as those students that were diagnosed early on in their lives. The challenges faced by students diagnosed early was mainly due to one or several of the following reasons. Firstly, they were diagnosed privately, so there was no record or interest in their dyslexia at school. Secondly, for some students, dyslexia was not identifiable as a learning disability in their schools, so there was little support or no interventions. Lastly, some students did not want to be singled out with a disability or receive specialist intervention for fear of being different.

The only exception was one student, Gavin, who attended private schools from the age 4-18 years. He recognised that going to a private school certainly helped, explaining: 'I don't think you'd get the same kind of one on one tuition and help or, like input that you will get at a state school'. However, those students diagnosed at university recalled their early school experiences as 'frustrating' due to their difficulties with learning not being identified as a problem. Many students also reported they were often seen as 'stupid' or 'dumb' by their teachers and peers when it came to reading out loud: 'You would have just been seen as dumb or… well because I had always had problems with reading out aloud in class'. Rory, who attended a private school but was not diagnosed with dyslexia until he was at university, pointed out that he never thought he was dyslexic,

assuming that ‘people who were good at essays just always knew… like they always knew how to write essays and things, and they never had to learn’. Another student, Jane, who managed to go unnoticed with dyslexia throughout her school years reported that the basics of reading and writing took her a very long time to understand and process. Although, once she was able to understand through different strategies she could begin to excel.

The long-time problems arising from dyslexia can remain particularly among the older students who attended school at a time when dyslexia was not understood as a disability, and there was no difference between ‘dyslexia and stupid’. These kinds of experiences helped contribute to the lowering of their self-esteem and the inability to understand the self- perception of their learning difficulties. For those students who were unable to connect their difficulties with dyslexia early on in their lives, it appears they formed a resilience and became very determined to succeed, despite their issues. From an early age, the students learnt and adapted to different environments very quickly. For instance, one student described how she could excel in classes where ‘teachers were a bit outside the box with sort of unorthodox teaching methods… it was much more a sort of an open and freedom education process’. Some students reported that they benefited from activities outside the classroom such as visiting museums and art galleries as the visual and multimedia displays were more appropriate to their style of learning. The capability for students to explore multiple ways of learning was a real benefit, but for many students they became strategic in their choice of subjects to study later on in life. One student said: ‘I dropped all essay subjects when it came to A-Levels, but part of that was I’m interested in science, but I also think part of it was I found the science type of questions easier and more logical’.

It is often questioned why a number of students are diagnosed with dyslexia later in their education or even at university. It appears from some of the students that when they were at school they could accommodate and support their difficulties. Additionally, they were also very good at adapting and working hard to compensate for their literacy problems. However, their problems became more apparent when they were studying at a higher level outside their comfort zone, such as learning within a new environment, managing increased workloads and studying a new subject. One student explained: 'I always did reasonably well at school because I worked very hard, I think the teachers just thought that I was lazy in my spelling and things like that, but then as I got further through school and the workload started to pile up I ran into more and more difficulties with doing my homework'. One element that cannot be denied to the students is that they all share the determination and commitment to working hard and focusing on their studies: 'I put a lot of effort in and, you know, I did get very good grades, and I came here, so I put in a lot of effort consistently to my education really'.

The students' use and access to technologies during their early school years was minimal as many reported that it was limited and unavailable. The students added that they used technologies such as their computer to aid their school work when they were at home. One student said: 'I think it was limited how much technology I used at school! I used it more at home when I would work on my homework, I would usually write on the computer'. Other than at home, some students also pointed out that the only time they used computers in school was for their exams. In comparison to their lives today, one student described her life as 'so much easier' for being able to store all cases of her work and 'keep everything organised'. It appears that during school classes students hand wrote and used their standard textbooks for note taking and revision: 'I would have used my computer a little bit, but not very much at school I don't think. Most of the stuff I needed

was just in one textbook, so I'd just look at that, and I'd make handwritten notes'. Only one student, Gavin, who attended a private school, was provided with technology support throughout his early school years. Gavin pointed out that he was given a laptop to use in class as well as in all of his exams from the age of 11 onwards and he has never not been without using technology while at school: 'I've been raised in the world where I've had so much technology given to me, my laptop when I was young, all this sort of thing throughout the technology and software era that I hadn't really got used to not having it, so I was never really dependent on the persons to begin with. I was always dependent on the technology in the first place anyway'.

5.2.2. Personal Learning Strategies

As the students progressed through the education system, many recognised and discovered new approaches to learning independently. In many instances, the students identified completing their work through various structured and organised strategies, as well as the use of visual elements.

It was identified that the students who were diagnosed later in life and the students that received no support or provisions went on to acquire a wide range of learning and coping strategies to support their dyslexia. For instance, one student, Hannah, who was not diagnosed until 18 years old, said: 'I always worked very hard making revision cards and things like that, um, from a very early age, which I think if I hadn't done I wouldn't be here. I would have fallen behind very quickly'. The students discovered and learnt 'tried and tested' learning and coping strategies to support their 'autonomous journey' through the education system. More widely, the strategies identified by the students can be categorised and presented as two specific practices: planning and organisation, and visualisation. Firstly, the approaches of the students' planning and organisation strategies

occurred through several contexts. For example, many students approached their writing and revision through planning their work early: 'I think the first sort of importance that I do is that I start planning quite early'. The students also outlined their key approach to their work as 'repetitive'. One student, Adam, explained: 'So I literally had to work through the material, make notes, read it again, make notes, read it again until something… until it stuck'. It is a process that another student, Emily, explained as 'copying keywords down in the column next to it just so I can scan through and like get a good overview and write like a three-bullet-point summary at the end, so I don't get too, um, weighed down with what's going on'. Other students also described the process of having the 'whole picture' of the topic in their head before they could begin their writing. A method they had worked through to ensure they had a clear understanding of their plan.

Chloe's Revision Strategies

Despite experiencing difficulties at primary school with writing, Chloe was diagnosed just before finishing secondary school due to her teacher, who was also dyslexic. He suggested she get assessed for the learning disorder. Acknowledging her dyslexia and the difficulties experienced with essay based subjects at school, Chloe achieved outstanding GCSEs and A-Levels despite many, including her parents, believing she was not dyslexic.

Chloe's success can be partly credited to her development of learning strategies, as she recalled her psychologist explaining: 'You have a lot of strategies because you got diagnosed so late and you've just seen them as normal… that's why nobody's noticed really; you just dealt with it'.

For revision, Chloe created posters throughout her house: 'Biology was the top floor of my house, and I had to go a certain way around the room in order to learn it, and everything was associated with something… so when sitting in the exam if I couldn't remember I just had to retrace my steps! My mum hated it!' Chloe explained that she still uses a lot of diagrams and stories at university to retain facts: 'It's like an illusion of ideas where you tell a story, and you've got the letters of certain things… but that really works well for short answers. It doesn't work so well for essays'.

The visualisation of learning is the second theme identified from the students' personal learning strategies. Described as 'thinking visually', 'understanding the shapes of words' and 'the visual act of looking', it empowered the students to recognise visual symbols very quickly. Some students highlighted that their strategies had a way of

creating a three-dimensional visual representation of their information so they could memorise it more easily. One student, Sophia, who created hand-drawn mind maps described it being 'more flexible' than using the software as she could instantly create different sections with various colours 'more instantly', linking the content and making the process more accessible, without the barrier of learning the software. Sophia said: 'There was a lot of diagrams and stuff mechanisms that need explaining so I don't think it was intense as looking down at a piece of paper… you could look at a section and just feel you'd understand that'. Other students said that they gravitated towards textbooks that tended to use more visual resources or the use of audio-visual presentations to explain specific scientific processes. Another student, John, recalled the visual process of learning to read when he was younger, despite being taught that individual letters make sounds and letters together make different sounds. John explained: 'I saw the shape of the word, and I sort of connected that shape to the shape of a word I've read or come across before and what I knew that sounded like from hearing it, err which meant I really struggled with certain words which were clearly close like definitely and defiantly –still an issue!' Moreover, a number of students explained the ability to organise revision notes in a more visual way through the use of coloured text, enabling them to explore a large amount of text for revision and writing essays. One student explained: 'I can just stare at a textbook page and if it's got colours or highlights in it I can kind of remember keywords and not the whole page, but I can remember the position of the word, and if there's like ten keywords on there and they all link together, and they're all in different colours, I can remember the exact position on paper of that'.

5.2.3. Role of the Family

Many students emphasised the important roles their parents performed when they were at school and how moving away to attend university changed the dynamics of the support previously provided. One student, Robin, explained: 'I always had my father proofread my stuff, and when I came to University that changed because I'm not living at home, so I didn't have daddy to proofread everything!'. Another student added: 'In A-Levels I had my parents reading all my textbooks to me, and now I have a computer which is good because you can't take parents to University'. Other students also indicated that their family also played an important part indirectly helping with their writing. For instance, Gavin, said: 'I get a lot of my mates to proofread things so… whenever I write out… a job application or a cover letter I would get them to read it for me or send it home to my parents, and they will do it for me'.

For many students, the involvement of their parents helped play an essential part in supporting and intervening with the diagnosis of their dyslexia. For instance, one student said: 'My parents had a lot of money around when I was diagnosed dyslexic because my dad worked for [well-known company] so they could obviously afford to

Kate's Family Perceptions

Since Kate was a child, she has always felt embarrassed when seeking help from her family. She pointed out that her family hold 'types of standards for each other' that expect each member to perform and achieve at a certain level. In one instance, Kate talked about the time when she asked her sister to help with an assignment and her sister could not understand why she was not reading properly: 'I clearly remember her telling me, "you're not reading. What's wrong with you? You're not thinking", and after that, I stopped asking her. I didn't ask anyone for any help'.

Being a first-generation American and learning English as a second language, Kate identified that she was one of the 'gifted' students in kindergarten, learning a second language relatively easy compared to her siblings. As she progressed through elementary school, Kate found it more challenging so withdrew from her interests such as sports and music. By focusing more time on her studies and immersing herself into further reading, Kate's mother did not quite understand what she was going through: 'My mom told me that she saw a bit of me die. Every single weekend I would just be immersed in the books, and that was really hard for her to see because she knew I was like a very funny lively person and her daughter was no longer like that. When I found out I was dyslexic, I didn't get much support from them…'.

pay phenomenal sums of money for me to have different types of teaching… I think I'd have done terrible in education if I hadn't had that'. Another student, Tim, said: 'I think my parents definitely were pushing quite hard for things to be done, so I do think there is an important element that you need your parents to be like on assessments… and are followed up by the school'. Some students indicated that their parents ensured that they received the appropriate study skills support both at home and at school. For example, one student, John, reported that both his mother and father have helped: 'Family's everything really… my dad's an English teacher, and I used to get him to proofread… my essays and stuff. Parents evening, mum would always come in and ensure they were on the right page. There were a few letters sent at different points, but it all depended on the teacher'. Another student, Hannah, indicated that both her parents were supportive at school and their 'work ethic' influenced her ability to overcome dyslexia. Hannah explained: 'Even though I wasn't diagnosed, they were still very supportive, and that kept me in school I think. But yeah I definitely felt that the hard work ethic has come from my parents as well'.

Nearly all of the students indicated that one of their parents or close family member was diagnosed with dyslexia or showed signs of the disorder: 'Quite large parts of my father's family are dyslexic… so is my dad and aunt and a couple of cousins and so on'. Another student, Richard, said: 'Well my whole family is dyslexic, so they were quite keen to get a dyslexia diagnosis relatively early'. In cases where dyslexic students had at least one dyslexic parent, the experiences (and in some cases mentorship) of the parent directly influenced the student's experiences with diagnosis and support. For instance, one student said: 'I've had the fortune of my whole family being dyslexic, and my dad is a professor… he's rather well known in his field, and that provides quite a good example of the fact that you can overcome many kinds of things and dyslexia'.

5.2.4. Current Difficulties of Dyslexia

As the students began to establish themselves at university, nearly all had come to accept and understand their dyslexia, although they still widely acknowledged their difficulties. The students' identification of their difficulties from childhood, such as reading, writing and spelling, continued to affect them while they were at university. The continuous difficulty of reading was reported by all students. However, undergraduates indicated they had to read a lot of books, articles and papers each week. Several of the students indicated that when faced with a number of books and articles to read they would start reading a day earlier. It was important for students to plan and understand the time it takes to complete their set tasks. Several of the students indicated that it takes them a very long time to read articles and they spent more time in the library compared to their peers. Although they sometimes just sat there and read a page 'again and again', not absorbing any of the information. One student explained: 'I take longer reading than everyone else, and I have to read and potentially re-read to really comprehend and understand what's going on'. Some students who had recently been diagnosed with dyslexia reported that since their diagnosis they had become more aware of their difficulties. The label of dyslexia had increased and brought forward the difficulties they experienced in challenging situations. For instance, one student, Liam, who did not like reading aloud to their peers explained that it was particularly bad in group situations where there was added pressure, preferring to speak in front of smaller groups: 'Ever since the diagnosis I mean… I'm more explicitly aware when I'm speaking or reading, I'm more aware of the fact that it could go wrong at some point and I get more stressed about it and then often it makes it a lot worse'.

Associated with the difficulties of dyslexia, many students indicated that they still experienced issues with writing and spelling even after many years of education and in

some cases support. However, they had learnt to minimise these issues through two means. Firstly, students' problems with spelling were often alleviated through their degree course: 'So it only affected when I was writing stuff up so… I did a lot of maths and physics, and in that case, you don't write that much, so it didn't affect me'. Secondly, several of the students highlighted that the use of computers with spellchecking devices had made 'it much more easier' and they can 'get by with word processing everything'. When writing, students acknowledged that the difficulties are often interlinked with other issues, such as reading, spelling, short-term memory and organisation of their work. The process for writing involves several stages, and it is these processes that can cause the student the most difficulty (the writing process is outlined further in section 5.4.2).

The students' problems with reading are connected with the process of encoding information in the short-term memory. Several of the students indicated that they experienced issues with reading comprehension due to their short-term memory. For instance, one student explained that their 'biggest issue' was recalling what they had read, or when they meet people it took them a long time to remember their name. Other students reported that during discussions and debates their short-term memory would affect their concentration and comprehension. In one example, a student explained that during her tutorial she loses 'the train of the conversation so easily'. Finding it extremely hard to keep hold of the

Ryan's Difficulties

Diagnosed with dyslexia at university, Ryan pointed out that his biggest problem is trying to write quickly for the several weekly essays he has to produce. He said: 'It's hard to maybe think of the right words and the right structure because it's more complex sentences… it's hard to find the right words to do that'. He also said that one of the biggest difficulties he faces with reading and writing is 'transferring their language into my own words, I mean absorbing the text is quite hard'.

When it came to talking about his work with his tutor, Ryan explained that he impresses the tutor more in tutorials than in the written work: 'I would rather be like, "can I talk for ten minutes about the work", than give them my written essay because I feel like I do myself better justice talking about it. I feel more confident in tutorials, and sometimes I've felt like it's annoying that I haven't written about what I talked about'.

fast pace of the current topic of discussion and new ideas: ‘So in tutorial when it’s moving fast pace and if it’s like ideas I’m familiar with I can keep up a little bit easier, but if it’s new content and someone has explained something and then they move on to a more advanced argument I’m just lost because I’ve missed like the vital information’.

In addition to the students’ difficulties with literacy, a number of students reported issues with organising their studies, specifically essays and structuring assignments to form concise arguments, as well as prioritising tasks. For instance, as the disability officer reported, the specific style of teaching with regular tutorials often means that the students are faced with more problems of organising and planning their work before meeting their tutor. One student emphasised that ‘dyslexic people don’t have that self-organisation’, while another student indicated that technologies had helped with the organisation of digital articles and files.

5.3. Disability Support and Provisions

This second section presents the students’ journey through university, identifying prominent areas from the data that can influence their use of assistive learning technologies with their studies. The three areas are: (i) foundation, examining identification, diagnosis and support; (ii) awareness, highlighting the students’ support and guidance in teaching and learning; and (iii) post-diagnosis, exploring the students’ journeys towards the acceptance of support and provisions. The themes provide an insight into answering part 2 of the research question: ‘what disability support and provisions do universities provide to their students?’.

5.3.1. Student Foundations of Screening and Assessment

The journey of diagnosis initially starts with the student or their wider support network taking steps to understand and recognise their learning difficulties. Following an acknowledgement of problems, the student usually begins the process of familiarising themselves with the assessment procedures involved in supporting their difficulties, either through family, friends or educational organisations. For many students, this process helps establish access to wider support and provision, and during this process, it is the first-time the students are introduced to assistive learning technologies.

In this study, just under half the students (n=10) were diagnosed with dyslexia at university. These students were made aware of the university's disability office either through their tutors, or peers who were already diagnosed with dyslexia. However, some students were made aware that they could be dyslexic when they were still at school: 'When I was in sixth form a couple of my very close friends were dyslexic, and I started to think actually, I spell things wrong all the time, and I read very, very slowly and write very slowly, but I didn't kind of do anything about it, and then I got to [university] and realised that it literally took me two or three times it took other people to read'. Another student reported that her school dyslexia diagnostic report was not recognised by the university and she had to visit an educational psychologist for a 'proper diagnosis'. It appears from this group that some students were labelled dyslexic without any formal diagnosis or assessment while they were at school: 'So they got me tested in year 10 for extra time… so I did all like written tests and stuff, and they put it down to having dyslexia, but it was never an official by an educational psychologist, it was always by one of their mini tests, so I got extra time in GCSE'. Although the students went on to be fully diagnosed with dyslexia at university, some students raised concern about the processes in

place for a formal diagnosis and the appropriate support for their difficulties when they were at school.

As mentioned earlier, several of the students became aware of obtaining a dyslexia assessment through their peers. As one student reported: 'I didn't know any procedure about how you get diagnosed as dyslexia etc. until one of my friends actually did as well'. An assessment via a peer could be identified as a positive as it enables students to become aware of their difficulties, identifying and finding solutions that can help support their learning. However, one student did raise concerns that some students were obtaining a diagnosis to obtain special provisions and access to 'free computers'. Although this may or may not be true, it appears to be an isolated opinion. Further research is needed to explore whether these views are shared among the wider student population.

The students that were diagnosed at university reported that they initially made contact with the university's disability office for a brief discussion. Some students described it taking 'a long time actually to get the appointment, so it wasn't until after the term was finished that I had the initial meeting'. While other students reported that the support they received from the office was 'really good' and they 'couldn't see any problems'. Some students also reported that their tutor was the first person to suggest they got an assessment for dyslexia. One tutor said: 'oh well he seems to have the ideas, but just no capability to sort of write it down'. Once the students had made contact with the disability office it was then the support officers' decision to decide if there was sufficient evidence to provide a full assessment: 'Once I've got an idea what sort of difficulties they are having then if I've got sufficient evidence I would put them through for a full assessment'. Another disability officer also supported this process by confirming that they would use an 'outline structure to try to identify if there are any indicators that a full assessment would be worthwhile'. Although she emphasised that the structural element

can be helpful in determining dyslexia, it is not a point scale rating that she uses, but an understanding of her ability to confidently identify students with a genuine disability. The disability office acknowledged that there is always that difficult situation where they question whether it is an underlined difficulty and if they need the historical perspective of the student to decide if there was something developmental early on in their lives. For instance, one disability officer said: 'I've done a lot of assessment across a huge range of people obviously over my professional career, and some cases are very clear cut and a lot here are not'.

5.3.2. Organisation of Support and Provisions: Disabled Students' Allowance

As the students learnt to understand and acknowledge their dyslexia, they embarked upon another journey ensuring they received the appropriate support and provisions through the DSA. Several of the students reported that the DSA provided a context that can contribute in facilitating their personal use of independent learning strategies and help explore technologies with their studies.

The majority of the students received the DSA (n=16), including 3 international students funded directly by the university. Overall, many students described the range of technological equipment they received: 'I got a laptop, and I had a lot of software like Dragon®, Read&Write™ which is another program which I used to create mind maps…'. Another student reported: 'I was given a load of techy stuff at the start of the year (laptop, printer, software etc.)'. Gavin described that he was offered a lot of equipment but decided not to take it as he did not think he needed it: 'I sort of kept them on the back burner and sort of something that I would use for later so I had a Dictaphone offered to me to record my lectures for instance'. Some students also frequently reported that they did not use all the technologies provided. One student said: 'I must admit a large part of

what I was given sits redundant in my bottom drawer'. Nonetheless, some students also reported that they only discovered the relevance of the technology provided when it was being used in context by another individual: 'I was a bit like, "oh I don't think I'll use that", like one of those microphones that record lectures. But I was looking at someone using it the other day, and I was like, "that would be quite handy I think"'.

Although students received a variety of technologies, some identified how it provided a positive approach to their learning, while others reported issues with support and access to training. One student, Hannah, described receiving software and a computer, specifically Dragon®, but reported not using it because the training she received was useless: 'She didn't actually teach me anything. I just can't remember the reason why; it was a bit rubbish. I never was really trained on my stuff'. More widely reported across the students was the dissatisfaction with the training provided on the use of software, such as speech-to-text, mind mapping and literacy-based reading software. Some students held mixed views on the training they received with the majority finding it unhelpful or not suitable for their studies. Although one student reported that her trainer was: 'Very, very, very useful in

Tom's Access to Support

Diagnosed just before the start of his A-Levels, Tom received 25 per cent extra time for his exams at school and used a computer in an isolated room. Acknowledging that the extra time helped, Tom, explained that he received some support at school, including basic typing and mind map lessons, but emphasised this was brief. While Tom was happy to accept whatever support was given to him, he remained conscious of being labelled dyslexic or dyspraxic. Tom said: 'I almost tell myself that, "I'm not dyslexic, I'm not dyspraxic". However, some things are better than others, but obviously, I'll take whatever is given to me that is helpful'.

By arriving at university with an awareness of difficulties and a previous diagnosis of dyslexia, Tom explained: 'Because I knew I was dyslexic it was quite helpful in that way I could go and contact the right people and I could get help before coming to University'. Receiving a variety of technologies and software from the DSA, Tom pointed out that one of the issues when receiving the software is 'not much follow up support, so I don't know how to use some of the stuff… It's assumed because we're young and able, we're all going to be great with new learning technology but the fact that we are dyslexic means that we struggle to understand new concepts! Which you know exacerbates… elongates the amount of time… trying to understand the new technology that they give us… that try to help us'.

terms like demonstrating and getting me involved in using the stuff'.

In addition to technology and training, some students also reported that they received a number of study skills provisions, including face-to-face support, note taker, as well as a book, paper and printing allowance. It was the study skills provision that raised the most discussion among students, with some arguing that they 'could not manage without' their tutors and some students complaining that they were 'useless' and 'not appropriate for their degree subject'. One postgraduate student, Emma, explained that her study skills tutor helped with encouraging and formulating her ideas. However, another student, Hannah, reported that she stopped using her tutor because she 'didn't think it was very useful' and she did not need someone telling her how to make notes and read things.

The international students reported that they had been provided with university-funded support and provisions because they were not eligible for the DSA. One of the postgraduate students who received the support explained: '[My University] is actually an institution that matches it for international students …so, yeah I was very grateful for that'. The student also said: 'They've given me a lot' and 'they reimbursed me for £400 worth of books that I bought'. Another student, Tim, described it as 'quite impressive' as he was provided with a laptop and literacy software relatively quickly from the start of term. While another student added: 'The fact that the UK has such good provisions for UK Citizens and I was very surprised that [the University] tends to bring that to the International students, so I thought that was wonderful'. One of the disability support officers indicated that the provision for international students is through the university's interpretation of its legal obligation to make reasonable adjustments, while considering its finances: 'So one university that does not have very much money might tell us, "well it's not reasonable for us to provide that", whereas as an institution like this obviously is in a better position'. Noticeably, the support and provisions provided to international students

once they have their diagnosis can be more direct than the DSA. Thus, they can expect to receive their support more quickly. The disability officer said: ‘As long as we’ve got all the evidence, everything and that can be signed off and then we will internally buy that stuff… then loan it to the student while they’re here’.

5.3.3. Responsiveness of Tutor Support and Guidance

The students’ teaching experiences at the university were influenced and affected by contact with their tutors, as well as the broader awareness of their difficulties across faculties and departments. While the tutors were not directly responsible for providing or promoting the use of technologies, or even identifying dyslexia, some students reported that their tutors played a part in understanding their difficulties. The turors guided them towards a diagnosis and demonstrating effective strategies to help with their learning. All these influences helped contribute to creating and sustaining an educational environment for the students to support their difficulties through a range of tools and strategies.

Firstly, the undergraduate students appear to have had a more positive experience with their tutors than the postgraduate students. As one undergraduate student reported: ‘I think [my university] system where tutors have a lot of independence, and sometimes that’s a great thing. So, I had a tutor called Ben… who’s the one who picked up on the essay thing, and I think he was great. I think it very much so depends on your tutor’. Another student added that her tutors were ‘pretty good’ and ‘given me extra help to write essay things and they are very aware of trying to make everything diagrammatic to make it sink in which really does help’. A recurring quality of the tutors is their ability to accommodate their students’ difficulties and develop several strategies to help. For instance, Chloe, an undergraduate student explained how her tutor worked with her in drawing explanations instead of written examples: ‘My main tutor, Malcolm, he knows

that I work via images as opposed to words so he would sit down with like a sheet of A3 and draw through all the pathways so that I can see it, which is mainly when we have one-to-one kind of stuff'. Additionally, a number of undergraduate students also reported how their tutors had helped them in guiding them towards an assessment as well as taking an interest in the difficulties they are experiencing. In particular, Emily explained that it was her tutor who suggested she get 'diagnosed' and added that they had been 'incredibly supportive particularly in terms of like comments… not just content for essays obviously, but like structure and things like that'. Another student indicated that her dyslexia was picked up straight away at the start of term: 'As soon as I got to [university] my tutors just said, 'you're dyslexic', literally in my first term so when I was 18, 19 and they sent me to be… they said, "right go and get yourself tested"'. Only one undergraduate student reported experiencing issues with their tutor, adding, 'she kind of thinks dyslexia is a lie really'. However, this student did manage to look beyond the tutor's personal views and receive appropriate support: 'The tutor who was being patronising has actually been incredibly useful lately in terms of, you know, comments on structure'. Although only one undergraduate student reported minor issues, it seems rather insignificant in comparison to the experiences of the postgraduate students who sometimes 'find it a little bit harder to talk with lecturers and so on about the dyslexia'. This could be explained because the undergraduates are in regular contact with their tutors, meeting once or even several times a week. Whereas the group of postgraduate students reported receiving less contact time. One postgraduate student, Peter, confirmed: 'So yeah most of my tutors haven't spent enough time with me, and so yeah I think they're not aware of my dyslexia'. Moreover, the postgraduate students are only studying on a one-year program, in comparison to the undergraduates who are studying for at least three years. Thus, allowing undergraduates to develop their confidence and build a professional working relationship with their tutors.

The tutorial emerged as a prominent factor for students with many describing the initial process of being provided with several essay questions. The students would select the appropriate question, complete and send to their tutor, several days later they would meet and discuss face-to-face. Although all of the students in the group reported that they had tutorials on a regular basis, it was more popular among the undergraduates than those studying at a higher level. One undergraduate student, Chloe, explained: 'I think that the tutorial system means that if you're not diagnosed by the time you get here, you probably will be because you've got such a close working relationship with your tutors that they will know if you've got problems'. The disability officer also suggested that the tutorials are handy because 'tutors keep a closer eye on students and they are more likely to pick up if they think there's a problem that hasn't been identified'. The students who had regular tutorials on a weekly basis with their tutor indicated that they were beneficial to their learning. One student said: 'You talk through everything' within a 'small class size which is obviously very good'. One student also firmly pointed out that the tutorial system is 'actually beneficial for my dyslexia' and 'I do well in it because of my dyslexia because I don't rely on written notes or anything so when I'm talking through something I understand it by talking it'. One of the key advantages many of the students reported was how supportive and helpful the tutors came across in their tutorials. Although many students found the tutorial beneficial, a small group of students highlighted that it can be 'difficult to engage' and keep apace discussing the current conversation as well as trying to understand everyone's views: 'It does take me longer to maybe discuss some sort of concepts as new and sort of, bit mumbled and it takes me a bit longer to comprehend'.

5.3.4. Teaching Resources and Accessible Formats

The extent of teaching resources, departmental adjustments and accessible formats helped in providing dyslexia friendly support for all students. For many of the students, they indicated that the university made sufficient provision and support around teaching resources, online systems and accessible formats. For instance, one student, Gavin, described their department as a 'dyslexic's dream', explaining that the tutors 'offer coloured lecture notes for dyslexic students' and 'print you out a coloured set of lecture notes if you have difficulty with diagrams'. He also pointed out that he is provided with printed lecture notes on arrival and they are also made available on the university's VLE: 'They're all available on that, so I have all the lecture notes from past years available, so if I don't particularly like this lecturer's style I can go back to last year's, two years ago and get different lecture styles'. Another student from a different department reported that she always downloads the lecture notes from the VLE before a lecture: 'The woman who runs Biochemistry knows I'm dyslexic so always makes sure that she's got them up [VLE] before the lecture'**.** Additionally, some students with their tutor's consent could use their Dictaphones and record lectures, enabling them to cross reference the audio with the downloaded PowerPoint slides to support their learning style. However, not all students were able to adapt the teaching material to their preference. For instance, one student identified that only '10% of all lecture notes' are made available online. The student suggested that only 'half of the people use it, so it's useless', and 'everyone [peers] complains about it'. Although several of the students praised their department and tutors in providing access to lecture notes online, it appears that it is not consistent across the university. The disability officer also pointed out that every department does things differently and essentially 'the individual experience of students will be influenced by

where they are, which college they're at, which department they're at and how flexible or otherwise they can or cannot be to meet the needs'.

In addition to the reflections of the students, the university staff also reported on the range of teaching resources and accessible formats available through the disability office and the library services. As identified by the disability officers, the resources cover a wide range of support and provisions, including one-to-one inductions to all disabled students, extended loans as well as a named disability contact in each library. Additionally, the disability librarian identified several services that students with dyslexia find helpful. These included: scanning facilities; coloured overlays and printing paper; accessible e-books; journals via computer stations; and a variety of open and quiet study spaces to accommodate different users. Many students reported that they visited the library to focus on reading, writing and revisions, with one student explaining that she uses software called SimplyNoise to block out library noise. The student said: 'I go to the library because it helps me concentrate but the noise distracts me so the white noise cuts it out'. Although some students indicated that they mostly use technologies with their studies when they are in the library, the majority reported that they could not use their speech-to-text software because 'you can't really talk out loud in the library'.

5.3.5. Post-Diagnosis: Understanding Technology Provision

Once the students had navigated the lengthy university process of screening and assessment, they commenced their next journey in understanding and supporting their dyslexia through a needs assessment. The assessment usually involved a meeting between the student and assessor where they discussed the range of technologies, provisions and study skills required for the students' learning.

The students reported that because the screening and assessment had taken several weeks to work through, it often meant that they either received their technology at the end of the term or during the examination period. As one student described: 'Kind of fell at a really awkward time because I got my assessment back like three weeks before my [exams] so the priority was to get me my laptop and my extra time in the exams and then they said, "next term we'll get you on the equipment"'. The student also highlighted the benefits of being able to go and try the software and identify if it was suitable for her learning requirements before it was ordered. Another student, Ryan, praised the disability office for completing and applying for all his assessments: 'I think they're really good for that, so they just told me everything'.

Nonetheless, several of the students from the group raised concerns about the provision of training and support with technologies, as well as the lack of correspondence from access centres and the university. For instance, one student reported that they did not receive adequate training with the technologies provided, despite being promised by the assessor: 'After I was given all this stuff I was just given a box of it, and the guy dumped the laptop on… he set some stuff up, but after that, there was not much follow up support, so I don't know how to use some of the stuff'. Although the student could potentially teach himself, he said: 'It's quite a lot of time messing… which at the moment I don't have'. He also pointed out that the support and training of the technologies are 'very inaccessible' and 'I'm not able to utilise the technology the Disabled Students' Allowance

has given me'. Other students pointed out that the access centres (which are linked and partly funded through the DSA) do not always allow the students to request specific hardware, even though it might enhance their learning. In one example, an undergraduate student, Gavin, decided to purchase a technology device independently: 'Yeah I bought it myself. They do say it doesn't cover iPad's or anything… I have it all the time, and I don't know how I would have got through my degree so far'. Another student reported that she had great difficulty in trying to understand and navigate the complex procedures of payment after replacing her laptop battery that was originally purchased by the access centre. The student said: 'If you e-mail your assessor saying I'd like this actual piece of technology but nobody knows who's going to pay for it and you're told, "oh you should phone Student Finance" and Student Finance say, "you should phone these", so Student Finance don't communicate with them, so I've literally spent about a year, and it's just impossible to get anyone to pay for it so like my laptop is now a home computer'. For some students, there appears to be confusion in who supports their technology needs, for example, the needs access centre, the DSA or disability office.

Sophia's Insight Post-Diagnosis

Studying in the final year of her Master's degree, Sophia was not formally diagnosed with dyslexia until she arrived at university, and was assessed by an external educational psychologist. Despite identifying herself as being 'slow' at school, she recalled that dyslexia creates a lot more problems at university: 'I think I've only noticed, the sudden coming to university and not being able to keep up in lectures'.

Provided with a range of technologies from the DSA, Sophia explained: 'The spellcheck is really useful because it means all the scientific words are self-corrected… but when it came to revision, I used the MindManager™ a lot, but actually found that it wasn't helpful doing it on the computer and I ended up getting flipchart paper and doing this massive flipchart mind maps… and writing it down myself which was more helpful because then I would add drawings in and place it anywhere'. While there are limitations to some technologies, Sophia added that one of the biggest barriers to using the technologies was due to the lack of training sessions and the appropriateness of where they are conducted. Sophia said: 'So, I had one training session, a guy came and trained me how to use it… he came to my actual accommodation. It would have probably been nicer to have gone to like a room like this because I think it was quite intimidating having a person come to your bedroom and sit there… I didn't feel comfortable in the situation'.

5.4. Multi-Modal Uses of Technologies

This final section outlines the final progression of the students' educational journey at university, exploring how they have integrated various multi-modal uses of assistive and learning technologies into their studies to support their writing and reading. As discussed in Chapter 3, multi-modal procedures for using technologies can help engage, scaffold, and model the various stages required for students to develop their learning (Vue *et al.*, 2015). The combination of multi-modal tools widely refers to several techniques that include features associated with individual modalities, characterised by types of activity and engagement with image, audio and text. The multi-modal procedures presented are identified as themes and demonstrate how the students implemented technologies with the writing process, including planning, integration and organisation. It provides an understanding into answering part 3 of the research question: 'what educational roles do assistive learning technologies play in the writing process for students?'.

5.4.1. Technology and the Reading Process

The most important role for the students was the ability to process and understand the written word quickly and fluently. Due to advances in technologies and the ability to find solutions to problems, several of the students acquired new approaches to using software and hardware to enhance their reading. For instance, the students identified that they used PDF readers to highlight text and make notes, as well as Read&Write™ and ClaroRead™ software on their computers. One shared problem among the students was following text on a screen and the glare from intensely looking at the screen. For instance, one student, Emily, said: 'If you tint the screen like a yellowy… I can understand it and see why it's better because otherwise I kind of jump lines, jump words, mix up letters

kind of thing'. Other students reported the use of line tracking software so they could read easier and at a constant pace: 'The bar in the middle I use to keep my place… when I scroll down, I can read that a lot quicker… without losing it'. Another student, Chloe, explained the process of converting her printed text to a more accessible format: 'If I had an essay to do then the first thing is the reading. So, if it was book work, I would be using that scanner thing to turn it into Word and then also occasionally use filters on my laptop. I intend to work better in yellow for some reason!'. Although the students found the use of the literacy software useful, they indicated that the text-to-speech software voice used to dictate their digitised readings was 'way too alien and unfamiliar to be able to use' and 'this all American voice doesn't make any sense… it sounds like a sentence is going to go on forever and not stop, and there's no intonation, just takes ages'. Other students also reported the issue of not being able to highlight text while reading online due to the limitations of the document or copyright restrictions: 'The most annoying thing is when you're trying to highlight stuff whilst reading online, and the online book doesn't let me use the highlighter on it, so then I have to either copy or paste, or take notes directly'. However, some students were able to use e-books, online articles and PDFs to annotate and highlight relevant text. For instance, one student, Tim, said: 'I started off using my iPad® a bit so basically for reading like PDF's and so on… doing highlighting and notes on that can be quite useful. It's much more neater if I did things digitally'. The students also pointed out that they used other tools to support their focus on reading, for instance, one student used a timer app on their iPhone® called Pomodoro. It would track time every 5 minutes and then allow a 5-minute break until achieving the cycle four times before receiving a longer break of 20 minutes. The student describes the strategy as helping her to 'concentrate for a specific amount of time just to make sure, goals for the day are reached, and the reading is focused and useful'. Some students used other media to access

content related to their academic subjects. For instance, one student described the use of iTunes U® as a 'friendlier' way of acquiring more knowledge: 'There's more feeding from more sources and… just to use it as an alternative to reading and because I said I find reading quite tiring, so it's sort of a supplement I use as well… to sort of learning additionally'.

The use of colour overlay filters or changing the colour of text was a prominent strategy used by students for reading. While several of the students described using assistive software to do this, some still preferred to print out their readings. For instance, one student, Tom, said: 'I prefer to analyse/work through material on paper rather than on a screen, and so I print articles off. I only print the short ones as I don't want to be carrying around several 40-page articles!'. Another student also pointed out that she preferred making notes from printed articles rather than reading from the screen: 'I try to avoid using reading articles off the screen and translated typed notes, I have a PDF article on one half of the screen and notes on the other. It's just a bit too much to deal with, so I'm printing the articles off with the printer, it's been very useful! I prefer paper way better than screens!'.

Although many students reported that they did not experience any major issues from using the reading technology, some students did identify that the continued connectivity of the Internet through their computer or mobile device meant they experienced a lot of distraction. Several of the students identified it as a 'continuous challenge', particularly when trying to focus on their studies. One student, Emily, reported that she used software called FocusWriter on her computer to create a distraction-free writing environment. She used it to block Facebook® and Twitter® on her web browser so she could immerse herself in her writing. Emma said: 'I have managed to block, Facebook®, Twitter®, BBC Good Food™ on Chrome™ so I don't really go on it… I have to type out word perfect

500 words, a lot of passage to be able to change the settings from 8.30 in the morning until 5.30 night. It's a bit frustrating sometimes because I actually do need to use those things'.

5.4.2. Developing a Plan for the Essay Process

One of the significant themes of the students' multi-model uses with technologies was to support the writing process and organise structure, particularly as writing composition can be problematic. During this process, students highlighted difficulties when attempting to start their writing but identified the benefits assistive learning technologies could bring to structure writing composition.

The students initially started the process of completing their essay by identifying books and articles from their reading lists. The process involves the students reading all sources and working through what is relevant for them to read (as outlined in section 5.4.1). Before beginning their essay, several of the students reported that they like to take 'time out' away from their studies to think about their subject before developing a structured plan. For instance, one student said: 'I have very long showers. I just sort of stand there thinking… sort of like this… basically, I just keep on thinking until I get that moment of… "yeah okay, that's actually really interesting"'. For many students, it is a process of getting into the 'right state of mind' for their task. Moreover, this was closely followed with students starting to plan their essay early, particularly as some students are aware they tend to lose focus easily: 'I find myself changing my outline multiple times mainly because I find myself diverting away from a more focused outline. It's really hard for me to start on assignments; which is why I start really early in the process'.

The focus of the assignment in the form an essay is an important method of assessment at the university because of its strong academic emphasis on students

formulating their own arguments, the tutorial based system and the prominence of final examinations. Each student reported having a unique and different process of completing their essays. Although some students shared similar elements of the composition process during their writing, it was not by any means identical or in the same order. However, some students reported that they relied heavily on their notes from journals, personal reflections and lecture notes provided by their tutor to outline their essay. While it can be argued that non-dyslexics also experience these difficulties, it is important to acknowledge that these are complicated issues about what does and does not belong within the notion of dyslexia and its associated difficulties.

When it came to the use of technologies, several of the students reported that they used their mobile devices and cloud spaces to help organise their academic work. These students described the use of these technologies as 'accessible' and helping with the organisation of their essays. One student, Emily, who uses the Evernote app on her computer and mobile phone, said that it helps 'keep my thoughts free flowing', as well as setting aims for study and personal reflections. Emily also explained: 'Evernote comes up straight away and I find that incredibly useful. In the note-taking process such as planning because I might start a plan and end up having to leave and when I'm out… I just get my Evernote up and just write down a few thoughts, and as soon as I get back, it's on my laptop I just get it up, and I can use it'. Another student who uses Google Docs™ explained that he uses it to assist in organising the content of his essay: 'I used Google Docs™ to start on an outline for the essay, I created a number of different documents, an outline document, a reference document and a notes document. In the reference document, I paste the links that I have found to various resources'. Some students also indicated that they created their own reference templates for addressing essay questions and forming arguments. For instance, Tim said: 'Having the reference documents, when I'm writing

and also the outline helps me to get clarity in my argument and I think it works much neater when I have it written down on computer because it would be much clearer than if I was writing by hand'. Tim also explained that he starts to complete his essay by utilising the use of colour to identify and associate sections where they belong in the essay: 'I would start filling it in and making it complete. Where I can, give each section a colour and then take each document I have and find out what the different sections relate to – whether they fit in the essay and I can just take a section and give it a colour… mark it purple, and I would also make a note in the essay plan to remind me where the different arguments are with page numbers and so on'. For a more 'hands-on' practical approach without the use of technologies, another student, Kate, organised her essay by cutting up her notes and categorising into themes to obtain a structured order. The process used in Photo 1 enabled Kate to build a link system of subjects, helping her to create a complex argument without the use of technologies. Kate said: 'I would just write notes and look at my notes from other classes… print those out and then cut them strip by strip, section by section, and then it would just be a big jigsaw puzzle that took hours, but now that I have this Inspiration® I do it just in the computer study'.



Photo 1. Organising the themes during the essay process.

5.4.3. Integrating Technology with Writing

The students identified a wide range of writing difficulties that were associated with their dyslexia and outlined several assistive and learning technologies that supported their independent learning strategies. The students reported using the technologies to support the numerous essays they are expected to submit each week. One student said: 'Well I write two essays a week. Depending on whether I'm doing Economics that might be, say five problem sheets and a short essay and an essay on whatever topic I'm doing'. Overall, 17 students reported using technologies through various forms to support their learning, with only 1 student expressing neutral views. The remaining 3 students explained that they currently do not use any assistive learning technologies, mostly due to the lack of awareness of technologies available or because of a recent diagnosis: 'The one thing I

don't know is what technology there is, I don't know, which might make reading a bit easier… I haven't really experimented'.

Although only a handful of the students indicated that they did not use large amounts of technologies in their studies, many students reported that they used their assistive learning technologies supplied by the DSA to aid their writing. Depending upon the type of software and technologies used during the writing process, as well as previous educational experiences and understandings of technology strategies, many students reported varying approaches and perspectives on completing their essays. For instance, one student said: 'I get my reading notes on one side of my screen, my lecture notes on the other and I just make like a plan by paper and then just type it up. So definitely having the technology in lectures makes a huge difference because it's better, more detailed'. Other students pointed out that they preferred typing their essays as they found it difficult structuring an argument. For instance, one student said: 'The computer, I wish I'd done it sooner… I find that maybe structuring an argument really is difficult and in my [exams] I was trying to put together an argument. It's so easy because you're linking what you've already done and you can chop and change the question… but when you're doing hand paper, it just gets so messy, so many asterisks. It's so easier!'. The common theme among students with the use of a computer for written assignments was being able to move and organise sections of text. One student explained: 'So I just found myself kind of adjusting and moving quotes and writing up thoughts and making connections, and explaining things out… I would basically move sections, kind of up and down that I felt relevant to certain sections'. A number of students also highlighted that they followed a set process of outlining what they plan to write, either for an essay or in preparation for an exam. For these students, their process of writing an essay often stems from the revision of readings, practice of previous exam questions and the organisation of what they plan to write. For

instance, one student, Sophia, said: ‘Using the examiners’ report and exam questions from previous years I told [myself] the questions and then wrote down everything that was needed in each answer. I then organised these into set topics, based on the questions. Using [the VLE] which had all the resources from previous year’s exam reports, I used Word to write all the information’. Another student also followed a similar example and formed their own strategy for practising their exams by timing themselves: ‘I would look at one mind map for ten minutes, after that, hide it and then time myself for 50 minutes and write an essay on that topic. I would then go back to the mind map after to see if there was anything that I had missed’. Other identified strategies students reported was the use of text-to-speech through Read&Write’s™ literacy software. For instance, one student said: ‘Read&Write™ enabled me to understand the main themes of the week as I respond better through vocal rather than visual aids’.

Nevertheless, one student’s preference for handwriting in examinations appeared to manifest from her previous experiences and difficulties of using a computer: ‘The keyboard is like a barrier between me and writing… it would take me forever to get going’. After experimenting with the use of a computer, she discovered that it would take ‘longer to create an essay, to type than it would to write’ and found it ‘easier to hand write’. She explained that she decided to stop writing for two reasons: ‘One because I would be able to bosh out essays quicker! Um, and two actually at the end of the day you write your [exams] so it was good practice’. In contrast to using a computer, the student argued that you have to be more prepared when writing as you do not have the advantage of going back and editing what has been written: ‘You’ve got to have a clarity of thought before you start writing which for me was good because I have always very much needed to organise my ideas. The process of writing would help my mind flow and almost to a certain extent calm my mind down so that I would write better than I would type’.

Moreover, the students recently diagnosed with dyslexia tended to show less willingness to use their assistive learning technologies in aiding their writing. For instance, one student, Kate, said: 'When I worked with paper I felt more in control because I managed to keep a constant view of the overall picture of my work and I was able to constantly see how it was progressing. I now feel confined to a small laptop screen and have noticed how my motivation to do work has decreased because I am forcing myself to use the new assistive technology to become more "efficient"'. Interestingly, the students identified a couple of reasons why they were hesitant to engage with the technologies, such as the speech-to-text software. Firstly, one student reported that it is due to their 'lack of familiarity with the software', such as training and 'not being able to see the overall picture' of the process of writing and operating the software. Secondly, another student indicated the lack of consistency of using the technologies: 'I've noticed that as I continue to use assistive technology my approaches to doing different assignments change all the time, I don't have much consistency. I'm just trying to find different ways of how to get used to the

John's Writing Experiences

A first-year undergraduate student, John admitted that he is not aware of being dyslexic. He initially received a diagnosis when he was in primary school, partly aided by his mother who works as a special education teacher.

Being a self-determined and focused individual, John described that he 'worked harder cultivating the image of being intelligent' as well as hiding his weakness of writing: 'I didn't like to show people the weaknesses, the actual writing. I didn't let people read my work. I'd read my work out to people, but at the same time I didn't like to read my work out to people because I couldn't read it'.

While John's mother tried to get him to use speech-to-text when he was 14 years old, he said: 'I didn't want to use it because I didn't want any help, I wanted to go it alone, which I think changes with maturity, you realise that she's just trying to help or whatever, but also it just wasn't good enough then'. Despite using speech-to-text software for his university essays, John was advised by his tutor to stop using the software because they were noticing that he was writing in a 'more colloquial manner' and 'lacking structure'. He also pointed out that he struggles to stick to a structure when using speech-to-text because it is spoken but also takes a lot longer to complete. John said: 'I have to proofread because Dragon® isn't perfect, but I have to spend 40 minutes spellchecking and then the same amount proofreading which makes it a much more arduous process'.

assistive technology'. Another student, Tim, also pointed out: 'There's a learning curve in understanding new software, and sometimes it's a barrier to start using the software'. However, in contrast to using the computer, several of the students highlighted the challenge of staying focused due to access to the Internet while writing their essays: 'There's something called the Internet which steals time… it's a bit of a challenge that you have that distraction all the time because I am very much dependent on having the computer to do all my work'.

Some students identified that they actively used their Dragon® software (speech-to-text) to dictate their essays and notes. The students reported that the software was a 'massive help' and 'pretty useful for creating notes'. Although some students reported that they used Dragon® for exams and writing their essays, for several reasons they decided to stop using it. For instance, one student, Chloe, said: 'I did use Dragon®, and I did like it until I hit such a point that I had to train it so much to recognise Biochemistry's specific words. My second year had been spent trying to get used to writing essays as opposed to concentrating on what I needed to know and the software just wasn't working. So, I took a year out, and I typed for exams because Dragon® and me just didn't get along!'. Nonetheless, those students that had only engaged with Dragon® through a short training session could see the benefits associated with their current working practices. For instance, one student said: 'I wish I did use Dragon Dictate®, sometimes I find that if I force myself to speak out loud, it makes me kind of make sense of the topics a little bit better. But I'm really looking forward to using Dragon Dictate® to see if it can really help me out that way'.

5.4.4. Visual Organisation with Mind Mapping

Throughout the students' journeys, many used the method of visualisation for processing and the development of their written assignments. The study also identified a three-stage development process to mind mapping from the students' experiences and cognitive learning processes.

Firstly, the students reported varying levels of using mind mapping software, such as Inspiration®, MindView™ and MindNode Pro, for outlines of their essays, revision notes and to create visual representations of scientific processes. For instance, John said: 'I use the mind view software all the time… so if I'm doing revision, I'll do a note in bullet points… and I'll put the essay questions in the centre of the mind map… I'll condense the mind map then into an essay paragraph plan'. A number of the students indicated that the visualisation of their revision notes enabled them to organise and find their way around a large amount of text with many ideas: 'It's simpler to organise the different revision notes after different ideas and draw links between them'. The students' process of forming mind maps was through 'creating nodes' and linking them together within different topics. It is a series of stages that the students described as creating an outline for their essays as well as using different colours, shapes and images; to differentiate sections of topics and apply questions. For example, one student said: 'It is useful when you have different subheadings to link things together – it's quite a useful tool. Sometimes I want to start using different colours for squares… so I can differentiate between the actual questions and the sections of the topics'. Another student explained that before creating mind maps, they would just 'highlight text in different colours' and 'move these within different sections'. With Inspiration® the students created a structure where they can easily 'move sections up and down, so they are still cohesive and together, so it's easier to manoeuvre'.

The students' process for creating their mind maps was identified as three stages:

- **Stage One – *Spontaneous thoughts***

The first stage is often referred to by students as 'spontaneous', a process of 'literally just putting down some words'. For instance, one student said: 'I use Inspiration® to collate all of the notes that I've taken… I just go through my notes and try to represent what it is I've learnt so far. Citing the literature which is something I struggle with without doing this'. Another student described the process of 'going from initial sprawl of thoughts in a mind map to easily just pressing a button and seeing a plan is incredibly useful'.

- **Stage Two – *Connection of meaning***

For the second stage, the students identified the process of adding further clarity and 'connection of meaning' to their mind map. During this process, the students began to consolidate all their information in the mind map and add further detail. Several of the students described it as, 'a little difficult to start making sense of things right away', but learnt to reduce and define the content as new forms of connections emerged. One student described the process as: 'just putting down all the information that I can and… direct quotes or direct lines or even just paraphrased, segments of the articles, and then I try going back and see if I can rethink what my original thought process is'.

- **Stage Three – *Linking concepts***

At the third and final stage, the students started by linking their content to a more coherent and complete structure. It is a method that the students see as combining portions of content with arguments and merging the research with information obtained from the

course readings. Some students continued to work towards creating the final outline of the essay, remembering ‘point’, ‘evidence’ and ‘explanation’ when finalising their mind maps. For instance, one student said: ‘This helps me a lot to get to the point, in relation to each of the keywords. Evidence from the citations and the explanation also comes from the small bullet points that I’ve put on the tree [mind map] as well’. Other students also described using embedded hyperlinks once they had exported their mind maps as outlines, with one student describing it as ‘making it easier and means I don’t have to go back and remember things’.

Although the students reported that mind maps are beneficial in helping them organise their thoughts through a visual process, several highlighted issues with using the software and ‘getting hands-on’ with the activity. The students identified issues around the lack of understanding and training of the software, and absence of time to complete the mind map process. One student described being overwhelmed when transferring their documents and information into the computer when trying to ‘brainstorm’ for exams: ‘I’m so used to having documents printed with notes and working with paper that I sometimes feel helpless... It could also be because I’m feeling pressed for time given the number of tasks I need to complete and my lack of advancement while trying to figure out new technology’. Some students also described the technologies used for their mind maps as ‘not helpful’ and ‘not enough flexibility in the layout and how information could be positioned’.

5.5. Conclusion

This chapter has identified experiences with the educational role of assistive and learning technologies by Redwood University students with dyslexia. From the findings, it can be identified that certain influences from the students’ backgrounds such as family

intervention, socioeconomic status, support and provisions, and diagnosis of dyslexia can affect learning with dyslexia. For some students, it can also be recognised that as technologies began to emerge throughout their journey from secondary school to higher education, the students learnt to adapt and integrate personal strategies and created a process of 'thinking visually' for their writing. This involved a process whereby the students organised their thoughts and ideas with visual maps and diagrams.

In the first part of this chapter, it was identified that the students who were presented with technologies from an early age became skilled and confident in shaping the manner in which they overcame their learning difficulties. But those students not fortunate enough to have access to technologies at an early age took longer to acquire the necessary support skills. However, with determination and resilience, they too were able to find technological solutions for their difficulties. It was also identified that those students who were diagnosed later in life shared similarly challenging school experiences as the students who were diagnosed early on in their lives. This was partly due to several factors; one example being that some students did not want to be singled out as having a disability or as receiving specialist intervention. Thus, regardless of the timing of diagnosis, all of the dyslexic students studied experienced difficult early school experiences.

When it came to understanding the students' current difficulties with learning, each student successfully learnt to accommodate their literacy problems. Nonetheless, some students tended to view their dyslexia as not only a difficulty with literacy but also concentration, comprehension and short-term memory. The involvement of the students' parents played an essential role in the successful management of dyslexia, particularly when the educational environments did not make appropriate accommodations for the students. For many students, parents supported and guided them through the process of

diagnosis, and this process sometimes resulted in the identification of one or both parents as dyslexic.

Throughout all of the students' lives, they learnt, discovered and acquired a range of study skills and learning strategies to support their educational progression which enabled them to achieve their ambitions. In many ways, the strategies were repetitive, which meant the students had to apply determination and dedication to succeed. In their higher education settings, nearly all accepted their difficulties, although this tended to occur after they had been formally diagnosed with dyslexia. While they still experienced problems with reading and writing in this context, some students also identified dealing with issues associated with demanding situations related to short-term memory such as tutorials and keeping up with the fast movement of discussions.

For the second part of the chapter, student journeys and the discovery of support and provisions uncovered three significant stages that were significant for the students in establishing the appropriate support and environment to help influence their use of assistive learning technologies in their studies: foundation, awareness, and post-diagnosis. The foundation stage highlighted that nearly half the students were diagnosed with dyslexia at university and experienced literacy difficulties when they were younger. Some students became aware of dyslexia assessment through their peers. Following a diagnosis, which was funded by the university, students did not always receive their technology provisions on time. When they did finally receive their provisions, it was often at the end of the term and sometimes too late to support their studies. Moreover, the DSA was a leading discussion among the students as it allowed them to facilitate their personal use of independent learning strategies and explore technologies in their studies. In the awareness stage, students discovered that it is a requirement for the university to deliver personalised, supportive and adaptable learning content for all students with disabilities.

This was facilitated by the tutor's awareness of students' dyslexia and by the tutor's support in developing strategies that were reinforced in weekly tutorial sessions. Lastly, the post-diagnosis stage revealed that the students who received technology provisions often experienced issues with inadequate training on the technology and a lack of communication from access centres and disability offices. Overall, the lack of training and awareness of the technologies was a factor in the students' dissatisfaction with the use of the software.

The final part of the chapter highlighted that due to issues with following text on a screen, some students developed unique ways of engaging with technologies. These unique approaches included using line tracking software, colour filters, or utilising tried and tested strategies previously learnt for print material. When it came to writing essays, the students described the process of 'getting into the right frame of mind' and learning to plan early as key strategies. While each student had a different process of developing their essays, each strategy can be described as a method of giving order and meaning to their work.

The analysis of the students' integration of assistive learning technologies indicated that they had varying perspectives and approaches to completing essays, and were often faced with the difficulty of structuring their work. Furthermore, the students' reluctance to engage with the assistive software was identified from two perspectives. Firstly, they were not trained or familiar with the software or were not able to see the overall 'bigger picture' when using the software with other tools or applications. Secondly, the lack of consistency in the user interfaces when using the different types of assistive software limited their ability to fully use the technology. Ultimately, when it came to adding structure and organisation to essays, all students used mind mapping software to enable the visualisation of concepts and information in order to aid cognition during the writing

process. From the analysis of the students' use of technologies, the application of the visual organisation process was identified as a three-stage activity: (i) the spontaneous act of setting out basic thoughts and words; (ii) adding clarity to a connection of meaning; and (iii) linking and connecting the content to a complete and consistent structure.

For students with dyslexia, factors such as self-determination, access to technologies and key prominent background influences all play a part in the successful integration of technologies for supporting difficulties associated with dyslexia. The following chapter presents the research data from Owen University.

Chapter 6: Findings

Owen University

6.1. Overview

This second findings chapter presents data from the sample of Owen University participants outlining the experiences of students diagnosed with dyslexia as they use assistive learning technologies with their studies. As in the previous findings chapter, the presentation of data here is introduced through shared accounts of the students' journeys from their childhood to university, exploring the identification and support around their dyslexia to enable the implementation and use of assistive learning technologies. The findings are focused on three sections each associated with the study's research questions:

(i) **Section 6.2. Background Influences on Students' Use of Assistive Learning Technologies**, reports on the experiences from early school years to university where family and educational backgrounds have played a part in shaping the understandings around dyslexia, as well as providing the framework to enable the use of assistive learning technologies with learning. Other factors such as the students' self-motivation and determination and the effects of positive and negative labelling are also identified as key influences on their ability to navigate the support systems.

(ii) **Section 6.3. Provision of Support for Disabled Students**, details the discoveries and insights into the provision of support through dyslexia assessment and diagnosis, access to technologies from the DSA, and the wider institutional resources that helped the students in assisting their difficulties, both practically and digitally.

(iii) **Section 6.4. Multi-Modal Techniques of Technologies to Assist Writing**, explores the broader insights into how the students have combined a variety of assistive and learning technologies into their studies. The themes from multi-modal methods of technologies include: creating order with mind mapping, enabling the writing process with speech-to-text and audio to enhance the learning experience.

Before presenting the findings, an introduction to the participants provides an understanding of their characteristics, and the range of ages the students were diagnosed with dyslexia.

6.1.1. The Participants

The study at Owen University involved 20 adult students, 10 male and 10 female. In total, all identified as British home students studying full-time degrees from a range of subjects, including arts and humanities, engineering, sciences and social sciences. From across the university, 7 staff participants took part in the study, 2 from the disability office, 1 from library support and 5 staff members from across the university's subject faculties who took an additional role of student support associated with their teaching. The students included 18 undergraduates and 2 postgraduates. From selecting a wide-ranging collection of students from different backgrounds, ages and disciplines, it ensured that the study reflected the diversity of the student population. In total, 18 students

identified receiving the DSA, with 1 student acknowledging that they were not receiving any disability support or provision and another student was currently in the process of applying. Table 2 in Appendix G presents an overview of the significant characteristics and profiles of the students from Owen University.

6.1.2. Summary of Students: Age Diagnosed with Dyslexia

The diagnosis age of the students varied considerably with no pattern of early identification of dyslexia emerging and only a handful of the students being diagnosed before their ninth birthday. From the sample of students, their average age was 27 years, ranging from 19 to 55 years. The median age of diagnosis among the students was just under 20 years, with the youngest age of diagnosis being approximately 6-7 years and the oldest 55 years.

Less than half of the students (n=8), Aidan, Dominic, Helen, Holly, Jackie, Neil, Stephen and Todd were diagnosed with dyslexia before reaching the age of 16 years. From these 8 students, only 3 attended a private school, while the remaining attended state schools. Among these students, several were influenced towards a diagnosis because of the involvement of their parents and wider family. One student, Aidan, explained: 'My school were hesitant at first to believe. My parents ended up having to go privately to fund the dyslexia test'. He also added that if it were not for his parents and brothers, he would not have realised there was a problem: 'I think it was the early support, links and nurturing of what I needed which provided me [with] the skills and ability to get where I am now'. Several of the students also identified that it was through their parents and siblings' diagnosis that resulted in their assessment for dyslexia. One student, Helen, explained: 'I was first diagnosed with dyslexia when I was 11, I was still in year 6, and my primary school teacher noticed that I had tendencies towards that and my sister was

diagnosed with dyslexia at the same age'. Some students also identified with dyslexia early explained that their parents worked as special needs teachers in private schools and could recognise their difficulties early on. Stephen's mother who worked as a dyslexia specialist explained that she always knew of his dyslexia: 'My mum is a dyslexia specialist, she's Head of Learning Support at a private school in [well-known city]. So, I was diagnosed early… she knew from a very early age that I was dyslexic, even when I was in primary school I was getting dyslexia work'. While these students were diagnosed before leaving school, some did not always receive appropriate support or provisions. One student, Helen, confirmed: 'I would just occasionally go out of class, have my reading assessed and go back to class and then I think as soon as I got the reading age of a 13-year-old they just dropped me, so I had nothing more'.

Over half the students (n=12), Amy, Diana, Emma, Erica, Garrett, Joe, Lucas, Patricia, Rick, Sophia, Vince and Yasmin, were first diagnosed with dyslexia when they arrived at university. The data presented in Table 2 (see Appendix G) suggests that due to the wider movement of understanding dyslexia both in society and the education system, it is understandable why some of the younger students may have been diagnosed early. However, the data also identified that those students aged over

Ray's Story

Describing himself as the 'grey child' in the school class, Ray explained that he always saw himself as thick and survived his school years by blending into the background, so 'no-one noticed'. He explained: 'I didn't really come out with any GCSEs. I came out with a D in Maths, and that was just through natural ability you know, the rest were like really, really bad'. After school, Ray joined the Army for 6 months before becoming a bricklayer and then self-employed.

First diagnosed at 25 years old during his initial year at university, Ray explained that his lecturers noticed that he was struggling with essays and advised that he went for a diagnostic test. Following the diagnosis, Ray pointed out that he has developed an 'independent way of coping'. Apart from some essential support with technologies after his diagnosis, Ray admitted that he has never 'sought any support' and defended his reasons for not seeking additional assistance: 'I suppose in my head that I am so used to them being not very good that I just make up… I just work my own way forward. That's basically my childhood experiences that I've found teachers and schools to be a let-down, so I've learnt to cope myself... and I generally still do that'.

25 years were less likely to have been diagnosed with dyslexia in their earlier years. Emma, Lucas, Ray, Sophia, Vince and Yasmin, were among the oldest students participating in the study and diagnosed beyond the age of 25 years. In addition to being diagnosed later in life, these students also experienced negative perceptions of their school years. Some of these experiences were of humiliation, lack of understanding towards their difficulties and the persistent labelling of 'lazy' and 'stupid'. As one student, Yasmin, explained: 'I was told I was stupid, I believed it… I thought, okay, this is going to be what I am. I would just go home, and I think my relief or sort of switching off was drawing'. Lucas also described his memories of school as being mainly anonymous: 'They used to just push me to the back of the class. I sort of went down to the lowest levels of everything'. They didn't even mark… my maths class, they didn't even mark me for the last year and a half. They had no idea of anything I was doing or not doing, so I pretty feel like they've let me down'.

The average diagnosis age among the older students was nearly 38 years. Although they did not attend university until they were mature adults, they did experience the effects of their dyslexia differently to the younger students in the case study group. Their ability to trust and gain confidence in an education system that they perceived to be against them was a problem for some students. One student, Emma, explained: 'I have major trust issues with people that do assessments and this kind of establishment. I'm trying to break that barrier down within myself, but obviously, I've got no confidence… it's never worked for me before'. The issue of trust and students' perceptions of acquiring support and provisions will be summarised more broadly in section 6.3.

6.2. Background Influences on Students' Use of Assistive Learning Technologies

By exploring the influences of the students' engagement with technologies, this first section presents several identified themes, reviewing and attempting to answer part 1 of the research question: 'how can students' personal and educational backgrounds enable them to use assistive learning technologies in their studies?'. Across the themes and examples, this section guides the reader through a shared narrative of the students' experiences from school through to university, identifying how they influenced their use of assistive learning technologies.

6.2.1. School Experiences on Support and Provisions

Access to school support and provisions played an important part in aiding several of the students in identifying their difficulties and implementing a range of learning interventions. From the group of students, half (n=10) were identified or diagnosed with dyslexia while they were at school, with only 7 acknowledging that they received some support and provisions when they were at primary or secondary school. Interestingly, the majority of the 7 students identified using some technologies in order to aid their difficulties. Aidan, Dominic, Jackie, Joe and Neil were all recognised or diagnosed with dyslexia before they were a teenager and acknowledged using technologies at school or at home to support their dyslexia. For instance, Dominic, who was diagnosed at primary school recalls being placed in separate classes with the SEN coordinator to develop his English language skills. In addition to face-to-face support, Dominic also described using literacy software at school to assist with his language skills: 'The software spelling test at the beginning was quite handy in the mornings because it was audio based and visual based on the computer. It was also tailored to me individually because it was smart programming. That really helped'. Another student, Jackie, who recalls being diagnosed

between 7-8 years, explained: ‘My mum bought me some software when she found out, so I used my mapping software, Inspiration®…’. Managing her difficulties through ‘learnt strategies’, Jackie acknowledged that she got no help throughout most of her schooling and it was not until her A-Levels when she started struggling. Neil, one of only 3 students in the group to attend a private school, added that he was diagnosed privately at 12 years old. He also explained: ‘The school didn’t help me at all, to be honest. Um, my Year 2 teacher thought I had it, then I went to get tested and then I went for like private help outside’. Describing his school as ‘tight’, Neil, explained that he was offered voice recognition software: ‘The only problem was they only had one lease for the entirety of the school, so it was like me and thirty other kids trying to get on this one computer over lunchtime for writing an essay’.

Aidan’s School Experiences

Initially identified as being susceptible to dyslexia at 12 years old due to his older brother being diagnosed, it was several years before Aidan became aware of his dyslexia. After failing his first year of the sixth form, Aidan’s parents decided to fund the dyslexia test privately, and at 16 years of age, he was found to have moderate dyslexia, dyspraxia and minor Obsessive Compulsive Disorder (OCD).

Attending both a state and private school, Aidan explained that the problems caused by his dyslexia were ‘simple ones, but it was ones that overall added up. Mispronunciation of words, misreading, incorrect understanding and comprehension. Stuff that I thought I knew quite well’.

With a diagnosis statement, Aidan’s parents approached the school and presented evidence that there was a problem: ‘We had pretty much shown them up at their own tests and said, “look, there is a problem”, and that’s when they gave me far more support than what I was entitled to’.

As well as the external support of his three older brothers, at school, Aidan was provided with specialist support staff who communicated with his other teachers and ensured he had a structured environment: ‘Teachers were personal mentors at all times where they would talk through any problems, any issues I would have. They would even recommend the use of IT technology, online websites, …the college internet would have specialist support packages’.

The students (n=3) that were also identified with dyslexia during their school years but did not receive any support or provisions at school or use technologies, they reported managing their difficulties through their parents or developing their own strategies. While these students, Helen, Stephen and Todd, all acknowledged that they had problems

associated with dyslexia, they quickly accepted that their school environment were not going to provide the appropriate support and learnt to adapt accordingly. For instance, Helen described that during her early secondary school years she was occasionally taken out of class to have her reading assessed. But as soon as she achieved a reading age of 13 years old, 'they just dropped me, so I had nothing more'. Instead, Helen's mother signed her up for a course to enhance her learning: 'My mom got this course… basically, you do an assessment, and it assesses your basic level. It sees the fact where your holes are and it sort of teaches you on those like individual holes… my mum was always pretty supportive'. Overall, students diagnosed or identified early with dyslexia were more likely to be receiving direct 'hands-on' support from their parents and family. This ensured that they had a diagnosis, the right interventions at school as well as resources to aid their learning (section 6.2.2 explores further). While students did not describe their school years as being particularly 'fun' or 'easy', the findings did not uncover severe forms of bullying or inappropriate name calling from their peers. The only form of negative labelling identified was from one student, Jackie. She recalled a time when some of her teachers perceived her to be 'lazy': 'My teachers weren't really told what dyslexia meant so there were things that people don't realise, like the getting tired thing and most people just think dyslexia, spelling, handwriting and they don't know about the other things, so they thought I was being lazy and things like that when I wasn't'.

For the second half of the group of students (n=10), all but one was diagnosed through the university. The exception, Garrett, was diagnosed after completing his A-Levels before the start of his university degree. In all, over half of the (n=6) students admitted that their experiences at school were 'horrible', 'traumatic' and not an environment for them to succeed –partly influenced by their teachers' perceptions of being 'lazy' and 'too stupid to learn'. Among the students in the case group, the 6 students

were identified as being the oldest, with an average age of just under 42 years and an average diagnosis age of 38 years. Data from the study group suggested that the older the student, the greater the chance that they experienced forms of punishment and problems due to their schools' lack of understanding towards their disability. The mature students would have attended a school at a time when dyslexia was unknown and not recognised as a disability, particularly when schools were not required by law to provide support and provisions. One student said: 'I mean no teacher picked up what I had. I don't know if it's because they didn't know back then, sort of in the 80's/90's. It was not well known… but it could be because they didn't know what they were dealing with'. The 6 students widely acknowledged that at school they were identified as having 'low intelligence' and were subsequently pushed to the back of the class. For instance, Yasmin, said: 'When I was at school it wasn't well known, dyslexia, so it was never ever picked up, and in the classes, we were always put at the back and then they just focused on the ones that were good'. Another student added: 'When I was at secondary school it was very traumatic. It was extremely hard. They didn't have the patience they do today where they didn't help you. You were put in a dunce's class, and that was it. I had to do everything myself'. When it came to supporting their difficulties, and receiving appropriate provisions, the mature

Sophia's Early Experiences

Not diagnosed with dyslexia until 51 years old, Sophia explained that she knew nothing about dyslexia until university: 'I knew I had a problem, but I didn't know what it was, but I also did know I wasn't thick'. Describing her dyslexia as 'very mild', Sophia defined it as 'Star Trek dyslexia', a distortion where printed words are appearing on the screen and, 'the words are actually moving up… that's what I see when writing and that's how I sometimes see people'. Sophia also explained that she has dyspraxia and it often disorientates her and affects her coordination.

Throughout her time at school, Sophia described receiving 'no support whatsoever… apart from being put in the lowest class' and constantly being told that she would 'never amount to anything'. Despite struggling and finding her school years very 'traumatic' and 'extremely hard', Sophia added that she did not pass her qualifications the first-time round, instead, passing them on the third or fourth attempt. Encouraged by her mother, Sophia would often hear her say, 'you're not thick, you just see things in a different way'.

students highlighted that there was ‘nothing available’. One student, Emma, recalled that the only primary support provided was ‘the remedial classes, but they were classed as the thick class for the retards’. Considering technologies at the time, students explained that ‘there wasn’t really any’ and ‘I wasn’t aware that there was any technology’. Instead, students learnt to create and develop their own strategies often supported through their parents (outlined in the following section 6.2.2).

For the remaining 4 younger students that were diagnosed at university, their school experiences were identified as being less ‘traumatic’ than the mature students in the group. This could be partly due to the younger students experiencing less severe learning difficulties, being educated at a time when society was beginning to understand the needs of those with learning disorders or having access to technologies and support. While the 4 students, Amy, Diana, Erica and Garrett, were not provided with direct personalised support or provisions at school, there was evidence of students receiving minor support from school and their parents. For the provision of support at school, one student, Amy, explained: ‘Apart from my English teacher, they gave me some extra lessons, but it was just on the side’. Another student, Erica, emphasised that she received ‘no extra help’ at school: ‘The only kind of thing I got was to be allowed to use a laptop in the lessons because I couldn’t keep up… which wasn’t really a dyslexia provision, it was a kind of “do it if you want”’. The following section outlines the involvement of students’ families in supporting their dyslexia through school and at the start of university.

6.2.2. Family Perceptions and Support

For many students, they recalled their parents, siblings or even close friends playing an important role in helping them navigate the support needed to progress through the education system. It was highlighted that families and friends were often on hand to help

when issues arose and played a part in introducing the use of technologies. For instance, one student, Garrett, whose parents took a direct role in supporting his dyslexia, provided him with mind mapping software and memory exercises: 'They didn't work all the time because I wasn't too motivated with memory exercises, but it helped me to slow down and to properly plan out and then use a computer as well'. Failing his A-Levels the first-time round, Garett's family ensured he had suitable provisions and support to aid his studies: 'I got the extra time and a computer to use. Um, I take a Dictaphone and record the lectures and lessons, but most of that was my family almost campaigning for this help. It wasn't that freely available'. By taking control of the situation, Garrett's parents, who he describes as doing 'quite a lot of reading about dyslexia', could influence his learning and help prepare him for his studies at school.

Despite the majority of students not receiving the appropriate support or provisions at school, some parents and family members, even though they did not know the full extent of their child's problems, were consistently involved in supporting their difficulties through interventions, technologies and encouragement. One student, Joe, said: 'My mum and my sister helped a lot in the first year like proofreading and then as times progressed, you know, I've used them less and also, I get weekly tuition from University as well…'. After receiving technology provision from the DSA, Joe, also said: 'It's taken a lot of strain off my mum and sister with proofreading my work, 'because with Dragon® it's made me a lot more independent. Not totally… but sort of less proofreading and sort of not having to restructure sentences, it's clearer of what I'm trying to say'. Another student, Erica, recalled trusting her mother to check the spelling and grammar of her work as well as time management. Although as soon as Erica started using the technologies on her computer and smartphone, she could manage her time and give her mother 'a bit of a break'. When it came to more direct and involved support, some students were fortunate

to have teachers as parents that provided personalised strategies. For instance, Holly, said: 'My mum has got a lot of teaching strategies with special needs… and if it wasn't for her and her friends at school, I would have never have got through my GCSE's because I was given no help at school'. Holly also added that her reason for not engaging with technologies when she was younger was partly due to her mother and the strategies she encouraged her to use. Holly explained: 'Technology is nice, but sometimes the old ways are the best... From her experience, my mum doesn't like technology either, so she works with the old ways as it is, but she finds she gets some results. So, my mum taught me all my practical strategies that I know, like, mind mapping, how to structure an essay out like a burger, so you've got like the two buns, just like an introduction and the conclusion'. Having parents with a background in special needs or teaching meant that some students did not always actively seek support or diagnosis at school. Instead, they could receive it at home. One student, Stephen, said: 'My mum is a dyslexia specialist, she's Head of Learning Support of a private school and always had a background in dyslexia. She knew

Diana's Family Experiences

Diana recalled that her cousin first brought up the issue of whether she was dyslexic when she was 15 years old, due to her slow reading time: 'My mother who is dyslexic was like, "no, no, no, you're not dyslexic", because I was getting all good grades, so I never actually got tested'.

At school, Diana recalled that she had specific issues with tracking text as it would appear to 'jump from line to line. They'd all get a little bit muddled up and blurry'. As well as experiencing issues with reading, Diana also acknowledged that being identified early with dyslexia 'would have helped a lot'. Despite some pastoral help to get through some family problems, she received no academic support at school: 'I just muddled on because I was in the top set for absolutely everything. Top set, "yeah she'll get on with it, she'll do it". I'd go to the revision classes they put on, but no additional help'.

When Diana was finally diagnosed with dyslexia at university, she said: 'It's been hard because of adjusting to it… my parents still aren't convinced that I actually do have dyslexia despite the tests, it's all there in black and white literally. They say "nah, nah, you're too intelligent for that"'. Although her family did help with proofreading, Diana explained: 'It's been something that I've dealt with on my own… but they are still 2/3 years on, "nah, you're not dyslexic, you're fine, you're just not concentrating enough, you're moving too fast"'.

from a very early age that I was dyslexic, but I wasn't officially diagnosed until I was 18 because she knew there was no need'.

Another factor that may have been involved in aiding students with the support of their dyslexia was through their parents own perceptions and difficulties of having the disorder. For instance, Dominic explained that his diagnosis with dyslexia in primary school was prompted by his mother's own diagnosis: 'It was because she had only just discovered around that time she had dyslexia through some training she was doing, but it was never a formal diagnosis'. One student's mother was educated about the disorder through his older brother's experiences with dyslexia: 'The signs, the symptoms and possible treatments or at least coping mechanisms with dyslexia gave my mom knowledge. It gave her the understanding which helped me, and my mom was the main one who pushed me in college and school to persevere really'. Additionally, several of the students also pointed out that their parents' experience and understanding of the disorder empowered them to support their difficulties: 'I have a lot of support at home, so my dad's also dyslexic, so if I didn't understand things I would go in front of my dad and be like, "maths, they're not explaining it in a way I understand", and he would explain it to me'.

6.2.3. Self-Motivation and Determination

As students learnt to overcome their difficulties both at primary school and at university, many recognised the need to become focused, determined and motivated. While some of the students identified that they were not motivated at school, they progressed through the education system, and in some cases, learnt to succeed through hard work and determination. The focus among several mature students who were aware of their literacy difficulties was to accommodate their problems with self-support and

develop independent strategies. As one student, Sophia, explained: 'I've always been really, really good with reading so it's like this self-determination to prove that I can do it and the fact I've managed to get to University… it just proves that I'm not stupid. I've just managed to find a way of understanding coursework and doing it with very minimum support. So, it's sheer determination to prove that I can do it. That's kept me going basically'. Another mature student also added that their dyslexia has made them develop an 'independent way' of coping with issues, particularly around the process of managing their work. In another example, Yasmin recalled being told by her teacher that she would be lucky to 'stack shelves in a supermarket'. However, determined to succeed, Yasmin, added: 'I was determined to make something of myself, it was kind of hurtful listening to one of my teachers saying that'. In addition to the mature students, the younger students' emphasis on being motivated and determined by their studies appeared to be more prevalent among those that were not diagnosed with dyslexia until arriving at university. For instance, Garrett, who was diagnosed just before starting university explained: 'It resolved a lot of things. It was a bit hard to accept at the beginning, but once I accepted it, I was able to then learn ways of coping with it and learning how to plan and how to write, but it took a while'. By understanding that dyslexia caused his difficulties, Garrett accepts that 'it's

Emma's Anxiety and Self-Esteem

Struggling through school and trying to avoid it as much as possible, Emma was diagnosed with dyslexia during her first year at university. Acknowledging her literacy difficulties, Emma recalled her school experiences: 'It was quite difficult I suppose, not knowing that you have dyslexia. Um, you pick up certain differences between you and the majority in the class, and you know that you're different, but you try to fit it, and so you try not to appear different, not knowing the extent of the problems'. Described as 'thick', 'low achiever', 'low intelligence' and placed in the remedial classes, Emma disclosed that she avoided High School 'like the plague', rarely attending classes.

Defining herself as 'working harder than everybody else', Emma added that she has 'no confidence in anything'. She self-identified herself with anxiety but associates this with her academic work: 'I don't see or understand certain things, like structure, very difficult patterns, so I overcompensate which means I'm exhausted most of the time… Um, so I think my biggest problem is my anxiety with it and really low self-esteem academically'.

just a challenge that I know I've got to try, and if I'm hitting the wall then I know that I've just got to try something else… It's helped me to become a bit more resilient because my long-term goals are quite big and to achieve those I've got to be quite constant in my effort'.

It is often perceived that because the students with dyslexia have been successful in navigating the education system and embarking upon a university programme they can cope. However, it is important to acknowledge that for some students, higher education is an environment where they begin to fail due to increased pressure and the demand for independent living, despite being focused and determined during their school education. One lecturer explained: 'They lose confidence and then there's potential that they stop engaging so they don't turn up or they're not doing the reading from week to week'. In many cases from tutors' experiences, students are encouraged to seek support and diagnosis provided by the university. Once students have the necessary support in place they can regain their 'self-confidence' and engage with their studies. One student said: 'It was that sort of sense of community, and I think community support, knowing that there are more around you rather than just knowing the supports there, but not knowing who there is, I think helps a lot. It gives self-confidence, and I think that has a big impact'.

6.2.4. Acceptance

The acceptance of dyslexia was more prevalent among the mature students who identified feeling confident about using the label. However, the younger students described their acceptance of dyslexia as a process of gaining 'confidence' in understanding their difficulties and 'coming to terms' with the disorder. This perspective is reiterated by one tutor who explained that the older students 'like the idea that they've now been given a label' and that students have to 'become quite mature before they

realise that this is sometimes a sensible thing to do'. Several mature students supported these views, with Sophia explaining that she has learnt to 'feel comfortable with it… it doesn't bother me now; I'm quite happy to tell people I'm dyslexic, that's who I am if you don't like it, hard luck'. From another perspective, Emma, who is also a mature student, added that she is 'a bit sick of listening to the word… I seem to be saying it all the time; it must sound like I'm saying it as an excuse'. However, while some of the students were reluctant to disclose their dyslexia due to feeling embarrassed or not knowing how their tutor would respond, the findings suggest that it could be because of early school experiences. One younger student, Amy, recalled: 'At school, my teachers were all like "yeah, you're stupid", so I feel like if I tell the tutors here [university], they might think that, so in a way, I just haven't told them… I'm scared of their reaction!'.

In contrast to the acceptance of dyslexia among the older students, one tutor explained that the younger students who received no previous support find it much harder to accept, particularly when 'they've been told that they're rubbish at school all the time and that they're rubbish because their dyslexic and then they've thought, "well I've got to university, and this is really good, so I'm not going to get that… I'm going to sort of, do it all myself", so I think that they have their own barriers…'. For the younger students, it is a process of gaining confidence, particularly as they begin a journey in understanding the disorder and forming their own ways of coping. While each student has a varied background, many learnt to manage and support their difficulties at school. However, after studying at university for the first couple of terms, some students realised they were not able to cope. For instance, one student who was diagnosed during their first term at university described it as 'resolving a lot of things' but found it 'a bit hard to accept at the beginning… once I accepted it, I was able to then learn ways of coping with it and learning how to plan and how to write, but it took a while'. Another student, Jackie, also

said: ‘It showed me what dyslexia really meant to me… so there were things I thought were my own fault, and I thought I was stupid, which turned out to be because of my dyslexia, it meant that I wasn’t stupid, it had never been pointed out’.

For the younger students that were diagnosed early and received some support, they acknowledged a more confident and positive view of accepting dyslexia. One student, Neil, said: ‘I don’t think of it as a disability. I think of it more as an advantage because given I can’t really spell or read that well but I’ve got other attributes that other people don’t have, so I figured that I concentrate on the attribute side…’. By receiving support and a diagnosis from a young age, students like Neil could begin to discover the issues facing them and recognise their strengths and weaknesses during their school years. This view is reiterated by another student, Aidan, who was also diagnosed early: ‘I think what helped was being diagnosed early. I know people who were studying in [another university] who have recently got diagnosed with dyslexia. He didn’t do too well in his first year, but I provided him with my experience and that allows him to realise it’s not just his inability, but it’s a problem. I feel if it wasn’t for my parents I wouldn’t have been able to truly realise that I have a problem… providing me the skills and ability to get where I am now’. Moreover, on the journey to accepting and discovering more about dyslexia, some students highlighted that their families also bought them assistive software such as Dragon® as a process of ‘trial and error’ to ‘figure out what would work and what wouldn’t’.

6.2.5. Reading Difficulties into Adult Life with Dyslexia

As the students progressed through their school education and into their adult lives at university, nearly all identified that they were in acceptance or beginning to recognise their difficulties with dyslexia, openly acknowledging it with their tutors or peers. Due to

dyslexia having a life-long effect on individuals, it is not surprising that all of the students continued to report difficulties during their time at university. Although reading was a prominent concern, the lack of understanding towards dyslexia and its associated difficulties from tutors and peers remained an issue for the students, particularly at the start of their studies. However, despite all of the students identifying that they still experienced problems with literacy, issues around their dyslexia was much broader. One student said: 'People don't understand dyslexia. They think you say "dyslexic", and they believe that handwriting, spelling and that's about it. Oh, and reading and that's not what dyslexia is at all. It's different for every person'. More complex issues with dyslexia included confidence, anxiety and other associated SpLDs, such as dyspraxia and OCD. Nonetheless, the prominent theme acknowledged by the students was concentrated around reading and the related issue of Irlen Syndrome, which was suggested during the initial dyslexia diagnosis. The main problem of reading for the students was a combination of the quantity of reading and the amount of time taken to process the information. One student explained: 'If we've got timed reading in classes it can sometimes be hard to get the gist of the scientific papers and I'm still on page one after 20 minutes. People are wondering why I've not finished all the questions or tasks in class at all'. Another student, Emma, who is currently in the process of receiving the assistive learning technologies, said: 'I'm struggling… currently, I'm struggling really with the reading. I understand there is a lot of software that's going to help me with that, so I'm waiting, and I'm hoping that it's going to be a massive improvement'. For several of the students, the initial diagnosis and the continued difficulties of reading at university were often the first stages in discovering that technologies could support their studies. For instance, one student that received the technologies added: 'I can now put the colour filter on my laptop, so it's a lot easier to read'.

When it came to reading and retaining written information, it was identified that the students also had issues with their short-term memory, mainly when writing essays and making notes. One student described it as 'having to re-read things' and 'it's hard to sort of remember what you're reading so I can only retain so much information before I then switch off, so it's kind of hard sometimes'. The emphasis of providing reading support to students was often followed through with a diagnosis of Irlen Syndrome, where some students were provided with coloured overlays and glasses with coloured lenses. For those students that used the coloured lenses, they described it helping to support their reading, with one student adding that she 'could see so much better and my eyes don't hurt as much!'. However, one student admitted to 'feeling funny having a pair of blue glasses' and did not want to wear them going into the computer room, so they used a blue sheet on the screen. A large number of students diagnosed with Irlen Syndrome may be associated with the disability office's position on referring students with dyslexia for the condition. The dyslexia tutor said: 'I'm kind of discovering more and more students now with Irlen Syndrome, which kind of sits side by side with a lot of SpLDs as well. I've teamed up with Irlen Central, so I'm sending them a lot of referrals now saying can you do a proper assessment with this student and he's doing it at a reduced cost'.

6.3. Provision of Support for Disabled Students

The second element of findings sets the scene for exploring the students' journey through university. It identified areas of disability support and provisions that influenced the students' use of assistive learning technologies. These recognised areas are focused on the diagnostic process of screening and assessment, the student support system, adaptation around technology provision and support in the university environment. The data from

these prominent themes will answer part 2 of the research question: 'what disability support and provisions do universities provide to their students?'.

6.3.1. Journey through Diagnosis: Screening and Assessment

As the students progressed to university, it was identified as a long journey in learning to navigate and understand the support systems. In total, just under half (n=9) the students were diagnosed with dyslexia while they were at university. The second half of the students (n=11) acknowledged that they received a diagnosis either before arriving at the university through a private assessment or during their primary school years. However, some students did emphasise that they received an additional assessment at university, required for the DSA application. Helen recalled: 'I was first diagnosed with dyslexia when I was 11 so I was still in year 6, but then I got reassessed last year when I was 20 for like DSA and stuff'. One of the biggest concerns reported by several of the students was the anticipated cost of a dyslexia diagnosis. The perception that dyslexia assessments would need to be financed was often a factor in the decision to delay assessment until university. One student, Amy, explained: 'My mom would tell me to wait because she said you have to pay for it while you're at school, but if you go to Uni it's free, so I waited'. Another student only found out that she could have a dyslexic reassessment through advertising on campus: 'I knew how expensive they were… so if I'd known I could have had that. I would have done that in my first year immediately instead of waiting halfway through the second year which could make a big difference to my degree'.

The students that received a diagnostic assessment at university were either encouraged to do so by their tutor or by approaching the disability office voluntarily. One student, Ray, described that he was 25 years old when he started university for the first

time: ‘Lecturers noticed that I was struggling, really struggling with essays and they didn’t really understand why I was struggling so much, and they sent me for a test’. One of the university’s dyslexia tutors also confirmed that ‘students go through a process, so, either they’re referred by their tutor or they self-refer; for some reason, they roll up at our office, we book them in for an initial screen…’. It was reported that the initial screen takes approximately an hour with an assessor guiding the student through a diagnostic screening. In explaining the diagnostic process students’ experience, the dyslexia tutor said: ‘It is an interview and part of it is the Lucid Adult Dyslexia Screen, we find the LADS is not particularly useful but we use it as part of our service really in order to make sure that the students feel that they’re getting a thorough screening before we put them through the pain and agony of a 4 hour dyslexia assessment. If there is a likelihood that they have dyslexia, we refer them on for full assessment’.

Several of the students highlighted that they were initially identified with dyslexia while studying on their access or foundation courses but were never diagnosed. One student said: ‘I was diagnosed with dyslexia just last term so my first term in my degree. When I came here, I previously did an access course which highlighted it, but they didn’t diagnose it. I was only given a provision in my exams’. Another student suggested that the reason for the lack of a ‘proper diagnosis from an accredited person’ was partly due to an absence of funding available. However, the disability tutor confirmed that ‘any student at the university is entitled to an assessment, and it’s always free. We claim funding from the Access to Learning Fund to pay for any students who require assessment, and if they can’t apply to the Access to Learning Fund we do it for them anyway’. Despite several of the students reporting that they had their ‘assessment sorted out quickly’ and ‘the support is very good if you can get the application in early’, some students highlighted that the university needs to promote its disability support service and ‘make it obvious what

you're meant to do' when requesting an assessment. Moreover, another student described the size of the university's disability department as 'not really adequate, it needs to be larger and needs to be more publicised really. When I first got to the university, I spent about a week trying to find the disability department…' (see section 6.3.4 for support in the disability office).

The initial stages of diagnosis can play a role in the direction of support and advice the students receive for the use of technologies to aid their difficulties. For several of the students, it was identified as an important process in the transition of adjustment and the discussion of technologies. For instance, one recently diagnosed mature student new to assistive and learning technologies said: 'I'm having high hopes for the software and the technology, and I do think and I'm hoping that it will cut down on my time that I'm spending doing what I know other people do in an hour'. Another student added that 'it's the adjustment period to really integrate because… I think one of the issues when I was first diagnosed was because I had never used the technology it was quite alien, it felt quite alien whereas now I've used it so regularly it's just fluent now'. The following themes outline in more detail the central role the DSA provided the students with access to technologies and study skills support.

6.3.2. Navigating the Support System: Disabled Students' Allowance

Once the students had received confirmation of their diagnosis, the next stage in navigating and establishing the appropriate support was through applying for the DSA. For many students, this involved discovering the implementation process of the DSA support structure aided by the university and the assessment of needs for technology provision from the access centres.

Overall, nearly all of the students received the DSA (n=18). The first difficulties faced by the students with the DSA was the 'processing time' taken to receive support and technologies. Some students reported that Student Finance England was the main reason why they were not able to make contact with the DSA to resolve their issues. Dominic, an undergraduate student, explained his frustrations: 'They are uncontactable. If you want to contact them, you go via Student Finance England, and they say, ''oh we'll get them to e-mail you back". That's useless. A phone call would help'. Dominic also adds that he did not receive his support and technologies until after 'four months of faffing around in a new city, a new learning environment trying to get something like this sorted'. Another student also suggested that the current system of the DSA is 'very undyslexic friendly' and 'un-customer friendly' due to the number of forms that need to be completed and submitted. Moreover, some students were also inclined to criticise the university for not making them aware of the process for applying for the DSA. One student, Emma, said: 'I feel a little disappointed because I flagged it up initially that I felt I was dyslexic, I don't feel I was given how to access it, so I feel a bit frustrated it was not made clear to me'. Another student, Jackie, also added: 'The whole system could be improved by just making it really obvious who you do it through, what you get paid back because the extra stress isn't helpful when you're trying to apply for Uni!'.

As part of the process for implementing the DSA, an assessment of needs for technologies and study skills provision was completed by an access centre for each student. From the needs assessment, students reported mixed views. Several of the students found the assessment process as being 'very informative' with the assessor engaging in 'loads of questions' and suggesting what technologies and support would be helpful. However, a number of the students reported more negative experiences. For instance, one student said: 'She wasn't listening, she didn't listen to anything I said, and I

just sort of gave up towards the end because I'm thinking, well you're just going to give me what you want anyway so what's the point of me asking'. The dissimilarity in students' experiences of access centres may be partly due to students' perceptions of the process and their inability to take control and describe what they need. This view is supported by one of the disability tutors who points out that these assessments 'vary from student to student'. The disability tutor also added: 'We encourage a student before they even go to the needs assessment to say to the needs assessor "that's not the kind of thing I use; think of something else". So, we try and empower them to not feel that they have to take stuff'.

6.3.3. Disabled Students' Allowance: Technology Provision

Once the students had navigated the requirements of their needs assessment, the next stage identified in their journey of support was receiving the technologies and provision. Despite some students highlighting issues around the process of the DSA and receiving their technologies, several of the students reported that if they applied early, they could 'get to grips' with using the text-to-speech and mind mapping software with their studies. Other students that applied for the DSA during their first year at university via the disability office described their experiences as 'helpful' and 'supportive', with one student being 'surprised of all the extra things that the university can give you for being dyslexic like extra time, computers and whatever… in exams'. More widely, the students reported receiving a range of technologies, including a laptop computer, printer, scanner, Dictaphone and assistive learning software, such as text-to-speech, speech-to-text and mind mapping programmes. As one student explained: 'Before I started uni I received a computer. I went for a desktop because I already had a laptop, and it came with Dragon® with some oral software to read out, some mind mapping software, the printer'. In

addition to the technologies, a majority of students also reported receiving wider provisions. For instance, Aidan described receiving '£500 DSA reimbursement allowance on papers, printing expenses or anything else that might support my learning'. Another student added that the allowance 'gave me all the technology I need to basically do my work… They also provided me [with] the insurances, guarantees with all my equipment and paid for any future licenses or anything I needed for my software or any upgrades'. However, only one student, Yasmin, identified not using the technologies provided to help support her studies: 'They gave me a computer package called, Read&Write™, err which I've… must say I've only used three or four times because it's not really what I needed'. Collectively, the variety of technologies and support provisions received by students was broad and reflected their diverse needs. For the university's disability office, they also reported offering drop-ins and workshops around exam techniques as well as unofficial mentoring. In addition to supporting British students eligible for the DSA, one of the disability tutors said: 'While we don't see an awful lot of internationals… we mirror what the DSA gives internally to

Vince's Experiences of Support and Provision

One of the oldest participants in the group, Vince initially worked as a bricklayer before deciding to go to college to study for his A-Levels. Currently, in his second year studying for a degree in youth and community, Vince was initially identified with dyslexia at college aged 52 years but later underwent a full diagnostic assessment at the university because there was no charge.

After applying for the DSA, Vince recalled that the process was 'very quick', 'all organised' and available two months after starting his degree. Describing the process as 'quite easy', Vince received a variety of hardware and software, including speech-to-text and mind mapping programmes: 'Dragon's my best one that I've actually got help with that… I'm never going to be no super typist so no, the Dragon® does help'.

When it came to receiving training in the use of the assistive software, Vince found the structure of the delivery unhelpful and too long: 'I mean he showed me, and I've struggled big time. It's just so time-consuming to actually do it when I've got a load of work to do within my assignments… I just found this very hard to actually do from a two-hour sitting with the person who explained me how to use the equipment'.

the students that don't get that, which I think is a good move that the university's done, we're not disadvantaging anyone that doesn't get the DSA'.

Following the selection and delivery of technologies, the students reported issues about how to use the software and integrate into their studies. This problem was primarily due to the poor quality of training when students received their software. One student, Lucas, said: 'They just basically show you the software, I mean the chap I had didn't even let me touch the keys. He was just doing it, I was just standing there watching, and even I know that's not how you're gonna learn'. Also, students highlighted that the intensity of the training sessions was too much for them to absorb and 'not hands-on enough'. One student said: 'It went out of my head after he'd left and I thought 'how do I do that now?', so there was no instructions, nothing really'. Despite some students not always accepting the training, the disability officer points out that it is important for students to break it into 'small sections, it's no good having two half days –it's too much. You need to break it down into four quarter days…'. Furthermore, general issues around the needs assessment and study skills support were also highlighted by several of the university's disability tutors. One of the disability tutors explained further: 'More students are being recommended one-to-one support whether or not they need that, I don't know if the assessment centres are recommending stuff regardless of need on that extent, um, but there's definitely more students coming through the system requesting it'.

6.3.4. Support in the Disability Office

The overall perception of support identified by the students was positive, with many students describing the disability office as 'pretty good' and 'amazing'. Only small numbers of students highlighted that it 'could be improved'. Some students held negative views of the disability office because of issues with self-confidence. For instance, one

student, Aidan, said: ‘There’s a lack of confidence and sometimes asking for support is an issue and having the main point of contact within the medical centre feels degrading’. The students also highlighted that their understanding of support could be distorted by the reflection of previous experiences at school and misconceived perceptions. As Emma described: ‘I think in theory the support they’ve got, seems reasonable, considering I’ve never had support before!... I think the process of it and the accessibility of it is of a poor standard. I’m not convinced yet that they truly want to support dyslexics, because my experience in life is that you are shoved out the way, so it makes you a little bit cynical when you’re my age, and you’ve had, I think, the experience that I’ve had’.

The students’ positive experiences from the university’s disability office were focused on their diagnostic assessments and tutor support. One student, Garrett, explained: ‘I think the university does very well, and when I went in to get my paperwork with my diagnosis, they were very accommodating and saying, “look, we know that you’ve got the technology, but do you want to have tutorials as well, because we can offer you tutorial times with either a personal tutor or drop-in sessions”’. The focus of support from study skills tutors was also emphasised by another student: ‘I’ve had so much support and so much help… obviously, I get my tutor every week, and it’s kind of like family. If I’m really struggling, I can go and see my tutor or just turn up and say, “help me, I’m having issues”’. In addition to supporting students, the disability office extends their assistance and expertise to providing dyslexia awareness training to teaching staff. One disability officer who delivers the training said: ‘We run dyslexia awareness training as well, which involves some tactics… but we encourage staff to come to us if they know they’ve got a student with any disability that academic year, we can talk through any immediate issues’.

6.3.5. Support in the Teaching Environment via the Tutor

Many students regarded contact time with their tutors as an important element of their studies. However, for unknown reasons, some tutors were not able to offer regular one-to-one weekly meetings with their students. Instead, several of the students relied on using their DSA-funded dyslexia tutor for regular support and advice. The mature students were identified as the most significant users of the DSA-funded dyslexia tutor. The dyslexia tutors supported students' learning through a range of strategies, including reading, organisation, proof-reading and composition. One student, Yasmin, highlighted her experiences in the panel below.

Early student introductions to their tutors were reported as an important factor. The sooner students discussed their difficulties and concerns; tutors could find solutions and ensure appropriate adjustments could be made. For instance, one student said: 'My tutors are definitely aware of it… she was aware of everything from the moment I came to the university from the UCAS signing sheet I put down that I had a learning disability and at the open day'. Another student, Garrett, who was required during Fresher's Week to complete a hand-written assignment, said: 'I haven't handwritten an essay for years now, but I just approached him [tutor] afterwards and

Yasmin's Dependency on Peers

Yasmin's parents were initially informed at a staff meeting that she was 'stupid' and that she would 'never amount to anything'. Determined to make something of her life with her mother's help, Yasmin was taken out of regular classes at primary school. However, she spent most of the time 'drawing all day' and not getting involved in any activities. She also said: 'As the fat kid… I always got picked on, but in secondary school, I was starting to find my way'.

Diagnosed at college on an access course before starting university, Yasmin described her dyslexia tutor from the disability office as 'very supportive' and 'always on hand via text or e-mail'. However, the support from her teaching tutors were somewhat more 'frustrating', particularly when asking for general information about assignments: 'I've e-mailed one of my tutors about three times, wanting some advice and she still hasn't come back to me about meeting up so we can go through it and she knows I'm dyslexic… I'm having to just look up what the outline says, talk to some of my peers; they're really supportive'. Yasmin explained that she is 'fed up' of saying she is dyslexic to her tutors but admits to still being 'quite dependent on people' for support.

said look, I'm dyslexic, is it ok if I just hand it in word-processed, and he was more than happy for me to do that'. Following receipt of diagnostic reports, several of the students identified that copies of their reports were provided to their tutor so they could begin to understand their difficulties and identify areas for further support. One student who gave their report to their tutor said: 'My personal tutor knows because I had to give him a copy of my dyslexia report, and he has made a lot of fuss about certain things to make sure that I get the support I need, which was amazing of him. He has also talked to people about my exam stress and things like that to see if I can get any help'. One tutor acknowledged that the report provided them with an insight into the support students need within a classroom environment, such as ensuring lecture notes are made available online early. Nonetheless, not all students that shared their diagnostic reports with their tutor described it as being beneficial or helpful. For instance, one student, Lucas, said: 'I approached my tutor and asked for her e-mail address so I could share the report and she said, "don't bother because I'll just forget, and I won't mark you down too much for it anyway", so she effectively marked my paper down before I'd even handed it in, …so when I went to hand it in I actually wrote at the top of the paper "dyslexic student"'. Although Lucas points out that the support he received from the dyslexia tutor was 'really, really, good' and 'very supportive', he often felt that his lecturers perceived him as 'faking it' with dyslexia as they 'really didn't care at all'. In contrast to Lucas's perspective, Patricia described her tutor as being 'very supportive' and explained: 'He remembers that I need extra time for my assignments… as well as giving me an extra day or some extra support or extra feedback to help me with my module work'.

Interestingly, only small numbers of students reported that they did not inform their tutors about their dyslexia. It could be suggested that students chose to do this to conceal their difficulties and to avoid an adverse reaction –an occurrence some students received

when they were at school. One student, Amy, said: 'I've been told that I should tell them, but I just haven't! I just think at school all my teachers were all like, "yeah you're stupid" so I feel like if I tell the tutors here, they might think that, so in a way, I just haven't told them… I'm scared of their reaction'. Another student also explained that he decided not to tell one tutor because he had a 'really bad experience'. He also added: 'My current tutor is unreliable and if you e-mail him, he won't respond, if you ring him he won't be there, if you arrange meetings he doesn't show. He's not exactly consistent'. The variation of support for students across the university was wide-ranging with some receiving better teaching and learning experiences than others. However, it was highlighted by the tutors that they approach students with dyslexia differently and work to resolve issues, so they remain fair. One tutor explained: 'I think you need to be very patient and give allowances for that, but we have to try and persuade students to take responsibility both for their learning and not be too over kind to them…'.

Overall, the more general support that students received from their tutors were from the access to course content provided online before lectures. In some instances, tutors provided access to lecture notes from the beginning of the term. Only one student highlighted that there was some initial resistance from their tutor when requesting access to online notes. The student said: 'The tutor very much felt that if they're available [lecture notes] to everyone then students just won't come in for the lectures which impart happens but on the other hand it can be made private so only those that need it get it…'. Some students also added that their tutors gave them 'special consideration' in lectures to use audio equipment to record their lectures. However, this varied among the tutors and some students reported not getting approval to use recording devices. One student explained: 'The tutors have quite often said no… there's one or two that say yes.

Majority, in my opinion, seem to tell me no, um, so I'm finding that a struggle. I really have given up now using it, I've given up asking'.

The views reported from the dyslexia tutors were that all students potentially struggle with the transition from school to higher education. However, the dyslexia tutors acknowledged that a student with a disability is likely to have an extra layer of problems to negotiate. One dyslexia tutor said: 'They have to suddenly become quite self-sufficient in going to the [disability] office and asking for support and filling out the form'. Although students with dyslexia often face a difficult time when starting university, one dyslexia tutor suggested it is because they are trying to 'navigate their way through the various systems to get funding', as well as finding their way to access the relevant staff. Another tutor described it is a 'very sharp learning curve in their first year… first term, a time when they are at their most vulnerable…'. However, the tutors recognised that the use of technologies could be integrated into students' learning as a way of placing them 'in control' and establishing a 'level playing field among students'. For the support of disabled students in general, the dyslexia tutors also suggested that it must be provided on a more 'individual basis' and identifying what the student finds useful.

6.4. Multi-Model Techniques of Technologies to Assist Writing

This final section explores the students' educational journey through university with dyslexia, presenting the explorative processes of how the students have used assistive and learning technologies in their studies to support literacy. The findings are presented around several themes: emphasising the students' engagement with utilising technologies to enhance the writing process; mind mapping organisation; speech-to-text technologies; and audio to enhance the learning experience. Each theme provides an insight into

answering part 3 of the research question: ‘what educational roles do assistive learning technologies play in the writing process for students?’.

6.4.1. Enabling Technologies to Aid Reading in the Writing Process

Many students reported the use of technologies to create mind maps and visual plans throughout their studies to support literacy and organisation. The students identified using several assistive learning technologies such as ClaroView™, ClaroRead™, Read&Write™, as well as other software built-in to their computers.

The process of reading and writing is a fundamental skill all students must continually employ throughout their lives to ensure they are successful and independent. Thus, enabling technologies for students with dyslexia can help improve the overall reading and writing process. For many students, they identified technologies and strategies for enhancing their learning experiences throughout the writing stages. One student explained: ‘In regards to my personal technique of constructing essays, I depend on technology a lot. If I try and do the essay straight almost from like no draft or prior planning I usually lack a concise argument, I lack structure, and usually, my language is very waffly and not concise at all’. As reading and writing are coherently interwoven, the students used assistive learning technologies through four stages to aid comprehension and writing composition with their assignments. The four stages are recognised as: (i) background reading and research; (ii) developing a plan with mind mapping; (iii) writing composition; and (iv) proofreading. The students described the four stages as being interconnected and reported navigating backwards and forwards to complete their assignments. The students used text-to-speech, digital colour overlays, Dictaphones, online resources and organisational software.

At the first stage, the students engaged with using their assistive learning technologies to support background reading. This enabled the students to establish a plan, usually in the form of a mind map or visual flow chart. One student, Todd, explained: 'I start with Read&Write™ to read the assignment and research articles to me and then I just use Mindjet™ to plan it out, typing and using Read&Write™ to listen to it back'. The students worked in parallel; developing a plan for their reading and research. Several of the students referred to the process as their 'essay preparation' and described conducting initial research online. Another student, Amy, also described starting with research capturing and making notes with their assistive software. Amy said: 'I'd start doing the research online with obviously the software that reads to me and then part of ClaroRead™, it will capture the site you went on so I can reference it straight away from that'. The gathering of references, notes and sources from readings were a process the students systematically followed through with the support of text-to-speech and organisation software provided by the DSA. One student described the process: 'I will use a ClaroView™ tool that will read the article for me and then if that is applicable I will use ClaroCapture™ which will then record the page I'm on and the time and date'. The use of text-to-speech was widely proclaimed by the students as being beneficial. They described it making them 'much more proactive' with their work and helping with their 'self-confidence'. Interestingly, some students also reported using their Dictaphones while taking notes from online journals and books. As Jackie explained: 'I use online libraries and usually take notes on a Dictaphone because I find this quite easy and concise. I can just read out the quote or area I wish to record, and I can use it later after putting it through "Dragon®", which I use quite extensively'. While reading was highlighted as a major issue among students, not all reported concerns. For instance, one student, Dominic, acknowledged reading at a 'reasonable pace', although he described his biggest

difficulties were ‘making notations’ and referencing correctly. However, to solve his problem going backwards and forwards to the sources when referencing, Dominic said: ‘I found that using Springpad, which is an online service very handy. I can just put the content into it very quickly; it’s quite visual’. In addition to students reporting the use of text-to-speech, several also identified using colour filters and screen rulers on their computers to help with the issue of line tracking when reading. Using ClaroRead™, Joe added: ‘The ruler keeps track of what words you are on and what screens because my track is so much worse on computer screens, but it keeps an eye on where I am’. The second stage, creating a plan with mind mapping, is summarised in the following section 6.4.2. It was identified as a prominent theme among students for creating visual organisation and meaning with mind maps.

At the third stage of the assignment process, it was identified that the students were involved in writing composition. Throughout this stage, the students were consistently referring to the original mind map, ensuring they had covered all the elements they had set out to complete. Describing the process as ‘drafting’, most of the students would focus their efforts on writing their assignments on the computer. Using assistive learning software, the students highlighted using text-to-speech software (ClaroRead™, Read&Write™) to regularly listen back to what they had written. One student explained: ‘I usually input the information via Dragon® and after I have got the first draft I will listen to it a couple of times, print it off and I will listen to it via Read&Write™ software, which allows me to see and understand the flow of the piece of writing. Allowing myself to refine it and make it more academic and scientific’. Another student, Amy, explained, ‘Once I’ve got enough notes, there’s like an essay planner on ClaroRead™ as well so then I put it into that, and I then put it on to Word and then start reorganising it myself’. The students’ process of reading, writing and then listening to what they had written was a

regular method used. Once happy with the style of the writing, the students would then begin the 'refining process' –the finishing stage.

At the final stage of the assignment process, the students emphasised the importance of editing and proofreading their work independently. The students identified making mistakes in their work by repeating and using the wrong words. For many students, it was a time-consuming process of completing all stages, often involving repeated processes and actions. One student explained: 'On average I usually have to do about 4 drafts until I feel that I am at a point where the style of writing is academic enough for me to then hand it in'. When it came to proofreading, the students reported checking the fluidity of the writing and grammar, particularly homophones. One student explained: 'I would check to ensure that it flows correctly and on top of that I then might check using ClaroRead™ for the homophones or if there is anything to think about and also the spellchecker'. Another student added that they use the text-to-speech when they 'need the extra help' as it ensures they are 'not skipping any lines'. Although some of the students used their technologies to help with proof-reading, several described receiving support from their friends or family to finalise their assignments before submitting. One student explained: 'Once I have done spellchecking and grammar checking, it is then time to make sure that everything I've written actually makes sense… I will send it back to my mom to reread it if I have changed large parts of it. I would then submit it myself after that'.

6.4.2. Creating Visual Organisation and Meaning with Mind Mapping

As the students progressed through school and into higher education, it was identified that those students introduced to learning support strategies early in their lives were most likely to be engaged in creating order and meaning with mind maps and visual plans. The creation of mind maps was usually one of the first stages in the development of

the students' assignments, often occurring in parallel with their reading or research. However, the findings suggest that those students that were diagnosed with dyslexia much later in adult life were much slower in the implementation of visual organisation and mind mapping support strategies. As identified in the Redwood University findings chapter, the majority of Owen University students also appeared to approach the construction of their mind maps from an initial three-stage process, including ideas development, establishing meaning and connecting ideas.

The creation and engagement of visualised mind mapping concepts were prevalent in this group of students, particularly among the younger students aged under 25 years. They identified using mind mapping software, such as ClaroIdeas®, Inspiration® and MindView™, to help support the creation of outlines for essays, scientific reports, planning and revision. For example, Aidan said: 'I started out by using the MindView™ software, I use this to create a map of what I was going to do next, and I've used it as a reference all the way through. Creating the basic structure of my thesis'. Several of the students highlighted that they would organise their ideas into sections to present the information in an accessible format, often forming lists. For instance, one student explained: 'For some assignments I use Inspiration® and draw out the criteria using a mind map —using it to explain everything I need to do as a "To Do List", connecting everything up and linking to relevant points'. Other students described the advantage of being able to 'move it [text] around in the way that I want' and 'flex things together' as 'one place where I can make notes where there aren't any boundaries to the page'. The use of icons and imagery with mind maps were also reported by other students as providing a stimulus for a 'checklist' of what they need to write. Sophia explained: 'The world image icon will remind me that I have to go to the Internet and do my research, whereas the spiral image reminds me of the things I am supposed to be doing and keep me

on track'. Despite most of the students choosing the use of digital mind maps to support their studies, only one student preferred to hand draw them. The student said: 'Primarily I will write on paper as I find it easier to hand draw out a lot of these [ideas], it's more tactile, and I just find it easier to use'. Another student also reported avoiding mind maps altogether: 'The mind mapping software wasn't any use… it's taken me so long to do this. I prefer when I write essays I very much write as I go and build the plan in my head as I go'. In contrast to using mind mapping software, students preferred the use of online versions of calendars and task planners to help with organisation or planning. For instance, one student, Dominic, explained that he prefers a more 'hands-on' approach that is both 'accessible' and 'flexible'. Focused around improving his time management skills —often an issue among many dyslexic students— Dominic implemented a more practical approach, as shown in Photo 2. He explained: 'Each colour is coded, the more visually striking, the more importance, so pink is university work… There is something about the physicality of it and the ability to push it over to the next day. It does rely on me being at my desk, but I take a picture of it'. For all students, not only those with dyslexia, the journey through university is about discovering new ways of learning and how to work independently.



Photo 2. Practical approach to improving time management skills with a 'tree-style' structure.

Overall, the typical methods that the students implemented when creating their mind maps were identified as three stages:

(i) Stage One – *Breaking down the information*

The first stage starts the process where students are 'breaking down' information and beginning to think freely. For instance, one student, Helen, said: 'What I do is break it down, so I get an understanding of what I am doing, so I break down all of the possible things I can think of and just let my mind flow'. Another student explained: 'I start by

taking the brief and then splitting it up into all different sections… once I have all the different sections which I need, I begin to add the tabs…'.

(ii) Stage Two – *Adding detail*

At the second stage, the students described 'forming the base of the essay' by 'giving order' and beginning to 'create structure'. At this point in the development of the mind map, the students are still constructing and adding the necessary detail to sections. The time taken to complete the stage can often depend on the subject and level of detail: 'I make it extremely detailed, so I know basically each sentence of every paragraph is in the mind map already. So, all I have to do is speak the idea into the software'. During this stage, the students described it as a process of 'meaning'. One student, Jackie, explained: 'In MindView™, I will put all my notes and points in order, so they make sense, it makes everything so much easier'. Other students studying science-based programmes also described using checklists to help complete laboratory report mind maps, as they often require a set structure. For example, one student said: 'I am constructing and ordering things in the mind mapping software by using a checklist, it helps me to balance everything out and to get the required detail in all the sections instead of just one or two particular areas, which are generally areas of interest'.

(iii) Stage Three – *Connecting ideas*

The final stage in the development of students' mind maps can be identified as connecting ideas to form a completed outline of their assignment. During this process, students 'draw up associations between the key points' and 'begin to link elements together'. For instance, one student said: 'Once I have completed the mind map I would then order it, create structure, add or delete any areas that I thought might be useful or not

useful and generally construct the essay from the mind map'. Several of the students emphasised that they created their mind maps 'extremely detailed' so each element 'links to every paragraph' and then 'it's just the case of putting it together and filling in the gaps'. Ultimately, the completed mind map acts as a plan or flow chart to guide students through a process of writing their assignments and ensuring they have discussed relevant parts of the essay question or brief: 'I just sort of use it as a plan and then I will just keep checking back to it to make sure I have referred to everything…'.

6.4.3. Effects of Speech-to-Text Technologies on Students' Writing

The most discussed topic of assistive learning technology among the students was the influence of speech-to-text software (Dragon®) on their writing. Overall, 17 students reported that they had engaged with using the software throughout their time at university, with some identifying that they had used it when they were at school. Despite many students being offered training with Dragon®, they did not always accept it.

Provided through the DSA and university, many students reported using Dragon® regularly to aid their writing, with only 5 students describing the software inappropriate for their studies. For those students identifying Dragon® as supportive, they described being able to 'speak from my mind instead of having to write it down' and 'record thoughts instantly'. Other students described Dragon® as helping them to 'quickly get my work into the computer'; a process of spontaneously capturing thoughts to form arguments and ideas. One student, Jackie, explained: 'I normally use Dragon®, so I just talk through my ideas as I struggle to get the words out from what I am thinking down to the keyboard. I find talking, especially at the very beginning really helps get what I need down instead of having to type every time'. Another student also described Dragon® as a 'huge help' and 'with short essays, I'll just put it straight through Dragon® and speak it

straight up, it's so much easier, and I can edit it straight afterwards'. Nonetheless, some students highlighted that while Dragon® helps with capturing their ideas quickly, they suggested creating an outline or plan first. Otherwise, speech-to-text can be 'a waste of time'. Furthermore, one of the biggest problems that stopped the students from using the software was the lack of quiet or private spaces available on campus. Joe explained: 'We desperately need quiet rooms in the library. Quiet, space sort of screened off or something so you could possibly use Dragon®…'.

For those students able to organise their verbal thoughts, the use of the speech-to-text software was identified as an ideal support tool. However, not all of the students found the software easy to integrate into their studies. Some of the students reported the length of time taken to train their voices before they could start using the software. For instance, Vince said: 'The first time I used Dragon® it took nearly two hours to train my voice, it takes so long to do, but it's amicable with me if I want to use it'. Another student studying for a scientific degree described the software not always

Dominic's Speech-to-Text Experiences

First diagnosed with dyslexia in year 2 at primary school, Dominic acknowledged that his mother discovered his dyslexia from her own experiences with the disorder. Despite receiving some support at primary school, Dominic described feeling 'segregated' as he was placed in an isolated class: 'The specific English classes did help, but some people were only there because they were getting poor grades… It was a bottom set not a dyslexia set'.

Engaging with some supportive technologies at primary school, towards the end of Dominic's secondary school he started taking his laptop to support his GCSEs and A-Levels, describing it as 'helping a bit'. As Dominic progressed to university he began to explore more supportive technologies: 'In University it's been a case of voice recognition, especially with Google® for my Android™ phone and through my iPad®. The voice recognition has been getting better and better…'. Although Dominic pointed out that 'voice recognition necessitates the requirement of a quiet environment'.

When it came to using speech-to-text software that requires pre-voice training, Dominic said: 'It takes far too long to calibrate and to get it set up… Apple® and Google® have managed to get this working almost perfectly word for word especially in sentences'. While Dominic sees speech-to-text software being used for note taking and capturing quick thoughts, he admitted that it can be a little more difficult when writing essays: 'It's impossible to write an entire essay by dictating it unless you've got it all on paper to begin with and then when you read it back you quite often stutter and stop and then it stutters and stops as well…'.

recognising specific keywords associated with his course. He explained: ‘Over the summer I picked up a couple of textbooks and just read keywords into the software. Anything I had to put in I just had to teach it, now I’m able to speak quite clearly, and it can recognise these words’. Moreover, some students also reported that the process of using Dragon® was a ‘steep learning curve’ and ‘slowed everything down’ when trying to navigate the rules of grammar through speech. One student, Diana, explained: ‘I’ve never understood the rules of grammar very well so using Dragon® and having to think where I’m putting a comma or a full stop or a semicolon –which I’m still not entirely sure what one of those is! It would take me an hour to do a paragraph, trying to put everything back in’. Interestingly, one student decided not to take-up the use of speech-to-text software as they felt it might de-skill them: ‘I thought that it would deskill me in a way because how am I supposed to get to know a computer and how to operate it if I’m not operating it ‘cause I’m not going to have to type and talk on everything I do… so I deliberately stayed away from that’.

6.4.4. Using Audio to Enhance the Learning Experience

One of the most significant problems reported by the students was ‘keeping up’ during lectures and seminars, and retaining the information during the sessions. However, to overcome this issue, the students described using Dictaphones to record talks and discussions from their classes to help enhance their learning experiences. For instance, one student said: ‘My lectures are fast paced. If you don’t keep up, “bye bye”, you know. Good luck sort of thing, so I record everything… my Dictaphone is always used in lectures, seminars, whenever I have something to do with the university. I’ve even been known to record my private meetings with a supervisor’. Another student also reported the difficulty of taking notes quickly, although when they came to read them, they were ‘a

mess… so being able to then hear it back and decipher what I've written is very useful'. Despite some students recording lectures and seminars without concern from their tutors, other students reported problems of not being granted permission to record in lectures.

Once the students had recorded their lectures and downloaded the audio files, they described using them to support their revision notes and enhance their written assignments. For instance, one student, Patricia, said: 'I would listen to them on my way back and forth to college as I drove home… my strategy was also to dictate my essays and the essay structures and then listen to that when driving'. Another student, Joe, spent the first year of his studies methodically organising recordings so he could quickly retrieve when needed for revision. However, as he progressed to year two, work pressures increased: 'As your workload increases, it's a case of I'll still record the lecture, I have the audio recording, but I'll come back to that when I need it… I won't spend the time of splitting the audio recordings because I can spend my time more wisely looking through notes and doing more further background reading'. Some students were provided with software, Audio Notetaker®, to help with combining their lecture presentations and recordings into one visual file. Thus, instead of the students taking notes during the lecture, they correctly observed what the lecturer was saying and used their Dictaphone to record. One student, Aidan, said: 'It's just made the process more streamlined. It's made it a lot quicker, and it's made it a lot more specific to my needs'. Overall, students reported that the software 'helped when revising for exams' and 'created an accessible environment'. One student recalled: 'I would transfer the audio files on to my iPod and listen to the lectures… revising at the same time and building up my conclusions that I could later work on… when doing everyday things, like running or cooking'. Similarly, small numbers of students also identified using an institutional system called Echo360. A process where lectures are captured (audio, video and presentation slides) and accessed

through the university's Moodle VLE. Students described the system as 'aiding their assignments'. One student recalled: 'You can look back at these recordings, stop and start on the screen and dissect what you were listening to… over and over again'. Nevertheless, one student, Yasmin, said: 'It's really good… when it works. Sometimes it doesn't work when they upload it… and it's quite frustrating!'.

6.5. Conclusion

This findings chapter has explored the educational experiences of assistive and learning technologies with a group of 20 higher education students identified with dyslexia and some of their tutors. It can be argued that influences from within families, such as parents or siblings' diagnoses, prompted the awareness of the disorder and led to a formal assessment of dyslexia for these students. Additionally, all of the mature and several of the younger students lacked access to assistive learning technologies early on in their lives. However, this did not limit their ability to integrate technologies into learning when they started at university.

The first section of this chapter highlighted that as compared to the mature students, the younger students were more likely to have received support and provisions at school and were more likely to have been diagnosed with dyslexia. The younger students were also more likely to engage with technologies due to their availability in school and in some cases, at home, provided by their families. The mature students who were not diagnosed or even recognised as having a learning difficulty by their school were less likely to have trust and confidence in their university education. This may be due in part to their previous experiences and their initial negative impressions of school. Thus, the mature students' resilience, support from families and friends and their ability to establish effective independent support strategies all played a role in overcoming their difficulties.

The differences in both the younger and mature students in the group suggest that the development of special education support and social acceptance of disabilities have helped create a more accepting environment for all students with dyslexia.

For the mature students and some of the younger students who did not have access to technologies until they started university, it did not lessen their confidence or ability when integrating technologies with their studies. Overwhelmingly, all of the students demonstrated self-motivation and determination to overcome their difficulties, particularly among the mature students who were focused on developing independent approaches to writing and managing their studies. Their attitude to succeed was often closely associated with the acceptance of the disorder and overall confidence in their ability to manage the disorder as a part of their lives. However, the younger students that did not receive support or diagnosis until university were less likely to experience this level of acceptance. This was due to being labelled 'stupid' and 'lazy' in their early school experiences, which translated to a fear of how their peers and tutors at university would respond to their disability. The younger group of students that did receive support and diagnosis at an early age did possess a more confident and positive perspective of their dyslexia. Thus, from this study it can be identified that intervention, support and provision at an early age can contribute to the positive acceptance of dyslexia.

The second part of the chapter presented four identified elements of the students' journeys through the discovery of support and provisions: (i) the diagnostic process of screening and assessment; (ii) the student support system; (iii) adaptation around technology provision; and (iv) support in the university environment. These four elements were fundamental in determining which environments are most suitable to aid students with the use of assistive learning technologies in their studies. During screening and assessment, half the students held back in obtaining a diagnostic assessment for two

reasons: the anticipated cost of a diagnostic assessment completed prior to university and the belief that they could manage independently. In the case of the latter, they often did not seek assessment until they were approached by a tutor who suggested their managing of the disorder was insufficient. Overall, the initial screening and assessment process helped set the scene for students' understanding of how technologies could support their studies. The second and third methods above revealed that the disability support and technology provision at the university, mostly funded by the DSA, was a key factor in providing nearly all students with study skills assistance and technologies to help their learning. However, despite providing wide-ranging access to support, issues regarding the implementation of the DSA and software training were raised by the students. Despite the students highlighting these issues, there was no indication of them abandoning the systems, processes, or not engaging with technologies. Instead, they instinctively carried on navigating and pursuing the support systems. Lastly, the sooner students discussed their dyslexia diagnosis or difficulties with their tutor, the earlier tutors could provide appropriate solutions. Initial student introductions and outlines of diagnostic assessments gave an insight into the kinds of support the students required. While supports varied, it was identified that many tutors provided course notes early in the term so their students could access them online. There was no indication from the students that they received additional teaching or tutorials from their tutors on a regular basis, even though this might have occurred among other students with disabilities across the university.

The final section of the chapter discovered the students' multi-modal methods of utilising technologies to assist their writing. While a number of different technologies were used in the writing process, the creation of visual organisation through mind mapping software was identified as being one of the first operations in the development of the students' assignments. It was recognised that students approached the formation of the

mind map through three stages: ideas development, establishing meaning, and connecting ideas to create structure. The use of mind mapping was particularly favourable among the younger students but was also widely used by all the students, as it allowed for flexibility and freedom to adapt information to their preferred style. When it came to the students completing their written assignments, assistive learning technologies were used to aid comprehension and organisation. Overall, four stages in this process were identified: background reading and research, developing a plan (mind mapping), writing composition, and proofreading. Overall, the writing process was overwhelmingly aided by mind maps, speech-to-text and text-to-speech literacy software, and the perseverance of the student to work independently. Nonetheless, some of the students did emphasise that it did take time to learn the assistive learning technologies and integrate them into their studies.

In all, the students' personal and educational background experiences influenced the use of assistive learning technologies in their studies. However, consistent support and provisions at university also played a leading role in guiding the students to engage with assistive learning technologies, particularly among those students who did not have the personal or educational opportunities when they were younger.

Chapter 7: Discussion

Experiences of Students Diagnosed with Dyslexia on using Assistive Learning Technologies

7.1. Summary of Study

This study has investigated an in-depth case study of the experiences of students diagnosed with dyslexia as they use assistive learning technologies for their studies at Redwood University and Owen University. While this study was not a comparative study, it attempted to illustrate how assistive learning technologies are broadly engaged during students' learning. The research questions presented for this study were:

1. How can students' personal and educational backgrounds enable them to use assistive learning technologies in their studies?
2. What disability support and provisions do universities provide to their students?
3. What educational roles do assistive learning technologies play in the writing process for students?

7.1.1. Chapter Overview

This chapter provides the reader with an interpretation of the main findings relating to the literature and theory and a discussion of how these findings contribute new knowledge to the research subject. The chapter begins by introducing a summary of the

research findings. From the presentation of data in the previous two chapters, the following sections discuss the conclusions drawn from the data in the previous two chapters and emphasises prominent themes as they relate to the research questions above.

7.2. Outline of Research Findings

From a qualitative approach, the study's data has been gathered from a series of semi-structured interviews with students and university staff, as well as diary logs and narrative task analyses from students. Overall, the findings contribute a wealth of knowledge concerning three areas:

1. Students' background influences can help enable their use of assistive learning technologies. The study identified early school experiences, family and personal strength as contributors to successful utilisation.

2. The integration and organisation of support and provisions are central to students' successful use of assistive learning technologies. The study identified interrelated themes around the screening and assessment of dyslexia and the implementation of the DSA for access to technologies and tutor support. The study also identified significant themes related to the ways in which students' engagement with technologies was shaped.

3. From interviews, diary logs and task analyses, several recognisable themes emerged from the data. Students used several multi-modal methods with assistive learning technologies to assist with their writing and organisation processes.

These findings are discussed further with the literature and theory answering the research questions.

7.3. Background Influences on the Adoption of Assistive Learning Technologies

While there has been a mixed array of literature concerning research in assistive technologies and SpLDs, there has been very little research exploring the contextual influences of higher education students with dyslexia. Furthermore, existing studies (e.g., Goodman, Tiene, and Loft, 2002; Pew Internet and American Life Project, 2004) have shown that several factors, such as education, socioeconomic status, attitudes toward technologies, and access to technologies can influence the adoption of technologies. However, there is little understanding concerning whether these environmental factors can affect students diagnosed with dyslexia and their use of assistive learning technologies. Thus, this study is well placed to explore and investigate whether and how students' personal and educational backgrounds enable them to use assistive learning technologies in their studies. The following themes help exemplify the significant ways in which students' backgrounds influenced their understandings of dyslexia and technologies.

7.3.1. School Support and Assistive Learning Technologies Enabling Students

In many cases, early diagnosis of dyslexia was due to intervention and acknowledgement of the label. Early diagnosis and therefore early access to support and provisions in school enabled students to more readily accept and adapt to a dyslexia diagnosis. A similar finding was reported by Hellendoorn and Ruijssenaars (2000) where Dutch dyslexic adults revealed that those with positive school experiences were more accepting of their disability. As discussed in the literature chapter (see section 3.9), one of

the benefits of receiving a dyslexia diagnosis is the suitable adjustment and support to the environment (Gallagher, 1976). It is widely acknowledged by several researchers (e.g., Lyon, 1996; Shaywitz, Morris, and Shaywitz, 2008; Snowling, 2013) that early interventions for children with dyslexia can help strengthen the basic foundations of literacy skills, alleviating all components of reading, including accuracy, fluency and comprehension. It is also likely that an early diagnosis and the introduction of initial support strategies and early interventions also had an impact on students' ability to use and understand assistive learning technologies.

However, a diagnosis of dyslexia becomes useless if no suitable interventions or strategies are implemented. In fact, as Macdonald (2010, p. 277) points out, 'the label becomes counter-productive'. Similarly, the findings of several mature Redwood University students suggested their early diagnosis appeared to have no significant positive impact on their school experiences. Despite being diagnosed privately outside of school during their early years, these students still experienced very challenging and difficult times at school. While their parents requested support, the schools at that time were not obligated and did not elect to provide access. Today, it would be expected that following a diagnosis, a child would automatically receive specialist support and intervention; however, this was not the case during the 1980s and 1990s. Singleton (2005) confirms that many children with dyslexia who were educated during the 1970s and 1980s have been widely affected throughout their lives due to the lack of appropriate acknowledgement of their difficulties.

Furthermore, it is important to acknowledge that some students decided to not publicly 'come out' with their dyslexia at school for fear of stigmatisation or being known as disabled. This mirrors several studies (e.g., Illingworth, 2005; Stampoltzis and Polychronopoulou, 2009) that recognise labelling an individual as 'dyslexic' or 'disabled'

may disadvantage them or undermine their confidence in ways that negatively impact their self-image. However, a study by Riddick (2000) suggests that while labelling can often lead to stigmatisation, it is not always the case. This variation could be due to context (Quicke and Winter, 1994). For example, some of the British home students in this study developed coping strategies with their parents at home, but remained silent about the disorder at school. This suggests that the British home students could have both an isolated and open usage of the 'dyslexia' label.

The absence of early support or intervention at school was most pronounced among the mature students of Owen University. The students did not generally receive a diagnosis and were only identified with the disorder because their parents or the occasional teacher intervened. Their experiences are consistent with the findings of Riddick, Farmer, and Sterling (1997) who point out that older students with issues around literacy are frequently not recognised as having a disability, even though their schools should provide allowances and support. Instead of thriving with proper supports, these students' perceptions of school were of those of humiliation and apprehension, and they were frequently anxious about how their peers would respond to their inability to read and write sufficiently. These perceptions have a direct affect on the students' experiences in university. As one student explained about early schooling: 'The environment just degraded you, humiliated you, and it was not pleasant to be in… my school report described me as 'a nice girl, not terribly bright, could perhaps be practical'. The research by Hughes and Dawson (1995, p. 181) supports the view that children's 'distressing experiences' at school can have 'long-lasting and deeply negative consequences' later-on into adult life. Nonetheless, the students were in some way able to resist the feelings of worthlessness and discover their own ways of fighting back. As identified by Singer

(2005), intent focus on academic progress and the struggle to fight against dyslexia can often help strengthen self-esteem (discussed further in section 7.3.3).

Both groups of mature students experienced an array of difficulties at school and into adult life. However, the findings highlight that over time, and sometimes with the help of their family (discussed in section 7.3.2), they all learnt to adapt and manage their dyslexia. Moreover, when technologies became available, they learnt to integrate them into their university studies without hesitation. The degree to which they were successful with this depended upon the individual's background and their personal views of technologies. These findings are similar to those of Deibel (2011) who suggested that individual background factors, such as socio-cultural, technical, economic and environmental, can influence adults' adoption and use of assistive technologies. Furthermore, these contextual factors are comparable to those of Gasparini and Culén (2012) where they acknowledge the influence of children's use of assistive technologies. The effect of background factors, specifically environmental, influenced both the Redwood University and Owen University students, and in both cases, early adoption of technologies was beneficial to students' subsequent studies.

It was highlighted that early private (sometimes with a parent) or specialist schooling was beneficial in introducing students to assistive learning technologies through self-knowledge and self-support interventions. Consequently, Kintsch and DePaula (2002) argue that for the effective integration of technologies to be achieved, an individual must navigate an adoption process. Thus, it could be argued that the advantages of early adoption of assistive learning technologies go beyond the technology and impart the skills necessary for dyslexics to successfully explore and assess processes for developing independent strategies. As LaPlante, Hendershot, and Moss (1992) point out, assistive technology devices enable individuals alternative ways of performing actions, tasks and

activities. However, while several studies and reports (e.g., Condie and Munro, 2007; Judge, 2006; Mioduser, Tur-Kaspa, and Leitner, 2000) highlight the benefits these technologies can have for young children with or without a learning disability, the Rose Report (2009, pp. 125-126) cautions that 'ICT should be seen as part of the solution and not the complete solution'. When provided access to technologies, children need to be supported and trained in how to successfully use the technologies, particularly if they are to be embedded in classroom routines. Beyond integration at an individual level, it can be argued that the best use of these digital tools is to use them as catalysts to enable innovations in instruction that benefit all learners (Rose and Meyer, 2000a).

One further finding that points towards background factors influencing students' use of technologies and the ability to implement support strategies was private education. From both groups of students (n=42), it was identified that those who had attended a private school at some point during their school years were more likely to have received support and provisions and engaged with technologies. Of the 9 students that received private schooling, 7 reported receiving access to either specialist learning support or access to technologies, or both. Whereas of the 32 students educated at a state school, only 10 students reported receiving access to support, provisions and technologies. While these findings present an insight into the range of school support and provisions received by the students, it also sheds some light on the impact private schooling can have on an individual with learning disabilities.

In all, Redwood University had the largest number of students (n=6) who attended a private school with an average diagnosis age of 14 years. The Owen University students (n=3) who attended a private school had a diagnosis age of 10 years. In comparison, the average diagnosis age among the state educated students (n=14) at Redwood University was 16 years, and at Owen University it was 21 years. Thus, it can be suggested that

private schooling can have a direct influence on early diagnosis. For instance, one Redwood University student, Gavin, who attended a private school from the age of 4 to 18 years, explained the level of support he received: 'There was always a specialist educational officer at every school I went to… In my primary school and senior house, I had a specialist group of people that help you… During my GCSEs, I'd have two hours a week with a specialist support officer'. None of the state school students reported an equivalent level of support or experience.

As reviewed in Chapter 3, despite a limited number of studies investigating SEN support within private and independent schools, one study by Burden and Burdett (2005) suggests that a school equipped with dedicated well-trained staff and small class sizes for pupils with dyslexia can achieve positive results. Due to many children with dyslexia encountering negative consequences related to self-development (Humphrey and Mullins, 2002), the private and specialist schools can be said to provide a more 'dyslexia friendly' educational environment due to increased access to early diagnosis, assistive learning technologies, and support that result in greater acceptance of the disorder (Humphrey, 2001). However, it is also important to acknowledge that some of the students who attended state schools also received a good level of specialist support.

7.3.2. The Family - Creating A Supportive Environment

Both groups of students emphasised the importance of the support of their families when attending school. While this research study did not explore the broader views of the students' parents, it suggests that through the reports of the students, it can be determined that parents play an influential role in schooling experiences. Overwhelmingly, all 41 students who were involved in the study revealed wide-ranging forms of interaction with their parents and/or siblings in supporting their dyslexia. Initially, several of the students

revealed that their parents played a key role intervening with the funding of a private diagnosis. Riddick, Farmer, and Sterling (1997) acknowledge that while parents can be seen as a source of pressure or anxiety for the need of their children to succeed, their roles can also be understood as essential for the belief in the child, especially when the environment outside of the family is unhelpful. Reid, Green, and Zylstra (2008) argue that the frustrations of parents can be in part down to the different agendas seen between home and school and, at times, the lack of focus and understanding on the progress of attainments. They propose that shared communication between parents and schools is essential for the needs of the child.

The findings suggest this to be a positive reason for ensuring that early intervention can help identify a profile of a child's struggles and strengths. The tensions and frustrations that can occur around parents and schools are related to the identification and assessment of dyslexia (Reid, Green, and Zylstra, 2008). Comparably, a study by Riddick (1996) exploring the experience of dyslexia with 22 families identified that the majority (n=15) of mothers were also keen to suggest that their child had dyslexia, even before teachers or other professionals. In many cases, students from both Universities revealed that when the students had a parent or sibling with dyslexia, it had a direct influence on their diagnosis as well as how they perceived dyslexia.

The basis of genetics in the occurrence of dyslexia in families has been widely debated as a key factor. As defined in Appendix A, researchers (e.g., Gilger, Pennington, and DeFries, 1991; Rutter, Tizard, and Whitmore, 1970) have identified that if a parent is dyslexic the probabilities of their child also being dyslexic increases. The findings from this study suggest it to be a considerable factor. However, it is also argued that the wider environmental influences are exaggerated by and interact with the setting or individual, as proposed by the Morton and Frith (1995) model. Thus, with the environmental influences

such as the school, teaching and educational support also influencing the anomalies of dyslexia, it can be suggested that the family-environment-education correlation are interlinked.

The parent's role in early diagnosis can prove beneficial for the child. The findings from both Universities suggest this to be true. For instance, those students diagnosed early with dyslexia were more likely to receive some form of 'hands-on' support from their parents or wider family. A similar finding by Hellendoorn and Ruijssenaars (2000), acknowledges that parents are frequently the first to recognise their son or daughter's problems and work hard to ensure their well-being is considered. On the other hand, Goswami (2008, p. 40) points out that early family environments are fundamental to a child's development where they can 'develop self-concepts that are secure, autonomous and based on self-worth'.

Several of the students revealed that their parents were professionally trained SEN teachers and could create individual learning programmes and implement coping strategies. It was acknowledged by the students that through their educational journey from school to university, their parents provided direct support with proof-reading, structuring essays and acted in the more general role of providing reassurance and self-confidence. Several studies by, Riddick, Farmer, and Sterling (1997) and Stampoltzis and Polychronopoulou (2009) support this finding, with students emphasising the wide-spread support they received with their studies and how it helped enhance their self-esteem. The support from students' parents also influenced their confidence, mostly in providing reassurance that they were not 'thick', 'lazy' or 'stupid'. The findings from this study suggest that the relationship between parent and son or daughter with dyslexia does not end in childhood. Thus, it is important that the support is continued into early adulthood.

Finally, despite some students lacking access to assistive learning technologies when at school, parents sometimes provided access to support students' learning. As discussed in the previous section (7.3.1), early access to technologies were beneficial to students' studies, and over time with the support of their parents, students were able to develop and refine their technology strategies. The early introduction of technologies from parents helped promote self-advocacy, independence, and self-determination among students. While there is limited research on the influence of parental support with technologies on dyslexia, Edyburn (2001) argues that students who are provided access to assistive learning technologies usually have parents with a strong view of promoting advocacy. However, a report by Russell, Stafford, and Sofres (2002), exploring the use of ICT for non-disabled children's learning and development, discovered that nearly 30 per cent of adults with children under 16 years stated they provided computers for supporting their children's schoolwork, general knowledge and development of computer proficiency. As different forms of technologies become more widespread, there is an ever-greater need to ensure young children with learning disabilities are guided to adopt the appropriate tools to help facilitate a journey towards independence. However, when considering technologies for a child, Judge (2002, p. 67) argues that with an 'increasing emphasis on family-centred early intervention, family involvement must be of paramount importance when planning for implementation of assistive technology'. Thus, although the consideration of technology is important, the integration, support and training provided to the child is also significant for their success.

Lastly, the findings highlighted the importance of parental involvement in a child's learning. The access to appropriate support and provisions can be closely aligned with the key research findings from the National Literacy Trust (2011). They acknowledge, from research since the 1980s, that families and parents are critical to children's attainment,

more so than family backgrounds such as social class and parental education. While this study did not explore these areas, it was evident that there were a variety of students from different social backgrounds. These variations in background did not appear to directly influence the kind of parental support students received. The National Literacy Trust confirms that the child's home environment is crucial, and parents have the greatest influence on learning and achievement and early interventions. Thus, as identified in this study, the parents' early introduction of technologies into the home environment can have a direct influence on the students' independence and confidence. As Maslow's Hierarchy of Needs (1962) confirms, individuals need to feel that they belong and are respected so they can influence their potential or self-actualise. Further research is needed in this area to thoroughly investigate the parent, child, disability and technology connection.

7.3.3. Motivation and Determination

From the previous discussions outlining factors that can influence students' dyslexia and their use of assistive learning technologies, this topic focuses on the inner-self of the individual. Firstly, it is important to note the distinctions between students' motivations and their determinations as they are inter-connected. For instance, the general motivation of all of the students was to become independent as they began their journeys discovering and learning how to manage their dyslexia. The determination characteristic of the students progressed from several origins: the desire to prove they were not 'stupid' or 'lazy'; the parental influence as a role model; and the aspiration to succeed in a specific profession. Equally, Reid and Kirk (2005, p. 41) acknowledge that dyslexic individuals are typically highly motivated, despite their apparent history of problems, difficulties and failures.

Students from both universities presented behaviours of motivation and determination in succeeding with their studies, although this was more prevalent among the mature students. Overall, the mature students motivated themselves to pursue a higher education degree as they were determined to prove their self-worth. They also had the mindset of wanting to learn and fully acknowledged the need to be resilient in the face of academic and social challenges (Yeager and Dweck, 2012). A study by Madriaga (2007, p. 404) also supports these findings, acknowledging that many students with dyslexia pursued higher education despite being discouraged in school, seeing it as 'an economic necessity or a place to prove their self-worth'. However, a description of one dyslexic higher education student by Mortimore (2008, p. 4) suggests that independent learning is made possible by success in three areas: (i) grit and determination; (ii) appropriate teaching methods; and (iii) discovery of learning style preferences that enable their strengths to compensate for their weaknesses. The findings from both groups of students suggest that learning styles and strategies from their parents and occasionally through school helped with maintaining motivation and determination. The exposure to various forms of learning approaches also enabled students to build an awareness of how they could independently support their university studies (discussed further in section 7.5).

Nonetheless, the findings also point towards some students' school experiences being destructive to their desire and motivation to learn:

> When I was in primary school like [there were] no problems, I was helped with absolutely everything. As soon as I got to high school, they refused to acknowledge the fact that I was dyslexic. My grades fell down and down. They kept telling me I was stupid. They said I wasn't paying attention that I'd never get anywhere in life. My self-esteem was very… it got lower and lower in high school. (Holly, Owen University student).

Several studies (e.g., Alexander-Passe, 2008; Burden and Burdett, 2005; Humphrey and Mullins, 2002) have presented that continued educational difficulties of children with dyslexia can lead to issues with self-esteem and motivational responses. As noted by Fasting and Lyster (2005), children's success at school in literacy is of vast importance to their motivation at school. Thus, the failure to gain the relevant support or attention, as described by Holly, results in the development of a negative self-image which in turn results in lower motivation and self-efficacy and lower effectiveness (Burden, 2008). For an individual with dyslexia and a history a negative self-image, it can prove challenging to achieve ambitions. A study by Graham, Schwartz, and MacArthur (1993) supporting these findings also revealed that the lack of motivation was the common reason why students with a learning disability had difficulties with their writing. While it is acknowledged that having a learning disability can prove challenging, it is the individual's motivation that is imperative in coping with the difficulties. The findings suggest that students' motivation and determination relate to environmental factors such as parental support and schooling, as previously discussed in this chapter. From the mid 1990s, several studies (e.g., Baker, Dreher, and Guthrie, 2000; Snow, Burns, and Griffin, 1998) have recognised that motivation is a fundamental component of reading achievement with parents playing a leading role in its support and care. Moreover, all students who reported high levels of interaction with their parents and wider family throughout their education showed high levels of motivation. A study by Wiseman, Emry, and Morgan (1988) suggests the reverse is also true; feelings of increased social alienation are related to decreased levels of motivation.

From the students continued persistence to learn and achieve, the findings suggest two important points. Firstly, motivation was a major factor in students' discovery and implementation of assistive learning technologies in their studies. This was true both for

students who were introduced to technologies when they were younger and students who adopted the technologies later at university. The students' enthusiasm and desire to incorporate the technologies into their studies was an important element in aiding learning and inquiry. In support of these findings, Scherer (1991), who developed the MPT (Matching Person and Technology) model, suggests that social factors can influence an individual's desire or ability to engage with technology. One of these factors is the lack of motivation to use the device or complete the task, with the environment and psychosocial setting also having an influence (e.g., Scherer *et al.*, 2005). Furthermore, a study by Goodman, Tiene, and Luft (2002) exploring the adoption of assistive technology for college students with disabilities, also revealed that the training programme, the technology provided and the characteristics of the individuals in the class appeared to contribute to the success of the experience. Thus, while motivation is an important behaviour for students to have for initial engagement of technologies, wider environmental influences also appear to shape these thoughts and behaviours towards technology.

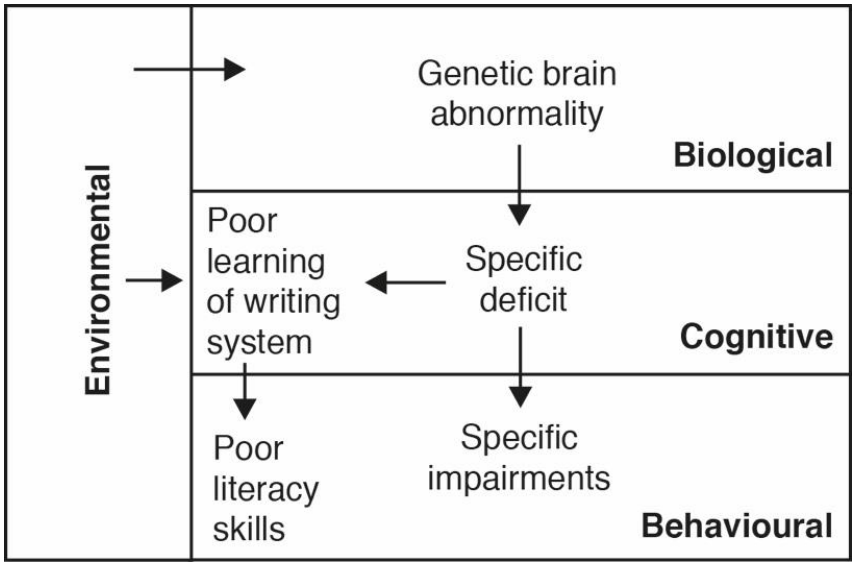
Secondly, the findings suggest that the continued use of technology compensatory strategies enhanced students sense of motivation and promoted feelings of independence and self-efficacy (discussed further in section 7.5.1). As outlined in Chapter 2 and 3 (section 2.5, 2.6.2 and 3.13), through compensatory technology strategies, students could achieve goals that added strength to their abilities and decreased the effects of their dyslexia. Several case studies by Newell *et al.* (1992) and Zordell (1990) share similar findings. They reveal that word prediction software can enhance independence and motivation, increasing writing and spelling among students with both learning and physical disabilities. While students' compensatory strategies are discussed later in the

chapter, from this section, it can be argued that motivation can play an important role in increasing students' independence through meta-cognitive strategies with technologies.

7.3.4. Environmental Framework Model for Assistive Learning Technologies

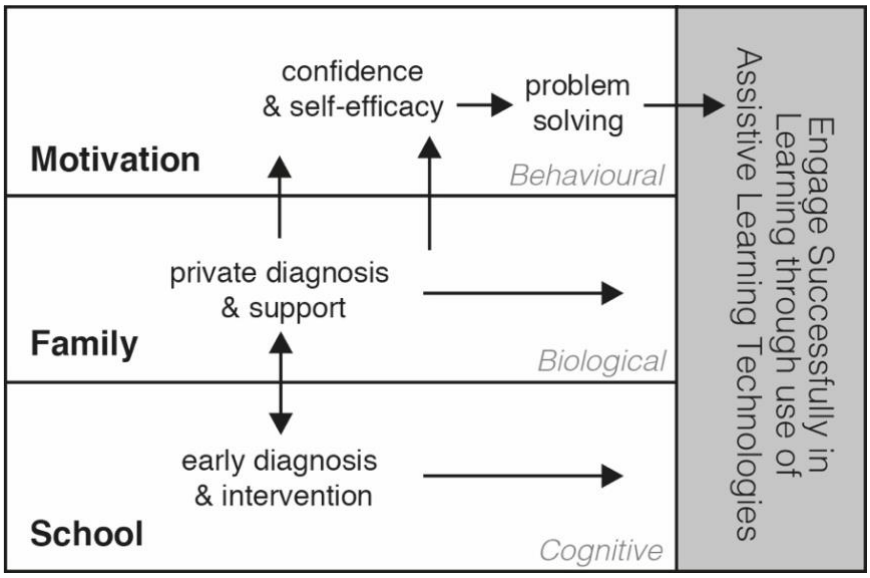
The findings suggest that students' environmental factors can have an influence on their use of assistive learning technologies. From the identification of environmental factors, the study proposes the foundation of a framework model (see Figure 14). The framework model suggests a theoretical understanding of the fundamental influences on the dyslexic individual and their use of assistive learning technologies. Drawing on theory, the causal modelling framework proposed by Morton and Frith (1995) (outlined in Chapter 2, section 2.8) offers a theoretical perspective to understand the causes of dyslexia across all levels: biological, cognitive, and behavioural. As Bishop (1997) acknowledges, these levels are influenced by the environmental factors and are likely to influence dyslexia. The three-stage causal model, illustrated in Figure 13, forms the basis for the proposal of the newly developed environmental framework model for assistive learning technologies.

Figure 13. Causal modelling framework diagram applied to dyslexia (Morton and Frith, 1995; Frith, 1997).



Formed from students' experiences of dyslexia and their personal, educational and family backgrounds, the environmental framework model proposes three levels. It demonstrates why some students lack the ability to engage with technologies to support their dyslexia. Bringing together the established theories of Morton and Frith (1995) and Maslow's Hierarchy of Needs (1962), Figure 14. demonstrates the framework model presenting school, family and motivation as key influences on technology engagement.

Figure 14. Environmental framework model for assistive learning technologies.



1. School – *Cognitive Influence*

The students' school experiences can be identified as having a cognitive influence on their dyslexia. Early diagnosis and learning intervention play a central role in understanding and acknowledging the disorder, which leads to self-efficacy and self-esteem (e.g., Glazzard, 2010; Humphrey, 2002). Longer term, early diagnosis and intervention can have a more significant influence on students' ability to problem solve. However, a diagnosis without any form of support is meaningless and does nothing to enforce confidence, acting only in a negative form. The school level should be used as a 'bridge' (Frith, 1999) for discovering students' family backgrounds and identifying if there are any self-esteem issues. Schools that provide excellent provision and support can remove the direct involvement from the family level. However, the student would still be required to be motivated and confident to engage with the technologies and would need to take responsibility and work hard in ways that ultimately lead to 'self-actualisation needs' (Maslow, 1987).

2. Family – *Biological Impact*

At the family level, students' parents are central to the process of seeking support and diagnosis, either through engaging with the school or privately. For any student that did not receive appropriate support or provisions at school, the family acts as the major support mechanism, providing coping strategies and technologies that can enable engagement as well as the development of reading comprehension skills (Snowling, 2006). In many cases, there is a high probability that the student will have a family member that is also dyslexic (e.g., Finucci, 1978; Pennington and Olson, 2005), and if they have recently been diagnosed, it can be an advantage.

3. Motivation – *Behavioural Affect*

'The whole individual is motivated rather than just a part of him'. (Maslow, 1970, p. 19)

As a goal-orientated behaviour, students' motivation is central to the need for achievement in engaging with technologies and developing a degree of independence to avoid failure. Influenced by both the family and school, motivation is the central component for the persistence of problem-solving and performance (e.g., Hung, Hwang, and Huang, 2012). According to Bandura (1986), motivational responses or human performance result from shared interactions between three factors: personal (e.g., biology, beliefs, expectations, attitudes); behavioural; and environmental (e.g., social and physical environment). Thus, the environment also has the potential to interact with the student's characteristics (e.g., confidence, emotions, prior knowledge) to condition how they behave and learn with their assistive learning technologies and education (Cook and Artino, 2016).

7.4. Integration and Organisation of Support and Provisions

The impact on higher education from the development of legislation in the UK has been transformative when it comes to access to support for a much broader group of students with dyslexia. However, few studies have looked at the landscape of dyslexia support and provision in universities and the detailed experiences of students navigating the environment for help with coping strategies and assistive learning technologies. From qualitative findings, this section attempts to examine and discuss these themes with the study's second research question: 'what disability support and provisions do universities provide to their students?'. The following themes characterise the integration and organisation of support and provisions from within the university around dyslexia and broader afield from government funding bodies.

7.4.1. Navigating Screening and Assessment

For students, the process of screening and assessment was the first stage in understanding their needs and navigating the support needed for their dyslexia. More than half the students from both groups were screened, assessed and identified with dyslexia while at university. The process of initially screening students was acknowledged by both university disability offices that used a structured system or dyslexia screening test to warrant a full diagnostic assessment. However, while researchers such as Singleton (2002a) and Fawcett and Nicolson (1998) propose the use of dyslexia screening tests, LADS or DAST, the Owen University dyslexia assessors found the LADS test to be 'not particularly useful' and only used it to demonstrate to students they were receiving a comprehensive assessment. The Redwood University assessors described using an outline structure, rather than a points-based rule. The reasons for these decisions were not explained. However, a report by Rodger *et al.* (2015), reviewing the support for higher

education students with SpLDs for HEFCE, suggests universities have cut back on screening due to resource intensity and the effectiveness of different screening methods not being clear. McLoughlin and Leather (2013) recognise that the use of dyslexia screening tests can be helpful in identifying individuals 'at risk'. They also emphasise that screening tests are not perfect. Furthermore, Harrison and Nichols (2005, p. 432) explored the use of the DAST test and also concluded that it 'appears to be limited in its ability to distinguish students with actual, well-documented SpLDs from those without any substantial history of learning problems'. The historical perspective of the students' underlying literacy difficulties is suggested by the Redwood University disability officer as an indicator of an ongoing difficulty that they often look for during the screening process. This also sits alongside one of the five elements from the DfES Guidelines (2005) required for a diagnostic assessment. Thus, as reported by the dyslexia assessors, the fundamental essence of screening is similar to Casale (2006, p. 69) who explains: 'screening is employed to identify which students are most likely to benefit from a full assessment, allowing for the effective allocation of resources'.

The findings from both groups of students suggested many similarities and a few differences when it came to referring students for a dyslexia assessment. One of the noticeable associations between both groups was the tutors' support and their influence on encouraging students to undertake a dyslexia assessment. Not all the students described their tutors as being supportive of their initial difficulties, but the majority of students did report tutors were understanding and responsive to any issues raised. Despite tutors not being experts in dyslexia, it did appear they had some knowledge and experience of what the known indicators of the disorder are. Tinklin and Hall (1999) suggest that students' experience of support, 'good or bad', can often depend on the tutors' awareness of their disability, either through their own personal experience or personal interest. However,

several studies (e.g., Holloway, 2001; Mortimore and Crozier, 2006; Singleton and Aisbitt, 2001) identify that tutors or lecturers appear to have a lack of awareness or understanding of dyslexia or have not received suitable training. Furthermore, one of the reasons why there are inconsistencies in tutors' awareness of dyslexia is suggested by Rodger *et al.* (2015) as being caused by a limited understanding of the problems associated with the disorder, particularly around assessment and identification.

It was also identified among both groups that some of the students initially held back from approaching the university's disability office for a screening or diagnostic test. Despite awareness of their difficulties, this study suggests that they learnt to adapt by developing their own strategies. However, their problems became more evident when their workloads increased and their tutors become aware. As outlined in Chapter 3 (section 3.9), Rodger *et al.* (2015) suggest that almost 30 per cent of SpLD supported students in higher education are those diagnosed toward the end of their first, second or third university year. Rodger *et al.* also points out that there is usually a 'crisis' in the student's life where they experience increased pressure and acknowledge the need for support. One of the biggest problems among the students was coming to terms with the problem and admitting they needed support. Shevlin, Kenny, and McNeela (2004) argue that the academic demands and the students' disabilities are a 'dual obstacle' they must learn to navigate carefully and overcome. Moreover, a students' reluctance and discomfort in publicly declaring their difficulties may also be a reason for not seeking support or a diagnosis early. Seale (2006a) adds that a student who has been living at home with family and friends, attending schools for many years within a supportive community, has been able to keep their disability a private concern. However, once the student is living away from home and studying in a different environment with new people, their disability starts to become a public issue and their privacy is lost (Shevlin, Kenny, and McNeela,

2004). In similar findings with those emphasised by students in the present study, Borland and James's (1999) identify that the process of becoming a successful student can un-intentionally strengthen disabilities, making them focus on their difficulties instead of the learning process.

For several of the students from Owen University, it was suggested that due to the anticipated cost of a diagnostic assessment, they waited until starting university so they could receive it for free and then apply for the DSA. One student only became aware an assessment was free through notices on campus. The students' perceptions of funding for a formal diagnosis of dyslexia originated from their previous experiences of funding in the mid-to-late 1990s. For instance, Riddick, Farming, and Sterling (1997, p. 17) reflect that at that time, the UK was muddled with a mixture of paternalism and self-advocacy. Some LEAs were paying for students to receive an assessment and support whereas others were not. Legislation during this time was limited (as outlined in section 3.3) and it did not go far enough in supporting the identification of individuals with learning disabilities (Disability Discrimination Act, 1995). Thus, the students and their families appeared to accept the situation and did not receive a formal diagnosis until it was provided for free by their university. Both universities acknowledged that they provided free diagnostic assessments to students. Redwood University funded the £350 per assessment, and Owen University required students to apply for the Access to Learning Fund (ALF). Despite the different processes for access to diagnosis, the findings suggest that it did not appear to have any direct influence on the students receiving an assessment.

The findings also suggested that several Redwood University students became aware of a dyslexia assessment through talking with their peers. Due to Redwood University being a collegiate institution, the findings indicate that this had an impact on the students being aware of the provisions and support provided to their peers. Living and

studying in the same environment led students to become more aware and informed of the diversity of the individuals around them. Redpath *et al.* (2013) point out that the levels of awareness from peers can have a direct bearing on the student. A case study by Mortimore (2013) exploring the inclusive culture of dyslexia in higher education also acknowledged that peers of dyslexic students often showed sensitivity, an understanding of the disorder, a willingness to offer support and respect for the use of compensatory skills. While the focus of the study was not aimed at exploring the relationships of students and their peers, it can be suggested that elements of the students' learning are also dependent upon the successful interpersonal relationship with peers, as well as academic and support staff (Harrison *et al.*, 2009). Due to limited research concerning the student–peer relationship and support in higher education, further studies are needed to explore this unknown community of support.

Overall, the findings from the two universities suggest that the majority of students viewed their experiences of obtaining a screening and diagnostic assessment through the disability offices as 'pretty good', and in some instances, 'amazing'. Only a small number of the students highlighted the support as being somewhat insufficient and 'could be improved'. These findings are presented and discussed from both positive and negative insights. Firstly, from students' more favourable perceptions, the findings acknowledge several elements that constituted these views such as support with disability staff in the completion and application of DSA forms, the organisation of assessments and arrangement of extra time for exams. As outlined in Chapter 3 (section 3.9), the support students acknowledged receiving was in accordance with the QAA (2010) standards, providing an overall core element of service to individuals with disabilities. The findings also suggest that the transformation and expansion of higher education from the 1990s with disability legislation (e.g., Disability Discrimination Act, 1995; SENDA, 2001;

Equality Act, 2010) and the increase in government funding has led to students with learning disabilities receiving improved access to support and provisions in an accessible environment. To measure this progression, an early study by Tinklin and Hall (1999) suggests that during the mid-1990s there were several barriers faced by students with disabilities, such as the physical environment, access to information and levels of awareness. A more recent study by Griffin and Pollak (2009) exploring student experiences of neurodiversity in higher education discovered more positive findings where the majority of students referred to the services provided by the disability office as being 'very good' and 'really helpful'. Moreover, the role of the disability office in helping to remove barriers from students' lives can also be closely aligned to those beliefs put forth by the social model of disability which proposes individuals be supported to become independent and equal with the ability to control their own lives (Goode, 2007; Oliver, 1996). Overall, it can be suggested from the study's findings that the disability offices provide a key role in the provision of support for students with dyslexia.

Finally, the less favourable student experiences from the findings were reported by only a handful of the students. They identified access to the assessment process as inadequate or 'could be improved'. Largely, the students' concerns were focussed around the time taken to get an appointment and the lack of communication from disability staff. For instance, one student struggled to contact disability staff after fresher's week, and it was not until six weeks later they received a reply. This delay impacted their provision for extra time in exams. Mortimore and Crozier (2006) and Goode (2007) also reached similar findings in their study with students expressing frustration at delays in having their needs recognised by the university. These failings in communication meant that in some cases, students became frustrated, particularly when trying to discuss appointment times. A similar study by Holloway (2001, p. 602) highlights the ongoing difficulties identified

by disabled students of receiving information and having to make 'the system' work with negotiating arrangements. The Equality Challenge Unit (2010) suggest several support mechanisms for disability staff to implement, such as holding regular induction events with prominent staff to explain levels of service and creating accessible online podcasts that outline the institutional provisions. Although universities may already engage in these kinds of awareness campaigns, Goode (2007) notes that cultural change in large institutions can be slow and requires continued monitoring and continuous 'effort'. Thus, it is important to note that students' journey from identification to assessment can be an intense and lengthy process, with each stage presenting challenges for institutions, particularly as students' progress to receiving their DSA (Rodger *et al.*, 2015).

7.4.2. Implementing the Disabled Students' Allowance for Access to Technologies

The findings from both universities indicate that the DSA was a significant factor in providing assistive learning technology provision and disability study skills support following the students' assessment of dyslexia. Together, technologies and face-to-face support for many students helped enable their independence and enhance learning. In total, 83 per cent of all students (n=34, including 3 international students) received the DSA with various levels of support. A further 3 from both universities were in the process of applying for the allowance. Comparably, 95 per cent of the Owen University students and 86 per cent of the Redwood University students were either in receipt of or in the process of applying for the DSA. According to Rodger *et al.* (2015), in most higher education institutions the DSA-funded support is estimated to account for more than half of the total SpLD support, suggesting that the SpLD funding model is significantly dependent on the DSA. Thus, in the need for universities to cover costs, disability offices

are keen for students to apply soon after a diagnosis, which may explain why a high number of students receive or apply for the allowance.

Overall, the range of assistive learning technology provisions provided to students were personalised, and they broadly reflected that students' needs were considered. The findings suggest that the DSA technology provision had a direct influence on their studies, particularly their writing, discussed further in following section 7.5. These findings are comparable to a survey by Draffan *et al.* (2013) where nearly 88 per cent of students reported the DSA having a positive influence on their studies. From both universities, students received a computer, printer, scanner, specialist software, such as speech-to-text (Dragon® NaturallySpeaking) text-to-speech (Read&Write™, CaroRead™) and mind mapping (Inspiration®, Mind Genius, MindView™), and Dictaphone. A review by Draffan, Evans, and Blenkhorn (2007) exploring assistive technology provision provided through the DSA to 455 students revealed that they also received very similar computer hardware and software. For instance, all students received a computer, and 76 per cent received both a scanner and a Dictaphone. Also, 70 per cent were provided with both text-to-speech and mind mapping software. Draffan *et al.* (2013) also reported similar findings with students overwhelmingly describing the technologies as 'useful or 'very useful', although concerns were raised around training. For some time now, these specific technologies have become standard equipment provided to students and as Chapter 3 outlined, research studies have found them to be effective for individuals with dyslexia. When some of the students requested devices outside of the standard provision, such as an iPad®, they were refused. According to one DSA Access Centre, Access2Learn (n.d.), devices such as iPads® or Android™ tablets can be recommended. However, there needs to be a 'suitable disability-related justification', with the funding body deciding on the evidence submitted. In the last 12 months, the funding of DSAs has changed considerably,

and computer hardware equipment is no longer entirely funded. Students are now expected to cover some of these costs. A further research study investigating the impact of these changes on students might uncover different experiences for provisions of support.

For international students, the findings suggest that they received comparable levels of support and provisions to those students funded through the DSA. At Redwood University, international students' confirmed that their experiences with support and provisions were comparable to UK students who received the DSA. While no international students took part in the study from Owen University, the disability assessor confirmed that they could expect to receive diagnosis support, equipment loans and study-skills drop-in sessions. Currently, there is very little research concerning the provisions and support provided for international students with dyslexia in UK universities. However, in a review of provision and support for disabled students, Rodger *et al.* (2015) point out that most institutions do support international students with SpLDs but not with the same level provided to UK students claiming the DSA. In contrast to the experiences of the three students in the present study, one international student from the review by *Rodger et al.* said:

> The university was very quick to tell me I had to have a test, but as an international student I was assessed first, and then I was informed I wouldn't get any funding. I was led to believe the university would pay, but in the end, they said they could not fund my support as an international student. It is a shame they didn't tell me that before the assessment. I did get support, but not the extent of support that I was led to believe. So, that needs clarifying. (M, International SpLD Student).

This student's experience demonstrates that there are very distinct differences between the funding arrangements of international students across higher education. Although the 3 international students in the present study show comparable support to their peers receiving the DSA, this too small number from which to draw definitive assumptions.

However, findings from the disability offices suggest support and provisions were similar among all students with dyslexia, particularly Redwood University.

As discussed in Chapter 3 (section 3.7), the needs assessment is an essential stage for students in exploring the kinds of technologies they need to support their difficulties as well as receive training. However, the findings revealed that the students from both universities experienced mixed views, primarily around the provision of training with software. For those students that experienced less satisfactory training and failed to engage with the technologies, it can be suggested that the intensity of the training was too much for the students to absorb in one session. Smythe (2010) points out that this can be particularly troublesome for individuals with dyslexia where memory and information overload are frequently a problem. Furthermore, the findings also suggest that the absence of sufficient training, such as 'not being hands-on enough', was also an influence in the students' dissatisfaction with using the software to support their studies. If students are not presented with a clear, definitive structure of learning objectives within a set time-frame after receiving the software, they are unlikely to consider using the software. A study by Goodman, Tiene, and Luft (2002), exploring the effectiveness of training in the adoption of assistive technologies among college students with a range of disabilities, revealed the need for specific training programmes to support access and skills in using technologies. While several researchers (e.g., Diraä *et al.*, 2009; Lange, Mulhern, and Wylie, 2009) accept that sufficient training in assistive software is needed to ensure students understand its full capabilities, dividing the training session into smaller parts, potentially through online training videos, would be more suitable. From the findings presented in Chapters 5 and 6, a two-way process between the student and assessor would have been helpful to ensure effective technological scaffolds were organised for each student (Price, 2006).

Although only a handful of the students studied reported abandoning individual pieces of software, the literature suggests that issues of technology abandonment can be much deeper than just a lack of training. For instance, factors such as moving to a new environment to start university and dealing with the demands of independent study can play a role influencing how students respond to training and can influence engagement with assistive software. The demands of higher education can also cause considerable stress (Gilroy, 1997), and combined with the effects an inefficient working memory (Jeffries and Everatt, 2004), it can create the cognitive burden of an additional learning process that acts as a barrier to technology use. Nonetheless, for the majority of students, their dissatisfaction with the training did not appear to hinder their use of the technologies. The students continued to find their own way forward in using the technologies with some students being supported through their study skills or by a dyslexia tutor.

In contrast, it can be suggested that those students who experienced more favourable training with their technologies were encouraged to do so by asking their assessors questions. Some of these approaches are recognised by Klein and Sunderland (1998) who suggest that an effective learning programme for dyslexic adults should be appropriate to the individual needs and goals of the person and enable them to take control of their own learning. Moreover, it can also be suggested that the personal characteristics of the students were factors in influencing their decisions to adopt the technologies. As discussed in section 7.3, background factors could also play a role, particularly students' previous experiences of technologies and training as it could provide a deeper understanding of the process and what to anticipate. Equally, Draffan *et al.* (2013) also conclude through their research that students who understand the benefits of assistive technologies are more informed of the needs assessment process and value the benefits of training more.

7.4.3. Tutor Engagement and Support

An important factor for both groups of students was the engagement and direct support of their tutors. The findings revealed that students from both universities had different forms of tutor engagement to support their studies. Firstly, many of the Owen University students received study skills support in the form of a dyslexia tutor provided through the DSA. Secondly, the majority of all students' teaching-based tutors played a central role in delivering and creating a supportive educational environment to enable learning. However, it was the Redwood University undergraduate students who experienced higher levels of engagement through weekly tutorials. As the findings revealed two different perspectives of tutor engagement and support, these are examined separately.

Overall, the majority of students described their study skills support provided via the dyslexia tutor as 'very supportive' and they 'could not manage without their tutors'. The findings suggest that this was more frequent among the Owen University students who appeared to rely on weekly study skills sessions to support their writing, organisation and provide general encouragement to their studies. It emerged that a higher diagnosis age among the Owen University students is linked with an increase in the need for dyslexia support at university. This is largely due to the mature students not being identified/diagnosed with dyslexia when they were younger and consequently not receiving any appropriate interventions or coping strategies. As outlined in Chapter 5 (section 5.1.1) and 6 (section 6.1.1), the diagnosis age of the Owen University students were higher in comparison to the Redwood University students. This was due in part to Owen University having a higher number (n=6) of mature students of 30+ years. While the majority of the mature students gained access to university through an 'access' foundation degree, their studies in higher education were often enhanced through their

dyslexia tutor. Reid and Kirk (2005, p. 97) point out that many adults with dyslexia are often unaware of how they learn and therefore maintain the same 'inappropriate learning pattern throughout their life'. Thus, when they do embark upon a university course, they find it particularly difficult. One-to-one support through a dyslexia tutor can aid the transition to learning with study skills support. As McLoughlin and Leather (2013) point out, such difficulties of executive functioning among adults with dyslexia often require a slightly different method of teaching which centres on the process of learning, specifically meta-cognitive skills. One of the dyslexia tutors acknowledged that study support is a two-way process when working with students, and support must be conducted on an 'individual basis' in a way that includes discussing requirements to ensure support is relevant and specific difficulties can be accommodated. A research study by Kirwan and Leather (2011) exploring university students' views of dyslexia study skills also recognise that the delivery of strategies must be negotiated repeatedly between the tutor and student. They suggest that a consistent and respectful approach to acknowledging achievements and focusing on the weaker abilities requires further development.

For students engaging with a dyslexia tutor, the findings suggest that their intentions of receiving support were to become enabled and acquire independent strategies. It is a process that Kirwan and Leather (2011, p. 40) describe as 'co-operative learning' where the student works together with their dyslexia tutor 'clarifying their thinking and the requirements of the task' and enabling them to work independently for their academic work. This approach from the dyslexia tutors suggests why both groups of students did not find their dyslexia tutor useful. Depending upon the students' early support and experiences, they may have already acquired the basic meta-cognitive skills such as time-planning organisation strategies and essay-plan diagrams. Thus, any study skills sessions would prove unnecessary and only further frustrate the student.

Research by Hatcher, Snowling, and Griffiths (2002) highlights the distinct differences between dyslexic adult students and their non-dyslexic peers who have persisting difficulties that affect their study skills. They argue that higher education institutions need to recognise students' study skills so suitable support programmes can be implemented. Given the proposed cuts to funding the DSA for the 2017-18 academic year, the students in this present study who received DSA tutors would only receive support if their needs were deemed more complex (Taylor *et al.*, 2016, p. 368). Thus, as Taylor *et al.* notes, universities will be required by law to 'employ strategies to remove the need for support workers and encourage greater student independence' (p. 368). For those less wealthy universities, support would probably be reduced below the level of the DSA and disabled students' experiences would suffer.

The second element of findings around tutor engagement and support highlight that the majority of the students' teaching-based tutors played an important role in shaping and supporting their learning environments. Initially, the findings suggest that the sooner the students contacted their tutor, the sooner they received appropriate support. The students' introductions to and discussions about their difficulties with tutors were usually positive. In many cases, tutors expressed an understanding of the students' disability and knew where to obtain support in the university. Some of the Owen University students' previous negative school experiences with identifying their dyslexia to teachers contributed to why they chose to remain silent at university to avoid a confrontational reaction. As discussed earlier in the chapter (section 7.3.1), early school experiences of these students can remain highly problematic, and students have been described by Pollak (2005) as arriving into higher education with emotional 'baggage'. However, while there were a handful of students not receiving appropriate support at school, the lack of support did not deter them from persevering with their studies. This contrasts with the findings of Griffin and

Pollak's (2009) research study which found students experienced negative attitudes towards their disabilities, particularly from some higher education lecturers. It could be argued that while the findings from Redwood University and Owen University did not report widespread issues among students with academic staff in comparison to Griffin and Pollak's study, universities and wider society are moving towards becoming more accepting and understanding towards dyslexia. The introduction of disability legislation (e.g., Equality Act, 2010) and higher education access entry courses for students with learning disabilities between 2000-2010 have contributed to increased numbers of students studying with dyslexia. At this time, dyslexic students make up 5.6 per cent of the student population (HESA, 2014; 2016). Nonetheless, as discussed in Chapter 3 (section 3.8) and as the findings suggest, there is still some scepticism about dyslexia among tutors. Some of the consequences of the tutors' personal views and attitudes meant students had to look beyond them and navigate their own path towards support. Thus, it is essential for universities to deal with these situations with care and on an individual basis, and where necessary, provide training and guidance for tutors.

Following this, another important finding was that regular tutoring sessions had beneficial results to both the students and the tutors. The regular tutorials were described by some students as 'beneficial' towards their learning as they could engage with their tutors verbally rather than in writing. The students' engagement with tutors was also a significant factor in improving their self-esteem in learning and engagement. Additionally, the more personal contact students had with their tutors, the more aware the tutors became about the specific manifestations of the disability, its effects on individual learning and the effectiveness of various supports. Researchers such as Tinklin and Hall (1999) and Riddell and Weedon (2014) acknowledge this relationship to be an important factor in successful support, as the tutors' personal understandings and sympathy towards

students can influence the level of teaching and engagement. These findings are also consistent with those of Ahluwalia (2009) who confirms that dyslexic students are likely to benefit from regular or extra tutorial sessions. By meeting regularly with students, Ahluwalia gained 'first-hand experience and knowledge', including gaining new ideas for support such as providing PowerPoint presentation lectures on a blue background. It should be noted, however, that while this benefit was identified among both groups of students, it was more prominent among the undergraduate Redwood University students who received regular weekly tutorials. This could indicate that frequency and regularity of tutorial sessions has an influence on how beneficial the student-tutor relationship is to both parties.

Nonetheless, not all the Redwood University undergraduate students found the tutorials beneficial, with small numbers describing it difficult to engage or follow the direction of the conversation. These difficulties of cognitive ability (specifically verbal and non-verbal ability) are often described and associated with dyslexia. Several adult studies (e.g., Callens, Tops, and Brysbert, 2012; Swanson and Hsieh, 2009) emphasise that dyslexics do not perform as well as non-dyslexics on measures of verbal memory and working memory (Singleton, Horne, and Simmons, 2009). Thus, the issues around working memory could be a factor in the processing and manipulation of information in a tutorial based environment for students with dyslexia. However, it is also important to acknowledge that some of these cognitive difficulties can be attributed to all students, including non-dyslexics. For example, a study by Hatcher, Snowling, and Griffiths (2002) identified that dyslexic and non-dyslexic students were equivalent in general cognitive ability, utilising verbal and non-verbal processing. Moreover, Elliott and Grigorenko (2014) argue whether dyslexia should be considered as a condition that is identical to or different from a reading disability. Elliott and Grigorenko also question if the fundamental

cognitive processes are significant enough to be markers of dyslexia, or if it is preferable to focus mostly on core academic skills.

Finally, the findings emphasised the importance of both groups of students receiving accessible teaching material in advance of a lecture and suitable format. Several of the students highlighted the importance of being able to access the lecture notes through the university's LMS in advance of a lecture. The process of notetaking among students with dyslexia has been recognised as being potentially challenging (Mortimore and Crozier, 2006). Several researchers acknowledge the need for providing lecture material in advance (e.g., Mortimore, 2013; Taylor, Duffy, and England, 2009) as this enables the student to not only adapt the font, colour and size of the text, but it provides easier access when using text-to-speech readers. Given that some of the students acknowledged difficulty with visual stress, specifically Irlen Syndrome, they were able to use coloured filters on their screen to aid their reading. Thus, to accommodate students with disabilities, many universities in the UK now encourage lecturers to ensure all notes and teaching material are available online. However, some of the students did report issues with tutors not willing to share access to notes in advance of a lecture. Cornett-Devito and Worley (2005) and Diraä *et al.* (2009) point out that some tutors are reluctant to share notes in electronic format as it might give students with dyslexia an unfair advantage over other students. It is also argued that it may reduce attendance if students can easily download notes in advance (Riddell and Weedon, 2006). However, a study by Gerrard (2007) exploring the role of the VLE for students with disabilities concludes this to be not the case. The students from the present study that received lecture notes via the VLE described it as 'important'. Thus, attendance was meaningful and the VLE did not substitute the face-to-face contact with tutors.

If tutors are simply repeating their notes in a lecture-style presentation, then students will most likely stop attending. The importance is to add more flexibility to teaching and try and involve the audience. Additionally, the findings also suggest that tutor's views were mixed on the students recording their lectures. While the Redwood University disability officer stated that, 'students are allowed to record lectures personally or even tutorials as long as the other students are happy', some students from Owen University were declined permission to record. Further research is needed to explore these experiences; however, Riddell and Weedon (2006) comment that intellectual property among tutors remains a concern as they do not want content shared without their permission.

7.5. Multi-Modal Methods of Assistive Learning Technologies

Through the growth of digital learning and the broader provisions of assistive learning technologies across higher education, student access to enabling tools has never been greater. Nonetheless, very few studies have explored how these technologies have shaped the learning and writing process of university students diagnosed with dyslexia. From the findings of students' semi-structured interviews and narrative task analyses, this final section discusses several themes, answering the study's third research question: 'what educational roles do assistive learning technologies play in the writing process for students?' The following themes present an understanding of the various multi-modal methods students use with assistive learning technologies.

7.5.1. Integrating Assistive Learning Technologies with the Writing Process

An overwhelming number of the students from Redwood University (n=17) and Owen University (n=20) reported using assistive learning technologies to support their learning. However, these findings suggest that the Owen University students appeared to show a more significant scaffold structure in their engagement of using the assistive learning technologies with the writing process, whereas the Redwood University students tended not to follow a strict structure, preferring to start writing and using technologies intermittently. As presented in Figure 15, students developed a series of stages with their writing that allowed them to integrate technologies. Overall, the Owen University students used levels of scaffold learning through a variety of technological techniques that enabled stronger understanding and greater independence. Reid and Kirk (2005) propose a structured outline of the writing process but emphasise the importance of splitting it into manageable sections. Understood as a Vygotskian approach, scaffolding provides a structured learning environment where a task or action can be completed with the assistance of technologies (Rapp, 2005; Vygotsky, 1978). The discussion of Owen University and Redwood University findings are explored together, presented as identified stages from the writing process, and where noted, similarities and contrasts between the two groups are highlighted.

i. Gathering of Information for Comprehension and Organisation

Through the first identified stage of composing a written assignment, Owen University and Redwood University students approached their writing through a means of background reading and organisation to establish an outline. Figure 15 presents an overview of students' processes for the writing process matched with assistive learning technologies and style of support offered. During the writing process, the findings suggest

that the students gathered references and notes, and systematically used their technologies (e.g., text-to-speech, colour screen filters and Dictaphones) to aid comprehension. Consistent with Price (2006) and Smythe (2010), the initial cognitive processes of writing composition include capturing the information in a digital format that it is suitable for the student before they prepare a plan. The findings from both groups of students suggest that online access to course material can help increase and enhance written assignments. A similar finding was discovered by Blankfield and Martin (2002) where a period of regular access to lecture notes by higher education students with disabilities was found to aid learning and understanding, as well as to enable the creation of more meaningful notes. Mortimore (2013) adds that teaching adjustments to include lecture material available on a VLE can enable students to choose the preferred medium to engage and learn. Further, findings from the Owen University students suggest that Echo360 also influenced students' ability to revisit lectures and aid their written assignments. In line with other research, a case study at McMaster University by Vajoczki *et al.* (2010) exploring lecture capture discovered that the majority of students with learning disabilities reported the lecture recordings enhanced their learning. The advantage of reviewing content and exploring lectures would have helped improve students' understanding as well as enforce and clarify difficult concepts.

With an understanding of their subject, the findings revealed that both groups of students used several technologies through various forms to aid note taking and capturing of digital content. Through the use of cloud-based organisation software such as Google Docs™, Springpad and Evernote, the students developed their own learning strategies to overcome problems. Some students engaged in learning on the move through mobile devices and apps, instead of using the computer-based assistive software. While only a handful of students engaged in learning through a mobile device, in the future this may

increase. For instance, the Office for National Statistics (2014) reports that Internet access for adults via mobile phones doubled between 2010 and 2014 (from 24 per cent to 58 per cent). Chmiliar and Anton (2015) described the iPad® as a mobile assistive technology for students with disabilities and described it as the next generation of learning. They revealed that students were starting to move away from the standard computer-based assistive software to using iPad® apps. Several assistive technology apps are available from Texthelp™ and Claro Software™, and it is likely that by 2030 students and higher education institutions will be moving towards a more integrated approach of using mobile devices with self-directed learning environments.

The findings also suggest that students used text-to-speech and colour to aid reading. These are discussed in the following sections to avoid repetition.

Figure 15. Overview of students' processes for essay writing identified from the findings and represented with assistive learning technologies used and style of support offered.

Students receiving no direct DSA-funded study-skills support	Students receiving the DSA-funded study-skills support
1. Collection of information - identifying books and articles from reading lists	1. Gathering of notes and readings from online journal articles and books
1. Technologies: text-to-speech, text editors, VLEs, cloud spaces	**1. Technologies: text-to-speech, text editors, VLEs, mind mapping, Dictaphones, screen rulers, colour filters**
2. Planning of essay through pre-designed templates and mind maps, as well as relying on personal reflections and lecture notes from tutors	2. Developing a plan with mind mapping software, followed through with a three-stage process: ideas, development and connection
2. Technologies: text editors, mind maps, text-to-speech	**2. Technologies: text editors, mind maps, text-to-speech, Audio Note taker**
3. Composition and writing of essay through computer text editor and some assistive learning technologies	3. Composition of writing, referring to the mind map to ensure all elements are covered and drafted; supported with assistive learning technologies
3. Technologies: text editors, mind maps, text-to-speech	**3. Technologies: text editors, mind maps, text-to-speech, speech-to-text, screen rulers, colour filters**
4. Proofreading and some editing assistance with friends	4. Editing and proofreading through repeated processes and actions with assistive learning technologies
	4. Technologies: text editors, text-to-speech, screen rulers, colour filters

ii. Creating Visual Order and Planning with Mind Mapping

For establishing a basis for an outline of written assignments, the findings reported that most of the Owen University and some of the Redwood University students progressed through to the second stage of their writing process by engaging with the visual elements of mind mapping. Mind maps were identified as beneficial in organising thoughts and navigating around large amounts of text by 'thinking visually' and creating a visual representation of information. Mortimore (2008) describes the mind mapping tool as invaluable for storing or revising information and reports that once students are confident, they are able to use the tool for all elements of their studies. As discussed in Chapter 3 (section 3.15.3), the visual organisation of information is an important process for students in creating the capacity to learn independently. The findings suggest that mind maps encouraged students' engagement in learning and helped to develop their writing techniques and ability to write more confidently through the organisation of large amounts of text. Thus, it can be argued that the students' preference for using mind maps is due to their ability to engage with a specific style such as visual or tactile learning (Budd, 2004) to problem solve, as opposed to the standard process of constructing ideas through comprehension and information processing. Personal preference could account for some of the students preferring a more physical approach of creating mind maps on a classroom whiteboard while other students could not get to grips with using mind maps at all. It can also be acknowledged that throughout the various stages of education some of the students were taught visualisation strategies. This aided the processing of information and revision by associating pictures with verbal and text-based processing, influencing the thought process and possibly the ability to use mind maps. However, an individual case study by Engstrom (2005, p. 38) exploring literacy and concept mapping identified a link between a visual learner and mind maps, suggesting that the student could make sense

from text patterns. Engstrom identified visualisation as a 'powerful comprehension tool'. While there have been many discussions regarding learning style, in particular Coffield *et al.* (2004), the findings point toward the students having a universal approach to learning depending upon the context. In some cases, however, this can be influenced by the visual organisation of teaching methods. Further research is needed to explore the impact of learning strategy methods on students with dyslexia and the impact on technologies.

Overall, mind map usage was most prevalent among the Owen University students under 25 years. The findings suggest several reasons for this. Firstly, the visuo-spatial tool of mind mapping supports the students' style of learning, making it easier to process and interpret visual information. Also, Owen University had a higher rate of students accessing a DSA-funded dyslexia tutor that provided support strategies in study skills, organisation and writing composition. More broadly, learning environment and the age of the students could also be factors, although further research is needed to explore this insight. However, it can be said that while the mature students learnt to use mind maps, the learning process was slower and usually involved navigating their support network first. For all students who used mind maps, the findings discovered that the students appeared to follow a three-stage process when composing them: ideas, development, and connecting. Each stage is discussed separately in more detail below.

1. Ideas

The first stage in the process is the breaking down information to form the basis of the topic. The students approached the use of a mind map to bring together their ideas and shape the structure for a detailed 'essay paragraph plan'. Mortimore (2008) adds that many students with dyslexia appear to belong to one of two categories when producing written work; they could either be so overwhelmed with ideas that their minds go blank

when presented with a screen, or they have so many ideas that they simply do not know where to begin. The findings suggest that these students were the latter category. Using the mind map to help contain their thoughts in an organised structure provided a trigger to 'set them off and free them' (Mortimore, 2008) so that they could begin to express information in their own way. However, this stage of activity can be time-consuming, particularly as the students focused on freely associated connections. During this initial process, the findings also highlighted that the use of computer mind map software programmes enabled students to easily move content around and place links to digital files on their computer. In a reflection of concept maps for use in education, Novak and Cañas (2007) imply that computer software programmes enable the 'moving of concepts together with linking statements and the moving of groups of concepts and links to restructure the map'.

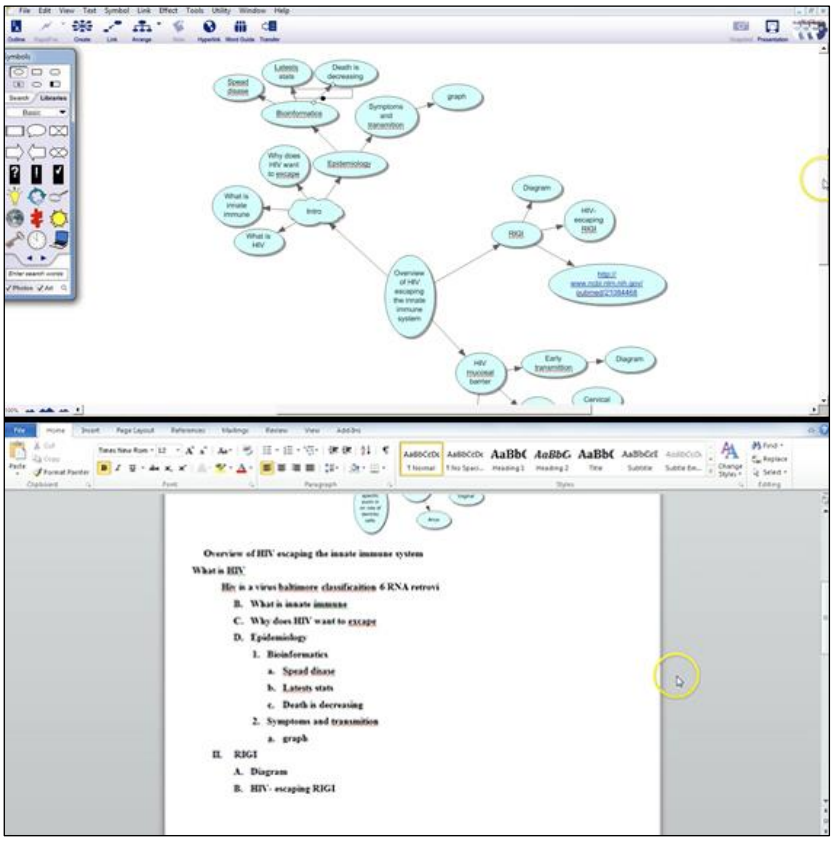
2. Development

At this point in the process, the students seamlessly progressed to the second stage by developing their mind map further. The findings revealed that the students are starting to add additional detail to their ideas, a progression of 'meaning' and 'restructure'. One student from a case study of dyslexic writers by Price (2006) shared similarities, describing that they use a mind mapping tool to create a flowchart of an outline of their ideas to help establish a content plan. It can also be understood that students are connecting with ideas and research, creating a template so they write more effectively. Equally, Mortimore (2008) also points out that during the process of ideas development, a writing frame usually starts to emerge and can substantially aid a student with dyslexia in completing their assignments and revision. Figure 16 demonstrates a students' process from mind map structure to writing frame.

3. Connecting

At the third stage, the findings indicate that the students are advancing their mind map to a complete and coherent structure with all the key points ready to be advanced during the writing process. The students are finalising their mind maps with arguments and merging course readings to support their ideas before they export as a text-based writing frame –a feature now common in most mind mapping software programmes such as Inspiration®. While Mortimore (2008) acknowledges that writing frames can limit the potential for thought, like mind maps they can be used as a scaffolding technique to progress the student through various levels. The findings suggest that students followed a step-by-step scaffolding learning technique, enabling a stronger understanding and greater independence in writing structure. Moreover, in line with Price's (2006) findings, the students' use of the mind mapping software developed into a 'technological scaffold' that enabled them to engage at various levels, providing support for their cognitive weaknesses.

Figure 16. From top to bottom image: demonstrating a student's process from a mind map structure in Inspiration® to an exported writing frame in Microsoft® Word.



iii. Writing Composition with Assistive Learning Technologies

The findings reported that both groups of students progressed towards writing composition, the third identified stage. However, between these two groups of students there were distinct differences. The Owen University students strictly followed their plan ensuring all elements were completed, whereas many of the Redwood University students preferred to begin writing as soon as possible, with one student even preferring to hand write instead of using a computer. While it could be argued that non-dyslexic students follow a similar process when undertaking essay writing, research by Kirby *et al.* (2008a) concludes that university students with dyslexia have a different profile of self-reported learning strategies and study methods compared to their peers without dyslexia. Thomas,

Englert, and Gregg (1987) point out that students with learning disabilities who do not have a plan follow an associative technique where they often write anything that comes to mind. However, Sturm and Rankin-Erickson (2002, p. 124) suggest that students with learning difficulties often deal with writing as a 'question-answering task', expressing 'whatever comes to mind'. Research in line with the findings on the importance of planning by Chalk, Hagan-Burke, and Burke (2005), confirm that skilled writing is partly due to the student's ability to plan before composing. The findings illustrated that both groups of students' composition of writing were based around word processing software with other assistive software, i.e., text-to-speech, operating independently or in parallel. While an advantage to all students, not just those with dyslexia, Johnson and Carlisle (1996) acknowledge that the use of word processing could enable students with learning disabilities to focus on difficulties with structure, organisation and clarity of writing and support better reading.

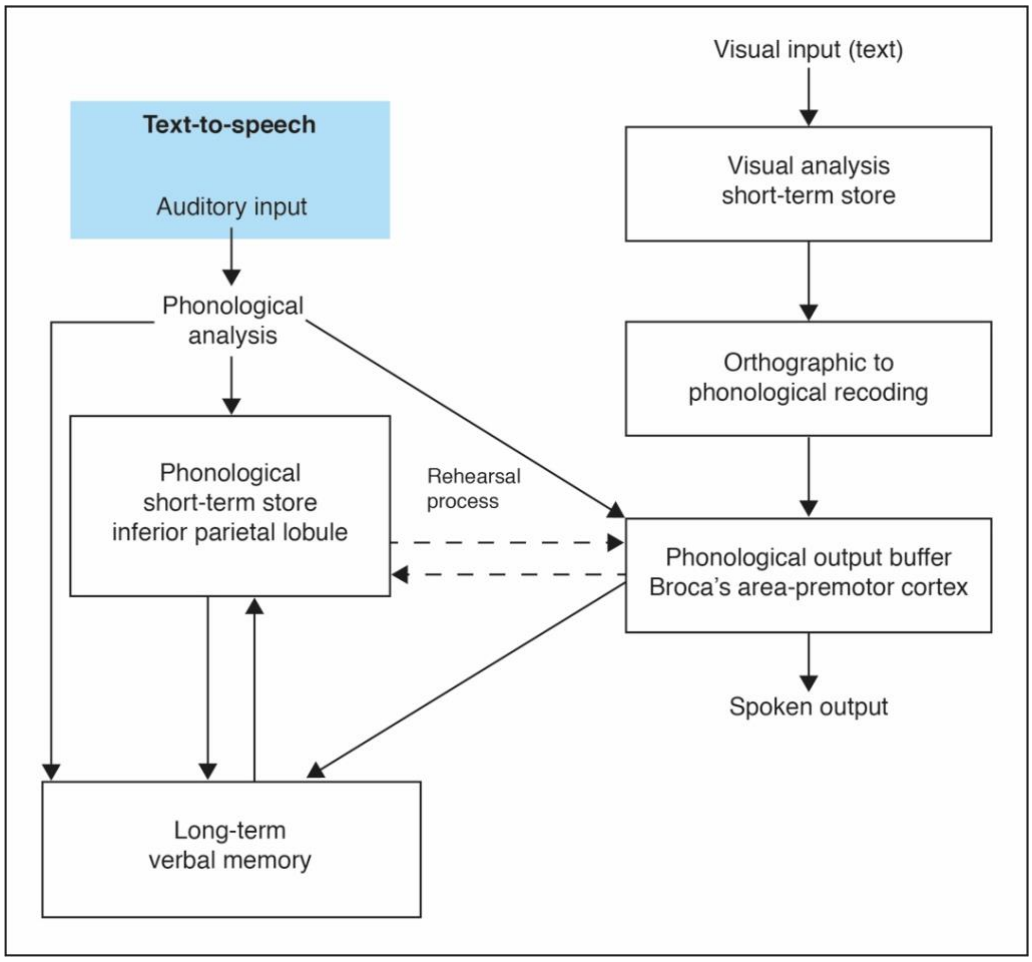
The Redwood University students reported varying approaches and perspectives on writing their weekly essays with many preferring to begin writing. Overall, their integration of assistive learning technologies was varied and individualised to their own way of working. Figure 15 presents an overview of students' writing processes. For some of the Redwood University students, the findings suggested that they preferred to continue using 'hands-on' practical learning strategies. It could be argued that these 'tried and tested' strategies were an important factor in their previous academic achievements and provided the confidence for students to continue using them. Lerner (2000) acknowledges that efficient learning strategies are a major factor in the academic achievement of students with learning disabilities. Although some of the Redwood University students gathered information to form the basis of their essays through mind maps. It appears that most students used the technologies as an add-on to assist their writing, moving between

different stages with no uniform scaffold process. Thus, it could be argued that a lack of a scaffold structure among the Redwood University students might be due to their cognitive weaknesses being not as severe as other students, such as some of the Owen University students who appeared to have greater cognitive difficulties and engaged in more detailed levels of scaffolds. While some of the Redwood University students acknowledged that they faced challenges with structuring their written work, they devised their own templates and reference documents to aid the process. As discussed in Chapter 3 and apparent from the findings, the ability to use a variety of technologies can increase the level of independence among students with dyslexia (Rapp, 2005). Further, it can also contribute to the facilitation of learning, raise motivation for participation in learning as well as aid in the development of compensatory strategies for managing difficulties (Wolfe and Lee, 2007). Given the intensity of the reading and writing activities that the Redwood University students had to complete each term, the findings reveal they used a variety of support strategies that had previously proved successful in enabling them to manage academic assignments.

The initial strategy adopted by many of the Owen University students involved the engagement of different assistive software programmes where they were frequently moving between them to complete their writing. Due to reading and writing being so closely associated, students engaged with auditory software to support and enhance both aspects of literacy. As explored in the literature chapters, if the auditory information is presented to the individual, it is processed and sent via the phonological loop to the central executive for storage. However, for visual (text) information to be understood, it requires orthographic to phonological recoding. A process where words or letters are sub-vocalised in the short-term memory, combining interaction between the phonological buffer and the short-term phonological store (Kelly and Phillips, 2016), as shown in

Figure 17. With dyslexia, it is understood that one or more of these processing steps is lacking or not working correctly. There is also a long-standing array of literature suggesting that dyslexics, in addition to underlying issues in short-term memory, have difficulties in storing phonological information in their long-term memory, as well as retrieving it once it is stored (e.g., Hulme and Snowing, 2009; Jorm, 1979; Snowling, 2006; Swanson, 1999a). Thus, this could explain why the Owen University students were navigating back and forth between text writing programmes, text-to-speech and mind mapping software to gain a sufficient understanding of information. As shown in Figure 17, auditory input from text-to-speech software would directly avoid the impaired phonological buffer and be directly processed by the long-term memory via the short-term phonological store. Equally, Engstrom's (2005) case study research suggests that through supporting instruction with assistive software, representing concepts and patterns in the text, it can help expand ways students understand and process the written language. It can also be contended that the structured scaffold approach adopted by many of the Owen University students with the integration of technologies could be due to a higher cognitive need or weakness. Individuals with dyslexia require instruction that considers and addresses limitations with their processing speed, working memory and general reading performance (Johnson *et al.*, 2010). Thus, the findings have shown that assistive learning technologies have the potential to pair its functions with the needs of the student and the demands of the task (Silver-Pacuilla, 2007).

Figure 17. Phonological loop model by Baddeley (2010), adapted and mapped with assistive learning technologies.



Furthermore, to support the development of writing, the findings suggest that the majority of the Owen University students and a handful of Redwood University students found the use of speech-to-text software beneficial for creating notes and recording ideas quickly. With many students acknowledging that they face difficulties with writing and spelling, the use of speech-to-text software enabled them to compensate by dictating their thoughts. The students' successful use of speech-to-text software suggests that they probably had strong oral language skills. Engstrom (2005) supports this view and highlights oral language as an essential component to support writing with speech-to-text

software. The findings from the study also identified the importance of the students creating a plan or outline of thought before using the speech-to-text software as it helped direct their writing. A similar finding was concluded by Raskind and Higgins (1999) who describe it as a 'scaffold activity' where the first five minutes before using the software are outlined or rehearsed. One of the most significant drawbacks identified from the findings to using speech-to-text was the level of voice training required by the students. Both groups of students suggested the training element slowed them down, particularly those students who had to train the software for specific scientific words. The issue of training speech-to-text software is noted by Ball, Rainger, and Draffan (2005) who argue that dyslexics can have problems reading accurately, particularly when needed to read aloud, thus presenting a challenge when training the computer to recognise their voice.

There are several reasons that may explain why the Owen University students were more prominent users of speech-to-text compared to the Redwood University. For instance, the findings suggest that while some of the Owen University students had used the software at school and readily accepted training, the Redwood University students, on the other hand, tended to show less enthusiasm. The lack of interest was prominent among those recently diagnosed with dyslexia. However, the findings highlighted that an unfamiliarity in the software due to a lack of training and the steep 'learning curve' was a barrier to engaging. Draffan, Evans, and Blenkhorn (2007) recognise similar findings from their research, adding that students' perceptions of speech-to-text software could be dependent upon their personalities, expectations of the software and ability to learn and understand the software. One further issue that also influenced the Redwood University students' adoption or acceptance of technologies was the timing of receiving the software from the DSA. The findings suggest that faced with a shorter academic term than the Owen University students, the Redwood University students did not have time to invest in

training half-way through their academic studies. A review exploring the provision and use of technologies for students with dyslexia in Europe by Ball, Rainger, and Draffan (2005) suggests the development of training platforms where the student can have greater autonomy in the learning environment and appropriate level of support.

iv. Editing and Proofreading Process

Identified as the final stage in the processing of writing, the findings suggest that both the student groups were involved in editing and proofreading their essays. However, this was far more prevalent among the Owen University students who described the importance of checking for mistakes. Primarily, the findings imply that the students used their assistive learning technologies to check for spelling, punctuation and grammar, particularly homophones, as well as utilising text-to-speech to listen to their written work. Used as compensatory tools, these findings share similarities with Lange, Mulhern, and Wylie (2009) who acknowledge that proofreading using an assistive software homophone tool is not only beneficial to students with dyslexia but also those with weak reading skills. Smythe (2010) makes the point that the proofreading stage is, in fact, a scaffolding process broken down into three stages: spellchecking; grammar checking; and proofreading. While the Owen University students were perhaps not aware of these methods as they progressed to completing their essays, the findings suggest that they are automatically checking their spelling and grammar as they write with computer word processing software. Several studies (e.g., Collins, 1990; Johnson and Carlisle, 1996; Hetzroni and Shrieber, 2004) have concluded that word processors can enhance the academic outcomes of younger students with disabilities. A longitudinal study by Owston and Wideman (1997) for non-disabled students with and without access to a word processor identified that those using word processing considerably improved their writing,

leading to increased motivation. However, Vue *et al.* (2015) raise the issue that by merely providing word processing software to the individual is not always the solution. Some students may need to be taught or develop writing instruction and planning and developing strategies for the software to be useful. Further, the findings also suggest that one of the advantages to using the word processors by the Owen University students was the ability to have their essays read back to them via text-to-speech software to check the fluidity of their writing. In a survey by Fidler (2002) exploring higher education students' use of text-to-speech discovered that the majority preferred using the software for proofreading. The research by Raskind and Higgins (1995) sheds further light on why the Owen University students may have found the text-to-speech software beneficial. They discovered that students revealed more errors in the text through text-to-speech software compared to having it read to them by another person and reading it themselves. In comparison to the Owen University students, one possible reason may be the software highlighting and isolating individual words to help improve reader focus.

In addition to text-to-speech aiding proofreading and overall literacy, the findings also conclude that the use of colour overlays used on the computer or worn by the student as glasses, aided their ability to engage with reading and writing. While this was more prevalent among the Owen University students due to several being diagnosed with Irlen Syndrome, the Redwood University students also experienced issues with following text on a screen and visual sensitivity. In comparison, similar findings were revealed by students with dyslexia in a case study by Price (2006). She recognised that coloured acetates and individualised coloured computer backgrounds helped reduce visual stress when reading. It could also be argued that because text-to-speech software such as Read&Write™ have them incorporated, students are naturally using colour filters. Nonetheless, the origins of dyslexia have long been associated with a visual processing

deficiency in the magnocellular visual system, although the causal debate between dyslexia and visual stress continues to be explored. The findings from this study equally suggest, in agreement with Kriss and Evans (2005), that individuals with dyslexia may have two problems when reading: the visual perceptual distortions of Irlen Syndrome (Wilkins *et al.*, 2001) and the phonological processing deficits connected with dyslexia (Snowling, 2006). With this is in mind, several studies (e.g., Grant, 2004; Evans and Joseph, 2002) reveal distinct similarities with both dyslexia and visual stress symptoms. However, this research study does not have a quantifiable result to suggest the increase in reading speed with colour filters can benefit some students with dyslexia. A study by Kriss and Evans (2005) shares similar findings that coloured overlays can improve reading speeds compared to the non-dyslexic control group.

Nevertheless, in contrast to the overall findings of the Redwood University students, they appeared to demonstrate fewer overall scaffolding techniques and require less face-to-face support. While one or two students highlighted the importance of regular study skills support, it did not appear to be a wide-spread problem among this group. Thus, a question remains as to how the Redwood University students, all diagnosed with dyslexia, became so confident and successful in supporting their writing in comparison to the Owen University students. The findings suggest the answer is highly complex and that several factors must be considered. Firstly, as already established at the beginning of this chapter, students' environmental influences such as family and school can play an important role in supporting and understanding dyslexia. These influences would have certainly had an impact on their literacy ability to write successfully at university, particularly those that received early interventions. However, it can also be argued that some of the Owen University students also received similar interventions, but overall their level of scaffolding with the technologies was greater, suggesting they experienced increased

cognitive processing difficulties. Thus, a second factor considering the wide-ranging spectrum of dyslexia (e.g., Snowling and Hayious-Thomas, 2006) could be a reason why some students are successful in specific areas where others are not. As already discussed in detail in Chapter 2, there are varying levels of dyslexia with every dyslexic individual having a unique profile of strengths and weaknesses. The diversity of dyslexia and how it manifests itself in different individuals (Björklund, 2011) remains a central challenge for researchers to discover (see Ramus, 2014). Finally, students' varying levels of intelligence (IQ) could also play an important part in their ability to problem solve, comprehend complex ideas and learn quickly. Although a complex area, researchers such as Conway *et al.* (2002) acknowledge that there are significant connections between 'general fluid intelligence' and the theories of short-term memory capacity, working memory capacity and processing speed. Thus, it could also be suggested that some of the Redwood University students may have above average or high IQs in comparison to other students who required a greater need of support and compensatory strategies with assistive learning technologies. As reviewed in Chapter 2, the review by Rose (2009) recognises that dyslexia is on a scale with no clear cut-off points and occurs across the intellectual spectrum. Further, Thomson and Gilchrist (1997, p. 42) argue that many students' IQs fall within the 115 range, with only small numbers of the 'academic elite' with an IQ over 125. However, Thomson and Gilchrist suggest that when an individual within the average range has dyslexia, it can be a 'crucial issue' and 'severely compromise' their education, particularly if it is not managed or supported appropriately. From the continued discussion that dyslexia is unrelated to intelligence (e.g., Frederickson and Reason, 1995; Siegel, 1999; Stanovich and Stanovich, 1997), it can be argued that individuals with dyslexia have high, middle or low IQs, similar to the rest of the population.

The following chapter concludes this study by summarising the overall findings, discussing the limitations, outlining the need for further research and presenting the overall unique contribution of knowledge.

Chapter 8: Conclusions

8.1. Introduction

This final chapter concludes the journey of the study by exploring and examining the experiences of higher education students with dyslexia and their use of assistive learning technologies in their studies. The chapter begins by drawing together the key findings of the study and presents the unique contributions to the field. The following sections present an evaluation of the study concerning the influences that could not be controlled, limitations that may have affected the findings and suggestions for future research.

8.2. Summary of Findings

As discussed in the introduction chapter, from my personal experiences of identifying a specific area of study through: (i) the range of support and provisions provided by universities; (ii) my own working relationships with students identified with dyslexia and SpLDs; and (iii) the appropriate selection of assistive learning technologies within different contexts and environments, I recognised an area of research that is notably lacking in knowledge. The growth in digital learning, technologies, greater financial and institutional support, and the development of disability legislation in higher education have all led to an increase in students with dyslexia studying in higher education institutions. However, limited in-depth research studies have not explored the broader association between these factors, or the influences (i.e., diagnosis, family, early

school education) on students' use of assistive learning technologies in their studies – specifically for writing. Thus, this study investigated the phenomenon of university students diagnosed with dyslexia at Owen University and Redwood University. It purposely discovered the influences of students' personal and educational backgrounds, the disability support and provisions provided at university and students' writing processes, all associated with the use of assistive learning technologies.

The study started with a comprehensive review of existing research across three areas of dyslexia: (i) an in-depth rationale for the methodological multiple case study approach; (ii) a detailed data analysis; and (iii) a discussion of the findings associated with the research questions. By using a qualitative method through diary logs, semi-structured interviews and narrative task analysis, a data analysis framework was established through grounded theory to gain an in-depth understanding of students' experiences with dyslexia and their use of assistive learning technologies.

To summarise, the findings suggest that students' personal and educational backgrounds played an influential part how they used technologies and learning strategies. Students' early access to school support and technologies enabled them to accept their dyslexia, as well as develop independent strategies for enhancing their learning. Findings suggest that the initial arrangements of technologies at school were an advantage to those students at university, as they held previous experiences of mapping their cognitive difficulties to supportive digital tools. Students that received some form of supportive classroom-based interventions or private tuition could also successfully engage with the technologies once they had access to them, albeit with some initial hesitation. For students that had no early intervention or access to technologies as children, the transition to engaging with technologies as an adult proved somewhat slower. Other variables such as

students' families and their determination to succeed also had a substantial influence on the adoption and use of technologies.

Additionally, students' enablement of assistive learning technologies can be partially attributed to the support of their families. All students recalled levels of interaction with their parents or siblings to provide support or intervene with the diagnosis of their dyslexia, particularly during their school years. The resilience, attitude and support from their families helped guide students to explore assistive learning technologies and how these could be applied to their studies. While not all students' parents provided assistive learning technologies, the findings indicated that their involvement in the engagement of learning strategies helped instil the ability to find solutions. Lastly, students' background experiences dealing with the difficulties and issues at school made them more motivated and determined to succeed, if only to prove they were not 'lazy' or 'stupid'. This was a driving force of all students but was particularly pronounced among mature students and those not diagnosed until university.

Overall, students' navigation of screening and assessment via the disability office played a major role in enabling support and provisions. For some students, the initial diagnosis was the first step in understanding how assistive learning technologies could potentially help support their dyslexia. Following a diagnosis, 30 of the 41 students that participated in the study received the DSA with several others in the process of applying. For students, the DSA provided a context that contributed in facilitating the use of independent learning strategies and the opportunity to explore assistive learning technologies in their studies. Although the variety of technology provisions received was broad and mostly reflected students' requests, the access centres responsible for identifying needs and supplying technologies were widely criticised for not always providing relevant training or support. More broadly, the issue of communication between

disability offices and students was recognised as a concern. In the study, the role of the tutor emerged as a substantive influence on students' integration and organisation of support and provisions. From both groups of students, contact with tutors had an overall positive effect and was a factor in improving confidence in learning and grappling with difficulties. This often followed through into tutors providing accessible teaching material online in advance of lectures and allowing students to record lectures. While only small numbers of students highlighted issues with their tutors, Redwood University undergraduate students identified more positive experiences with their tutors. This was due to weekly one-to-one meetings which provided the ability to build rapport over the duration of their studies. These findings suggest that the more personal contact time students have with tutors, the more accepting towards their disability they become.

There are common themes that suggest students developed several multi-modal methods with assistive learning technologies to support their literacy and organisation processes. Primarily, both student groups created order and understanding of their written work with visual elements in the form of mind maps, structured around a three-stage process of ideas, development and connection. It was the Owen University students, particularly those under 25 years who were the most prevalent users of mind maps. The use of these maps were aided in part by their dyslexia tutors and by their early coping strategies. Each group of students took a different approach to combining assistive learning technologies with the writing process. For instance, most of the Redwood University students did not follow a strict scaffold writing process with assistive learning technologies. Some preferred to first establish a plan or outline and then begin the writing with a word processor. This process was enabled by the repetition of essay assignments, compensatory writing strategies or, possibly, higher levels of general cognitive ability. Each Redwood University student had varying approaches and perspectives on

completing their essays, but all relied upon support strategies used at primary and secondary school. Students used technologies as a supplement to review their writing when required (i.e., spellchecker, text-to-speech). In contrast, the Owen University students were identified as integrating assistive learning technologies throughout all four recognised stages of writing. Their technological enhancing of the writing process was overwhelmingly aided by scaffolding techniques through the use of mind mapping, speech-to-text and text-to-speech software. Students learnt to move backwards and forwards between the processes, enabling greater independence. Both student groups acknowledged that colour overlays and filters assisted their ability to engage with reading and writing. As such, the findings and literature (e.g., Grant, 2004; Evans and Joseph, 2002) suggest there could be a causal link between dyslexia and visual stress symptoms.

This study puts forward that assistive learning technologies can provide students with significant levels of independence. However, several factors such as personal and educational backgrounds, support and provisions, and level of cognitive ability can have a profound influence on how and when these technologies are used.

8.3. Unique Contribution

The originality of the study lies how it explores students' backgrounds and early experiences of dyslexia and their current use of assistive learning technologies in higher education settings. The findings make a potentially important contribution to the limited research available on dyslexia and the adoption and use of assistive learning technologies as a compensatory tool for students' writing in higher education. The findings raise awareness that environmental factors (i.e., school, family) and early interventions are essential for the adoption of assistive learning technologies. Moreover, it highlights the level of support assistive learning technologies can provide to students with varying

degrees of dyslexia and the role the institution plays in ensuring students receive appropriate teaching and technological support.

As identified from gaps in the literature, the significance of the findings are across three levels: (i) the development of an environmental framework model for assistive learning technologies –as students' background influences can contribute to enabling the use and adoption of assistive learning technologies; (ii) the implementation of a case study approach to exploring a diverse population of students diagnosed with dyslexia from a modern university (Owen University) and a traditional (Redwood University); and (iii) Owen University students in the study presenting more scaffold structure during the writing process with assistive learning technologies, in contrast to the Redwood University students. These three significant findings are further examined below, outlining the areas in the literature where they contribute unique knowledge.

Firstly, the foundation of an environmental framework model for assistive learning technologies is identified as a significant contribution because of gaps in the existing empirical literature. As discussed in Chapter 3, these research studies (e.g., De la Paz, 1999; Draffan *et al.*, 2013; Price, 2006) simply attend to the impact of the use of assistive learning technologies on individual learners and do not address or explore the background influences that can affect a students' adoption of assistive learning technologies. Moreover, existing research (e.g., Goodman, Tiene, and Luft, 2002; Pew Internet and American Life Project, 2004) that does address factors influencing the adoption of technologies does not extend to higher education students diagnosed with dyslexia and their use of assistive learning technologies. Thus, combined with theory by Morton and Frith (1995) outlining the causations of dyslexia and the present study's findings, an environmental framework model for the engagement of assistive learning technologies is proposed: (i) school –*cognitive influence*; (ii) family –*biological impact*; and (iii)

motivation –*behavioural impact* (see Figure 14 in the previous chapter). The model presents why some students are not engaging with assistive learning technologies to support their dyslexia at university. The combination of levels within the model provides structured and in-depth insight for educators, practitioners and researchers to support the successful engagement and adoption of assistive learning technologies.

The present study, as far as I can tell, is the first in the field to provide an in-depth student-led perspective from two very different universities around the integration and organisation of disability support and provisions for dyslexia. While other studies have investigated the student experiences of dyslexia and disability support in higher education (e.g., Harrison *et al.*, 2009; Holloway, 2001; Mortimore, 2013; Mortimore and Crozier, 2006) they have not explored a diverse student population, or examined all aspects of the students' navigation of support through screening and assessment, implementation of the DSA for access to technologies, and tutor engagement and support. The strength of the study in filling this gap of empirical research is in the highlighting of the differences between Owen University and Redwood University for support and provisions. For instance, while Owen University provided face-to-face support funded through the DSA, Redwood University delivered similar support provided through its weekly tutorial based-system. These differences are also extended to diagnostic assessments and technology provision. Thus, this study suggests that elements of support provided by the university and the DSA are beneficial to students. However, changes to the funding structure of the DSA from 2017 (see Taylor *et al.*, 2016) could leave many new universities in a position to have to fund specialist learning support independently.

Furthermore, the final element of unique contributions from this study is the discovery of the Owen University students presenting more scaffold structure during the writing process with assistive learning technologies in comparison to the Redwood

University students. While both student groups followed a Vygotskian approach to move through the writing process, it was the Owen University students that displayed increased structure and greater use of the technologies. As discussed in the literature review, although several studies (e.g., Engstrom, 2005; Price, 2006) have explored and identified students' scaffold structure with technologies during the writing process, they have not investigated the different types of universities or students. This study, therefore, adds knowledge to the field by defining the type of students more likely to use increased levels of scaffold structure when using assistive learning technologies for their writing. This unique technology usage was mostly attributable to factors such as early environmental influences, the spectrum and severity of dyslexia, and intelligence. Additionally, the present study adds further knowledge by exploring the use of more recent assistive learning technologies (i.e., cloud spaces and mobile devices) to aid the writing process among a larger group of students diagnosed with dyslexia from varying backgrounds and experiences. Not only do these findings enrich the field with a new understanding of the scaffolded writing process, but it also raises important awareness for tutors, institutions and assessors who support their students' independent learning strategies.

8.4. Limitations of the Study

The findings from the study have provided insights into students' experiences with assistive learning technologies. The levels of insights have been due to key elements of the design, sampling and purpose of the methodology. As Patton (1990) points out, all research studies need to be open and clear about their limitations. Thus, this section outlines the present study's limitations focused on the sampling and methodology. The limitations and reflexivity from the position of the researcher were discussed in Chapter 4 (section 4.7.1).

Overall, this study included 41 students and 10 university staff as participants across two institutions. While the participant sample size of students can be argued as being appropriate in comparison to the qualitative studies reviewed in the literature chapters, the sample number of university staff participants was smaller in size. Despite the university staff mainly consisting of disability tutors and assessors, the university tutors interviewed were largely from Owen University due to their faculty support role with the disability office. The addition of tutors from various disciplines could have provided a deeper understanding of the support and issues experienced by students. Thus, it could be argued that the findings associated with the tutors could not be generalised across the broader field of the institution or even higher education. Nonetheless, students' experiences were the focus of the study and their perceptions were sufficient for the study to conclude its findings.

The main criteria for students to participate in the study was to be diagnosed with dyslexia. To ensure the students were formally diagnosed, I enlisted the support of the university's disability offices to contact students through their database. However, due to data protection laws, I did not have access to students' personal details. This was an advantage as it ensured students' anonymity, removed the pressure of participation and directly targeted a specific audience needed to take part. However, there are several limitations to using this approach. For instance, students who are not aware of their dyslexia, have not been diagnosed with the disorder, or are choosing not to identify themselves with the disorder, were not represented among the subjects of this study. Additionally, because the study relied on institutions to recruit students, the study is beholden to the diagnostic practices of each institution. That is, although the institutions would have followed the standard DfES (2005) guidelines recommended for an assessment, different assessors could have used a range of tests and processes to diagnose

students. It is important to acknowledge that this could lead to possible differences in how diagnoses were made. Moreover, by not having access to students' diagnostic tests, it was not possible to explore the severity of dyslexia in each student, a point exacerbated by the fact that conducting diagnostic tests would have required an external assessor or screening method and was therefore beyond the scope of the study. Nonetheless, matching students' severity of dyslexia with the engagement of technologies could have identified some interesting results.

Another possible limitation of the findings could be the lack of comparison of test subjects' perceptions of support and teaching and their engagement of technologies to those of non-dyslexic students. While assistive learning technologies have the potential to support individuals with dyslexia, they are likely to benefit non-dyslexics, as well. However, due to time pressures and the ability to manage a more extensive study, it was not possible to include non-dyslexic students.

The methodology used for this study proved manageable and effective for the number of institutions and participants involved. However, it is important to acknowledge elements of the research design that may have influenced the data. For instance, while the diary logs gave an in-depth insight into the context of students' use of technologies, it could be argued that asking students to record one academic week was too restrictive. A longer period over the duration of an academic term may have captured a more reflective experience of students' engagement across a broader context. However, there was a risk that given the other data collection components, collecting data over a longer period of time, given the other data collection components, could have proved difficult to organise, follow-up and analyse.

The use of the narrative task analysis to record students' engagement and experiences of assistive learning technologies helped strengthen the overall findings. The

advantages of the screen recordings enabled students to capture a 'real-time' perspective of their engagement process with technologies first-hand and in a relaxed environment. However, for some students the screen capture software caused issues. It was partly due to the software being cloud-based which lead to problems with students installing temporary software on their computers. Thus, it delayed a small number of students from recording their experiences, and in several instances, forced some to repeat the process or record on their mobile phones. While I talked through the process with students, demonstrated the software, and provided guides and videos on how to engage with it, it may have been more helpful to ask students to send a test recording before embarking on the final process. Furthermore, the task purposely gave an insight into understanding students' views of their technology experiences. Thus, more regular student narrative recordings throughout the academic term may have captured more personal insights from a broader and richer context.

8.5. Directions for Future Research

The overall potential for further research established around the study remains in students' long-term use of assistive learning technologies over the course of their university programmes. The findings suggest that there is the potential and need for further research to explore and understand three specific areas: (i) students' personal and educational backgrounds influencing the use of assistive learning technologies; (ii) wider disability support and provisions across higher education; and (iii) use of assistive learning technologies to aid writing and organisation strategies. These areas for further research are discussed. Firstly, while there is limited research on personal and educational backgrounds influencing the use of technologies, future research is needed to demonstrate the longer-term effects of early environmental factors. For instance, by expanding the

study to include a longitudinal study around a series of in-depth case studies, including students' school and family environment, it could provide further depth and understanding into the engagement of technologies to support dyslexia. This type of study would also reflect not only the impact of possible environmental factors but also provide clearer evidence of learning strategies being mapped with technologies. Secondly, to explore the wider disability support and provisions across higher education, the study could be expanded to investigate a variety of different disciplines from institutions across the UK and internationally. Moreover, this research should be extended to explore the broader perspectives of academic staff regarding inclusion with teaching and learning, as well as evaluating interventions that are designed to enable students with dyslexia. Finally, there is a need to investigate the use of assistive learning technologies to support individuals with dyslexia across all ages. Due to the ever-changing world of technologies, it is important that research studies continue to explore the role of assistive learning technologies within both primary and secondary schools. A mixed-method longitudinal study would not only add further understanding of students' use of technologies with literacy but also present evidence on the effective early intervention of technologies – specifically if reading assessments were conducted throughout the experiment. It could be conducted alongside a control group to explore the effectiveness and enablement of assistive learning technologies. Moreover, to explore the effects of technologies on students' writing, this study could further explore in-depth case studies of students across several institutions both in the UK and USA. It would also be beneficial in examining students' journeys over a more extended period, conducting diagnostics assessments to identify cognitive weaknesses and the associations with technologies. In agreement with Pino and Mortari (2014), further research is also required to compare dyslexic and non-dyslexic students' experiences studying and using the same technologies.

That said, one of the challenges faced by researchers, and acknowledged by Smythe (2010), is that research on assistive and learning technologies can take time to construct. Thus, it is important to note that by the time research is published some of these technologies may have changed in ways that could impact the way individuals learn with them.

8.6. Final Thoughts

The thesis represents a journey for myself. But most importantly, it reveals the experiences of students diagnosed with dyslexia as they use assistive learning technologies in their studies. It has been my intention for many years to explore the broader impact of dyslexia on learning and how technologies can play a role in enabling individuals. Thus, the study has embarked on an investigation to explore the detailed experiences of students diagnosed with dyslexia as they use assistive learning technologies to enable their studies. Through exploring over 40 students across two higher education institutions as case studies, the study has examined in detail the research processes, findings and benefits assistive learning technologies can provide to students with dyslexia. While this study acknowledges that the severity of dyslexia varies from one individual to another, it is the impact of the environment that can have the most significant influence on how the disorder affects the individual. The findings from this study have attempted to contribute to the broader discourse that compensatory strategies with assistive learning technologies, combined with appropriate support and provisions, can bring substantial benefits to the individual. Nonetheless, while assistive learning technologies may not be the solution for all the problems associated with dyslexia, it does highlight the ever-changing capacity to enable and support cognitive weakness in a variety of tasks. Equally, it is also essential for the individual with dyslexia to be

determined and have the mindset to overcome challenges; a theme echoed throughout the thesis. Overall, this study has the potential to not only inform educators and policymakers around higher education provision and support but aid students in identifying suitable writing strategies with assistive learning technologies.

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Appendix A: Theories of Dyslexia

1. Introduction

This appendix presents a detailed overview of the prominent leading theories of dyslexia that have developed since the 1970s. There is now considerable empirical research spanning the behavioural, neuropsychological, neurological, and causal levels of investigation (Peterson and Pennington, 2012). From the perspective of neuropsychological research, the phonological theory continues to be the most significant and dominant factor of understanding dyslexia. However, beyond the consensus that dyslexia is a neurological disorder with a genetic origin, there are several other leading theories surrounding dyslexia: phonological deficit theory; cerebellar deficit theory; magnocellular theory; visual deficit theory; and genetics of dyslexia. In this appendix, these theories and topics will be examined in more detail. The conclusion presents an overview of themes and outlines the merging of theories for a universal understanding of dyslexia.

So far in this thesis, attempts to define and identify dyslexia have presented an understanding that it is a neurologically based cognitive difficulty that affects memory, perception and language. However, there are several other theories that conceptualise dyslexia as a phonological, magnocellular, cerebellar or visual deficit. The heterogeneity of the symptoms around dyslexia suggests that there are very likely even more subtypes of dyslexia not yet discovered (Heim *et al.*, 2008). Frith (1992; 1997) establishes a significant level of inquiry between three levels of theory: biological, cognitive, and behavioural; all of which justify and focus the importance on the variations of developmental dyslexia.

With a perspective on cognitive neuroscience, this appendix explores these theories of dyslexia further, starting with the phonological deficit theory (e.g., Liberman, 1973; Snowling, 1981) which relates to the ability to separate and use speech sounds (phonemes). Following on, the cerebellar deficit theory (e.g., Nicolson and Fawcett, 1995; 1999; 2008, Fawcett and Nicolson, 1999; 2008) suggests that reading disabilities are a result of an impaired ability to automatise processes. In contrast, the magnocellular deficit theory (e.g., Stein, 2001; 2008; Stein and Talcott, 1999) outlines the claim that dyslexia is a problem affecting the speed of processing information, either visually or auditory. Finally, the visual deficit theory (e.g., Goulandris and Snowling, 1991; Lovegrove *et al.*, 1980; Stein and Talcott, 1999; Stein, 2008), which has been at the centre of the hypothesis of dyslexia since the late 1970s, identifies the impairment of processing letters and words as a prominent manifestation of the disorder. A further section on genetics (e.g., Gilger, 2008; Grigorenko, 2001; 2007) will briefly examine the foundations of developmental dyslexia and factors of the environment. This appendix discusses if there are any attempts to unify all these theories together and if there are association or connection between them.

2. Phonological Deficit Hypothesis

The Phonological Processing Deficit (PPD) hypothesis has been the most acknowledged and dominant theory seeking to explain why some individuals fail in obtaining adequate reading abilities (Everatt and Reid, 2009; Pope and Whiteley, 2003). At a fundamental level, Wolff (2009) identifies that there are two forms of reading procedures necessary for skilled reading (Høien and Lundberg, 2000): phonology and orthography. Phonology is an indirect strategy that supposes that in order for a child to be able to read adequately, they must develop an understanding that spoken words can be

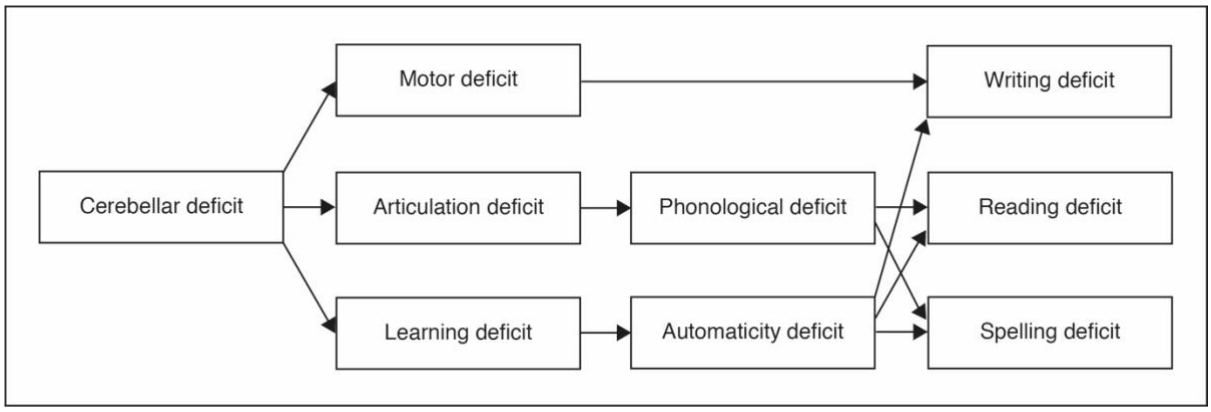
combined into smaller units of speech (phonemes) and the letters in a word indicate these sounds (Shaywitz, 2003). Orthography is also an indirect strategy, but it supposes that adequate reading requires a child to be able to recognise whole words in one glance.

As outlined in Chapter 2 (see section 2.5), short-term memory plays a vital role in the recalling of verbal sounds and understanding what has been read (de Jong, 2006). The verbal information is processed by the phonological loop in the short-term memory, as a form of 'speech code' before being managed and organised by the 'response selection' from the central executive attention system (Baddeley, 1983; 1990; Snowling, 2006). For some time, there has been a close relationship existing between speech coding and short-term memory (Baddeley, Lewis, and Vallar, 1984). Research by Conrad (1964) indicated that an individual's short-term memory codes information according to 'speech code' or 'acoustic similarity' (Baddeley, 1966; Hulme and Roodenrys, 1995). Conrad's study showed that individuals without impairments found it harder to recall visual lists of words or consonants when they sounded similar, for example, 'p' was recorded as 'b', 'c', 't', or 'v', in contrast to when they sounded dissimilar as 'f', 'm', 's', or 'x' (Conrad, 1964, p. 84; Snowling, 2006, p. 36). It can be identified that this phonetic similarity effect (Baddeley, 1986; 1990) can be seen in both children and adults (Hulme, 1984). This effect highlights that the 'majority of subjects verbalize the stimuli, rather than attempting to store them in visual form' (Conrad, 1964, p. 79). Thus, for individuals with no impairments, their short-term memory is primarily encoded based on sound. However, for those individuals with dyslexia, it is likely that due to an inefficiency in phonological encoding and/or articulatory output it may underline some of their poor performance on verbal short-term memory tasks (Cohen, Netley, and Clarke, 1984; Pennington *et al.*, 1990).

3. Cerebellar Deficit Hypothesis

Perhaps one of the dominant causal hypothesis of developmental dyslexia is the cerebellar theory, which was developed through cognitive neuroscience pertaining to the cerebellum. The cerebellum is located at the back of the brain below the cortex and accounts for 50 per cent of the brain's neurons (Brodal, 1981). It is made up of two hemispheres (left and right) and receives input from all the senses through the primary motor cortex and other areas of the cerebral cortex. According to Ramus, Pidgeon, and Frith (2003), the biological view is that the dyslexic's cerebellum is somewhat dysfunctional, which causes several associated cognitive difficulties. For instance, the cerebellum is central to the involvement of motor control and speech delivery and problems with these functions would likely lead to difficulties in phonological development. Ramus, Pidgeon, and Frith (2003) also add that the cerebellum is engaged in the automatisation of newly acquired tasks such as reading, typing and driving, and a weakness in automatisation could potentially affect the learning of grapheme-phoneme associations. Nicolson and Fawcett (2010) acknowledge that there is increasing evidence that language and cognitive skill can be associated with the cerebellum. Neuroanatomical associations among the neocerebellum and the cerebral frontal speech output regions have led to the understanding that the cerebellum is central to the participation in cognitive learning (Leiner, Leiner, and Dow, 1989). In addition to 'motor learning' where the acquisition of 'language dexterity' plays an important role (Nicolson, Fawcett, and Dean, 1995). The connection with the acquisition of language and cognitive learning has guided Nicolson and Fawcett (2010) to propose a more refined causal analysis of the cerebellar deficit, as shown in Figure 18.

Figure 18. A causal analysis for cerebellar deficit by Nicolson and Fawcett (2010).



While the cerebellum has long been understood as being engaged with motor function (Holmes, 1917; 1939; Ito, 1986; Marr, 1969), that understanding has been recently re-evaluated due to new advances in brain imaging that have made it possible for the cerebellum to be imaged for the first time. Fawcett and Nicolson (2008) acknowledge that this new evidence suggests that the cerebellum is an essential part of those cognitive skills associated with speech. It should also be noted here that deficits in 'motor skill, automatisation, and information processing speed' can impact an individual's ability to acquire and process new skills (Nicolson and Fawcett, 1999, p. 68). Taken together, this evidence supports initial findings by Nicolson *et al.* (1999) from a PET (Positron Emission Tomography) scan study, which discovered that dyslexics had lower activity than normal readers in the cerebellum when performing a motor sequence learning task. This was also asserted by Denckla and Rudel (1976) in their controlled study, which found that the dyslexic group had language problems that were associated with difficulties in Rapid Automatised Naming (RAN), in addition to other related motor problems. The use of rapid naming tests is a routine measurement used on a participants' performance, through repetitive identifying of elements, such as pictured objects, colours, letters or

digits (Wolf, Bally, and Morris, 1986) that directly evaluate the speed of retrieval of a familiar name from the long-term memory (Vellutino, Scanlon, and Tanzman, 1994).

For individuals identified with both phonological difficulties and problems with RAN, it is acknowledged by Wolf and Bowers (1999) they have a 'double deficit'. Originally defined by Wolf and Bowers (2000, p. 322), the double-deficit hypothesis represents both 'phonological deficits and the processes underlying naming speed deficits' where they are described as two independent foundations of reading dysfunction. They are developed into three impaired reader subtypes, two single subtypes and one double deficit subtype: (i) phonological deficit readers with only phonological processing difficulties; (ii) naming-speed deficit readers with only naming speed problems but with no phonological decoding difficulties; and (iii) double-deficit readers who are impaired across all measurements of reading with co-occurrence of phonological and naming speed difficulties only allowing compensatory routes (Wolf and Bowers, 2000). These findings highlight that while dyslexia has a neurological foundation, it is a complex and varied disorder with numerous factors influencing how individuals respond to learning within different contexts.

4. Magnocellular Deficit Hypothesis

Magnocellular cells, or M-cells, are neurons which are part of the visual system that are required for the fast processing of temporal information. Initially identified as the transient system deficit theory, it has been reported that the neurological structure of dyslexic brains differs from non-dyslexic brains. In dyslexic brains, the parvocellular and magnocellular layers merge, and magnocellular neurones are reduced by 30 per cent (Livingstone *et al.*, 1991). Lovegrove *et al.* (1980) was one of the first studies to implicate the underlying issues of the magnocellular system as a source of the manifestations of

dyslexia. The study identified that magnocellular functionality was somewhat weaker in dyslexics compared to fluent readers: non-dyslexics are identified as having high magnocellular sensitivity whereas dyslexics have an impaired function of the visual magnocellular system (Frith, 1999; Stein and Talcott, 1999.

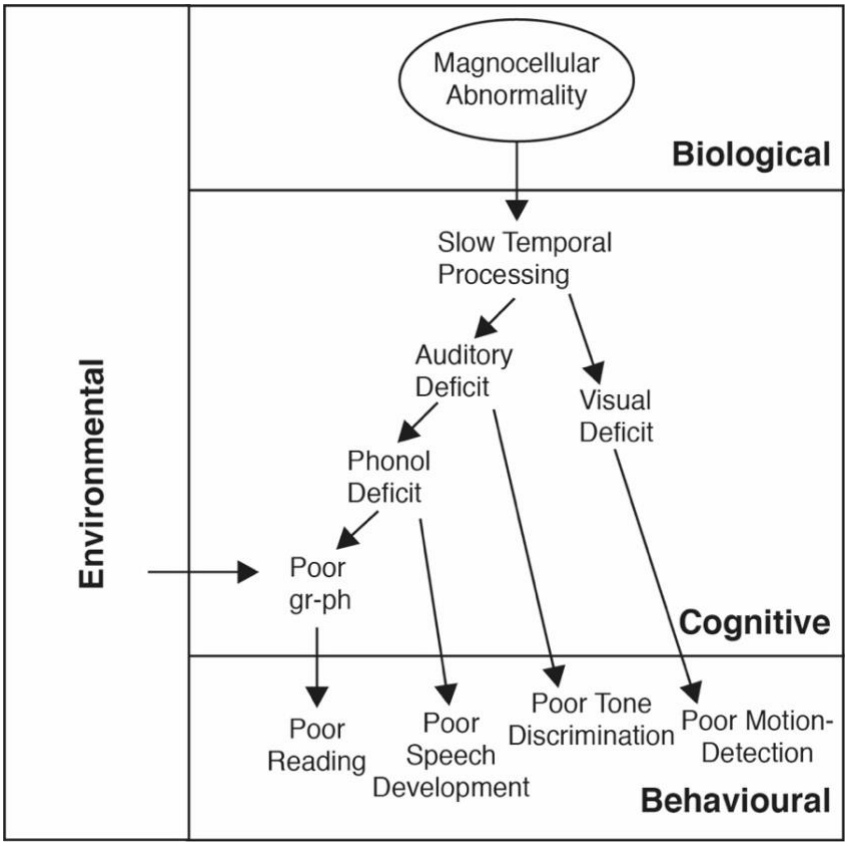
As Stein (2001) explains, the timing of visual occurrences when reading are the sole responsibility of the visual magnocellular system. This system signals when involuntary movements occur with images moving away from the fovea ('retinal slip'). These signals are then processed and used to bring the eyes back on target. It is a regular occurrence among some dyslexics to identify words seen on a page or computer screen as they often describe them as 'floating around' and 'appearing to flicker on the page'. Lovegrove *et al.* identified that dyslexics required a greater contrast between stationary black and white grids to help distinguish them, and individuals with dyslexia will often identify that 'small letters appear to blur and move around when they are trying to read' (Stein and Walsh, 1997, p 147). These accounts are consistent with other several studies (e.g., Martin and Lovegrove, 1987; Talcott *et al.*, 1998). According to Livingstone *et al*. (1991), Stein and Walsh (1997) and Stein and Talcott (1999), these findings suggest that dyslexics could have a specific impairment of the visual magnocellular system.

From numerous studies, the magnocellular deficit hypothesis suggests a detailed and wide-ranging account of dyslexia from biology to behaviour (Rice and Brooks, 2004). Stein (2001, p. 29) acknowledges that evidence regarding the genetic basis of links to reading problems is of 'great significance', but at the moment it is 'still circumstantial'. Skottun (2000) argues that evidence from the studies of contrast sensitivity has been strongly disputed, and it has been argued that magnocellular deficit is minor and is not discovered in all dyslexics, with only a small number of participants used in some of the studies. Nonetheless, Stein and Walsh (1997, p 147) present that evidence from the

abnormalities of the magnocellular component visual system is somewhat consistent with a widening understanding of dyslexia, 'that does not single out either phonological or visual or motor deficits'. Stein and Walsh's view is that the temporal processing in phonological, visual and motor systems appear to be impaired. Thus, dyslexics may be restricted from processing all kinds of sensory information sufficiently.

It is acknowledged by Frith (1999, p. 205) that the magnocellular theory, along with the cerebellar deficit hypothesis, is establishing itself as the leading abnormality of dyslexia, where the phonological deficit originates from a profound underlying problem, within the magnocellular component, or the phonological deficit as an extra problem 'superimposed on other difficulties', as shown in Figure 19. Furthermore, Frith (1999) points out that all these theories seem to recognise the issues presented by the phonological impairment but differ in their signs and symptoms of describing dyslexia, as well as suggestions for diagnosis and remediation. Thus, it is important to acknowledge that further neurological research is required to understand functioning and processing in specific language impairment fully.

Figure 19. A causal model of dyslexia as a consequence of a magnocellular abnormality (Frith, 1999).



5. Visual Deficits: The Role of Visual Factors

Since the very first discoveries of developmental dyslexia, there has been an ongoing discussion considering the role of visual processing deficiencies with the disorder. The term ‘word-blindness’ became known as a defining feature of the disorder, and during the period and beyond was used by both medical and educational professionals (Critchley, 1970; Singleton, 2012). The theoretical connection between dyslexia and visual stress can be termed ‘threshold shift’, due to the understanding that dyslexia can increase an individual’s ‘susceptibility’ to visual stress, and it is therefore likely to increase the intensity of visual stress (Singleton, 2012). Numerous studies have identified

that visual stress will be more widespread in dyslexics and poor readers, compared to the larger population (e.g., Kriss and Evans, 2005; Singleton and Henderson, 2007). Although the more dominant theories of dyslexia, such as the phonological deficit, have taken a more leading approach in cognitive research and defining dyslexia, Stanovich (1993) reveals that researchers have tended to disregard research on visual perception even though visual processing could occur alongside with phonological deficits in children. According to Singleton and Henderson (2007a), two competing theories begin to explain the cause of visual stress. Firstly, it is claimed by Wilkins (1995; 2003) that visual stress is caused by pattern glare, a characteristic where the visual cortex is over-excited due to hypersensitivity to contrast. An over response to geometric patterns of stripes can induce seizures in individuals with photosensitive epilepsy or create distortions in normal individuals due to the brain being 'overloaded'. This overload is because 'the nerve cells in the brain fire too strongly and cause others to fire inappropriately (Wilkins, 2003, p. 22). The second explanation for visual stress suggests the magnocellular hypothesis (Singleton and Henderson, 2007a). As previously outlined, several researchers have argued that visual stress is caused by a deficit in the magnocellular visual systems, including contrast sensitivity (Evans, Drasdo, and Richards, 1994) which is triggered by eye movements (Stein, 2001; Stein and Walsh, 1997). Thus, it can be understood that visual deficits present a clear causal biological link and its impairments are life-long.

6. Genetics of Dyslexia or Environmental Factors?

It has been debated and questioned for many years that the problems often associated with reading difficulties are genetically inherited from family members. This concept of genetically inherited disorders stems from some of the earliest studies exploring 'word blindness'. Hinshelwood (1917) was one of the first to make the

association that a defect involving the acquisition and storage of visual memories of letters and words in the brain were hereditary. In his study, Hinshelwood noted that reading disabilities were frequently found in siblings and/or multiple generations of a family. He also claimed boys had a higher prevalence of word blindness than girls. A few years later, Orton (1925) published his work, titled 'Congenital Word-Blindness', identifying a link between children with language difficulties and its occurrence in family members. Another study by Hallgren (1950) examined 276 cases of dyslexia, discovering that 88 per cent of individuals with dyslexia were identified as having at least one family member with the same condition. Following these early stages, evidence from the familial nature of reading problems has accumulated (e.g., Orton, 1937; Drew, 1956; Hunter and Johnson, 1971; Gilger, Pennington, and DeFries, 1992) making it achievable to assess the risk of dyslexia in individuals and families. A finding from a similar study reported by Rutter, Tizard, and Whitmore (1970), identified that 34 per cent of children with a specific reading difficulty had a sibling or parent with a reading problem compared to 9 per cent of the control group. According to Gilger, Pennington, and DeFries (1991), it is estimated that there is approximately a 30 to 50 per cent risk of a child developing dyslexia if their parent is also dyslexic, with a 40 per cent risk for a boy being dyslexic if his father is too. From the perspective of familial risk, Pennington and Smith (1988) comparably identify that 40 per cent of boys with a dyslexic parent are also dyslexic, whereas for girls, it is 18 per cent. However, Snowling (2006) argues that these types of data studies are 'insufficient' and that the evidence does not suggest that genetics are involved, particularly as families share very similar environments. While it can be determined that dyslexia is familial, it can also be questioned whether they are necessarily heritable (Catts and Kamhi, 2005). One way forward for researchers to understand the estimation of heritabilities and the impact of environmental factors on dyslexia is by comparing

concordance rates in twin pairs. The advantage being that twins share between 50 per cent (fraternal) and 100 per cent (identical) of their genes, and although concordance rates can vary between individuals, they present a more reliable perspective of the story (Snowling, 2006). In one of the largest representative twin study of dyslexia (The Colorado Twin Study: DeFries, Fulker, and LaBuda, 1987), involved 64 pairs of identical twins and 55 pairs of fraternal twins with at least one member of the pair dyslexic. The report identified that the concordance rate for identical twins was 68 per cent and 38 per cent for non-identical twins, thus suggesting that genetic influences are an important factor (Hulme and Snowling, 2009). Riddick (1996) adds that the findings highlight that the reading disability is not an inherited condition but a genetic defect or deficit in one or more of the cognitive skills can be a cause of underlying language and reading.

The occurrence of dyslexia has been widely recognised that it is more prevalent in males than females (e.g., Finucci and Childs, 1981; Vogel, 1990; Rutter *et al.*, 2004). It is argued by Hawke *et al.* (2009) that these gender differences are much greater due to more severely affected samples. One other explanation may be owing to schools referring more boys than girls for a diagnostic assessment because boys are more disruptive than girls in a classroom-based environment (Shaywitz, Morris, and Shaywitz, 2008). While some researchers suggest that genetic influences on dyslexia 'operate similarly in both males and females' (Pennington and Olson, 2005, p. 472), neurologically, Blakemore and Frith (2005) explain that the language area of the brain (left planum temporale) is more highly activated during language processes in men than in women. It is claimed that this is due to men's brains being asymmetrical than women's brains, using both hemispheres throughout language tasks. Thus, women can outperform men on verbal tasks and men appear to perform better at spatial tasks. However, these claims are not without

controversy, Blakemore and Frith acknowledge that many of results between males and females are still vague with 'much overlap between the two genders' (p. 63).

For some time, there have been long-held theories that dyslexia is inherited and a 'dyslexia gene' is a marker for the disorder with scientists pursuing a cause to uncover genetic mechanisms. Between 2000-2010, several studies have positioned themselves on discovering a susceptibility gene for developmental dyslexia (e.g., Cope *et al.*, 2005; Fisher and Francks, 2006; Grigorenko, 2005; Paracchini, 2009; Schumacher *et al.*, 2007a). As Snowling (2006) points out, the 46 chromosomes which make up each human, 23 from the mother and 23 the father, contain sequences of DNA that comprise the human genome. While Snowling adds that locating the chromosomes associated with dyslexia is extremely complex, several 'markers' have been identified (e.g., Fisher and Francks, 2006; Grigorenko, 2005). The process for identifying and examining these chromosomes is lengthy, but scientists believe that they are linked to areas of phonological processing, decoding and awareness (Francks *et al.*, 2004; Kaplan *et al.*, 2002; Petryshen *et al.*, 2001). Further research is needed to fully explain the biological pathways of reading difficulties and present a new supportive framework towards understanding underlying cognitive functions.

7. Conclusion

The debate around dyslexia continues to be pushed to the forefront due to prominent developments in neuroscience, brain imaging and genetics; however, it still appears that researchers and scientists are divided when explaining the disorder. Some of these professionals investigating different themes related to dyslexia propose that their ideas and theories are correct and should be the dominant causal model. As highlighted in this appendix, several deficit theories are claiming to be the cause of dyslexia and have come

about from extensive exploratory work based on the phenomena. Nicolson and Fawcett (2010) suggest that to understand dyslexia, theorists develop a theory to explain underlying processes and to gain acceptance of their work. Initially, Morton and Frith's (1995) theoretical model is one of the first attempts to bring together prominent theories of developmental dyslexia by connecting the biological, cognitive and behavioural levels with the influences of environmental factors to establish multiple frameworks. The real issue with one definitive definition of dyslexia, or one theory, is that it does not define the disorder for clinical or educational practice. While theories offer distinctions for scientific researchers, they can often lack clarity in language for the wider learning disability community.

When Miles (1995a) asked the question: 'Can there be a single definition of dyslexia?' It appears she was also challenging the theoretical understandings around dyslexia and that symptoms can vary from one individual to another. If we briefly look back at each theory, we can begin to identify that each explores a deficit or defect associated with a cause of dyslexia. From the outline of literature in this appendix, not one theory can solely explain this cause of dyslexia. Thus, there is a need to merge both empirical facts and theories to create a 'dyslexia' hypothesis (Tønnessen, 1997).

One of the prominent theories of dyslexia is the phonological deficit, which proposes that reading problems of dyslexic individuals are linkable to difficulties with language sound processing. However, Ramus *et al.* (2003) point out that one of the main weaknesses of the phonological theory is its failure to describe the manifestation of sensory and motor disorders in some dyslexic individuals. This is contested by researchers of the phonological theory who do not regard it as part of the fundamental features of dyslexia. Snowling (2006, p. 175) on the one hand suggests that 'the sensory processing impairment in dyslexia may be associated with poor reading skill via the operation of one

or more cognitive skills,' but holds short of claiming that it is related to the core phonological deficit, stating it is 'simply too early to argue' and further research is required. Moreover, the magnocellular theory also fails to fully explain the lack of sensory and motor disorders for many dyslexics. In contrast, the cerebellar theory presents both of these types of problems (Ramus *et al.*, 2003).

While research into these theories is expanding our knowledge of dyslexia, there is an emerging trend in the discussion of different subtypes of dyslexia linking to an independent profile of reading difficulties. Ramus, Pidgeon, and Frith (2003, p. 712) accept that the several theories surrounding dyslexia are 'compatible with the idea that a phonological deficit is a direct cause of dyslexia, but challenge the specificity of such a deficit'. From their study in exploring the major themes, Ramus *et al.* discovered that there is evidence to suggest that there are different subtypes, with 59 per cent of dyslexic children having an impairment in motor skills and 77 per cent in phonology. Nonetheless, Stein (2001, p. 13) maintains that the majority of reading problems are associated with a 'fundamental sensorimotor cause'. Stein argues that the cerebellum is central to the acquisition of all sensorimotor skills, particularly in the reading process where it helps to control eye movements and mediate inner speech required for phonological analysis. Although evidence for the phonological deficit has been discovered through numerous experimental studies, Pennington (2006) and Pennington *et al.* (2012) debate that dyslexia occurs due to a combination of deficits in several areas. Researchers often refer to this as the 'multiple deficit' such as auditory processing, but it is often argued that these deficits are not causally connected to reading and spelling (e.g., Marshall, Snowling, and Bailey, 2001).

Ever since the 1960s, researchers have been exploring and making attempts to organise children into different subtypes, with Myklebust and Johnson (1962) among the

first to identify subgroups of children with auditory and visual dyslexia. Today, the discussion around dyslexia subtypes continues with neuroscience playing a more dominant role. For instance, a recent brain study by Jednoróg and Grabowska (2014) investigated different cognitive subtypes of dyslexia among children and identified that their brain areas of local grey matter volume differ from controls and between dyslexic groups. Their research highlighted evidence to suggest that there are noticeable phenotypes of dyslexia that exist on the cognitive level, but noticeably the 'relationship between brain structure and behaviour is more complicated than anticipated' (p.1705). While the environment can place unconditional variables on an individual with dyslexia, the next decade in scientific and neuroscience research will play a major role in beginning to unify the theories surrounding dyslexia and provide a more comprehensive connected understanding for the individual with the disorder.

Appendix B: Student Diary Log

Participant:

Week Commencing:

Assistive Learning Technologies - Student Diary Log

Use this diary log to record your use of technologies that assists your learning over a period of one week. The technologies can include anything that helps with your studies or personal work / communication.

The example included in the table below demonstrates the type of information required.

Date	**Time**	**Task / Exercise** *What did you do?*	**Assistive Learning Technologies** *What assistive learning technologies did you use and how did it support your task / exercise?*	**Difficulties** *Were there any issues you experienced while supporting your own learning?*	**Location** *Where did you work / study?*
Include date:	Include time:	Include what you are doing, working on and the subject area.	*Include the assistive learning technologies you used and what for:* Consider how the assistive technology helped you complete your task / exercise.	Consider the following: • The transition from one software to another • Assistive learning technology ease of use and accessibility • Engaging in the creation of ideas / written material with assistive learning technologies.	Include the location (i.e., **home, university, lecture, seminar, group work**) where you start and complete your task / exercise.

Date	**Time**	**Task / Exercise** *What did you do?*	**Assistive Learning Technologies** *What assistive learning technologies did you use and how did it support your task/exercise?*	**Difficulties** *Were there any issues you experienced while supporting your own learning?*	**Location** *Where did you work / study?*

Appendix C: Semi-Structured Interview Questions

Student Interview Questions

Personal Information

1. Firstly, can we start by introducing yourself?
   a. Name, age, degree programme

Dyslexia Background

2. When were you diagnosed with dyslexia?

3. What problems did dyslexia cause you when in school?

4. What problems does dyslexia cause you now?

5. What were your school experiences like with dyslexia?

6. What support and provisions did you receive at school?

7. Did you use any technology / software at school to support your dyslexia?

Technology and Software to Support Learning

8. Have you applied for a Disabled Student Allowance?
   a. If yes, what support and provisions did you receive?
   b. If no, why not?

9. Do technologies and software help support your learning?
   a. If yes, how?

10. Where are you most likely to use technology and software?

11. Have technology and software made you less dependent on another person?

12. Do you experience any difficulties when using technology and / or software?

University Support / Provisions

13. Are your tutors aware of your dyslexia and difficulties?

14. Do you receive any support and provisions at university?

15. Overall, how do you feel the university supports dyslexic students?
   a. Could this be improved?

Academic School / Faculty Interview Questions

1. Firstly, can we start by introducing yourself and your role within the university?
    a. i.e. academic and supportive

2. From teaching and lecturing, what difficulties can you identify that student with dyslexia experience while at university?
    a. What reasonable adjustments can / do you make?

3. In general, what provisions and support does your Faculty or School offer / implement for students with dyslexia?

4. What are the challenges and difficulties you experience when supporting students with dyslexia?

5. How do you make your teaching and learning materials accessible to students with dyslexia?
    a. Do you use the university's online teaching environment to support students?

6. Finally, how could the university support students with dyslexia more?

Disability Office Interview Questions

1. Firstly, can we start by introducing yourself and your role within the university?
    a. i.e. academic and supportive

2. Could you describe how you assess a student with dyslexia?
    a. What assessments, exercises and tests do you use?

3. What are the difficulties students with dyslexia experience while at university?

4. What levels of support does the disability office offer students with dyslexia?
    a. i.e. staff support

5. What provisions and support does the university offer / implement for students with dyslexia?

6. How do you make your materials accessible to students with dyslexia?

7. What training and experience do disability staff have to support students with dyslexia?

8. Finally, how could the university / disability office support students with dyslexia more?

Librarian Interview Questions

1. Firstly, can we start by introducing yourself and your role within the university?
    a. i.e. experience of students with disabilities etc.

2. What difficulties do students with dyslexia experience when supporting their own learning in the library?

3. What levels of support does the library offer students with dyslexia?
    a. i.e. staff support

4. What assistive technologies are available in the library to support students with dyslexia?

5. What provisions does the library offer / implement for students with dyslexia?

6. What are the challenges and difficulties library staff experience when supporting students with dyslexia?

7. What training and experience do library staff have to support students with dyslexia?

8. Do copyright restrictions and policies in the library influence support for students with dyslexia?

9. Finally, how could the library support students with dyslexia more?

Appendix D: Narrative Task Analysis

Thank you for completing the interview.

The final stage of the research is the narrative task analysis.

What is narrative task analysis?
A 'narrative' is a story or description of a process.
The purpose of this task is to record your experiences of using assistive and learning technologies with your studies and how you integrate this with your assignments.

The objective is to examine software use and how students with dyslexia use the computer to complete tasks. It will help understand how students with dyslexia organise their ideas and manage issues when learning.

What you have to do?
The aim of this task is to record and demonstrate your use of assistive and learning technologies. The main purpose is for you to talk through your use of assistive and learning technology (including Internet, mobile app use) and how you use these to create your assignment, i.e., essay, report, presentation etc. from the start to completion. Explaining your use of technology and how it helps support your assignment.

The time required for your narrative is from **5 to 15 minutes**.

Downloadable software is available for you to use. It is important that you enable the microphone and set the record area of the screen before you start recording. Instructions are available on the following page.

If you have any questions, please contact me:
E-mail: **paul.grove@education.ox.ac.uk**
Telephone: **07xxx xxx xxx**

PLEASE BE AWARE
The online software provided will record your activity on your computer. Please do not open any personal files, web sites, e-mails (i.e. photos, documents, internet banking etc.) that you do not want to share with me.

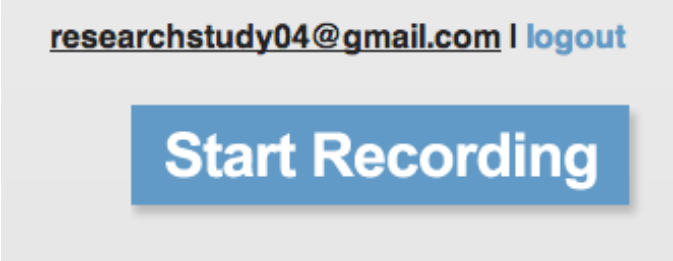
If you have any folders or files on your desktop computer that you would not like recorded, place them into a new folder. Also, if you have a personal desktop screen image and would not like it recorded, either remove it or replace it with a different image.

To begin the task, please go to:
http://www.screencast-o-matic.com/login

Enter the following: (For accuracy, copy and past):
Username: **researchstudy04@gmail.com**
Password: **xxxxxxxx**

Please try and test the software as many times as you feel necessary.

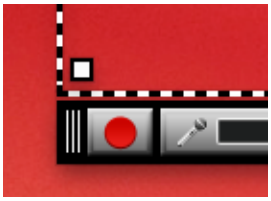
Select: **Start Recording**



A dotted window frame will appear. You can drag this to anywhere on your computer desktop to record (below):



Press the **record button** (red circle) in the bottom left of the dotted window frame to **start** the recording (below):



Press it again to pause the recording (below):

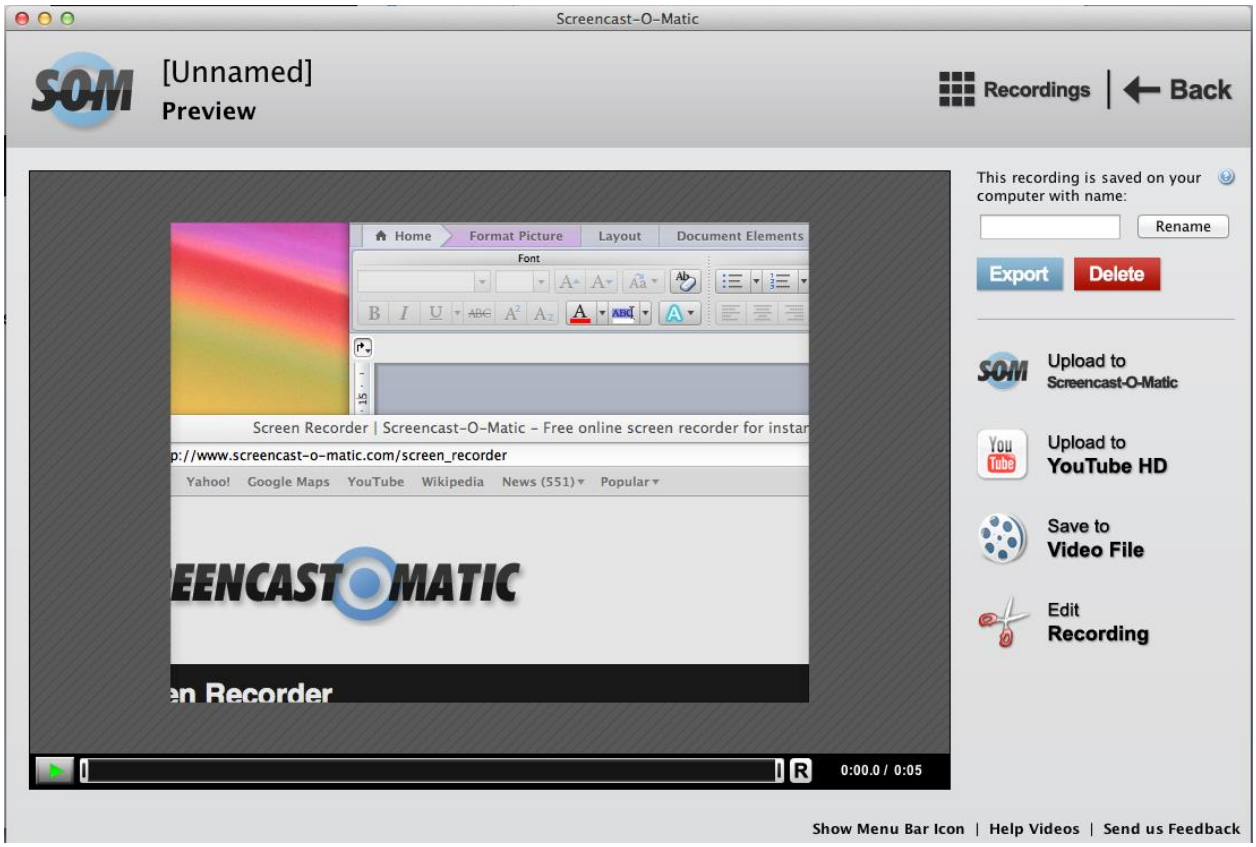


When you have finished recording, press **Done** (below):

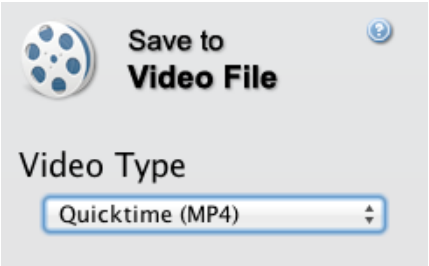




The following window will appear (below):



Select: **Save to Video File**
Select: **Video Type - Quicktime (MP4):**



Press **SAVE VIDEO**

Save on your desktop and give it a title including your first name:
i.e. **yourname_video.mp4**

Please contact me when you have completed this:
paul.grove@education.ox.ac.uk

For further help, see the following links:

1. **Start Recording using Screencast-o-matic**
   http://www.screencast-o-matic.com/watch/cXhbbqb9C

2. **Save to a Video File**
   http://www.screencast-o-matic.com/watch/cXhFezbSY

Appendix E: Research Participant Request E-mail

Dyslexic Participants Wanted for Study

Paul Grove is a research student at Oxford University investigating how technologies shape the learning experiences of students diagnosed with dyslexia. A recent graduate, Paul is also dyslexic and was formally diagnosed with dyslexia in his first year as an undergraduate student. Paul is looking for undergraduate and postgraduate students to take part in his study.

Each participant will be asked to take part in a semi-structured interview, record their daily use of technologies over an academic week, and record their personal experiences of using technology and software on their computer.

The study lasts 80 minutes and participants will be compensated £15 for their time. Further information can be found online at the researcher's online site: http://research.dyslexicsonline.com/student-participant-call

If you would like to participate or have any questions, please contact the researcher paul.grove@education.ox.ac.uk

The study has been approved by the Central University Research Ethics Committee (CUREC).

Appendix F: Table 1

Redwood University Participants

Table 1. Main characteristics and profiles of Redwood University students.

Pseudonym	Gender	Age	Age Diagnosed	Student Status	Degree Subject	Level	Disabled Students' Allowance	Used Technology at School	Support and Provisions at School	Technology Currently Supports Learning	Private / State School
Adam	Male	49	8/9	Home	Arts and Humanities	PG	Yes	No	No	Yes	State
Amy	Female	22	16	Home	Sciences	UG	Yes	No	Yes (minimal)	Yes	State
Chloe	Female	22	18	Home	Sciences	UG	Yes	No	No	Yes	Grammar
Emily	Female	20	19	Home	Sciences	UG	Yes	Yes (minimal)	No	Yes (minimal)	State/Private
Emma	Female	37	37	International	Social Sciences	PG	University Funded	No	No	Yes	State
Gavin	Male	20	11	Home	Sciences	UG	Yes	Yes	Yes	Yes	Private
Hannah	Female	20	18	Home	Social Sciences	UG	Yes	Yes (minimal)	Yes (minimal)	Yes	State
Jane	Female	20	20	Home	Arts and Humanities	UG	Yes	No	No	Yes	Grammar/State
John	Male	19	7	Home	Social Sciences	UG	Yes	Yes	Yes	Yes	State
Kate	Female	25	21	International	Social Sciences	PG	University Funded	No	No	Yes	State

Pseudonym	Gender	Age	Age Formally Diagnosed	Status	Degree Subject	Level	Disabled Students' Allowance	Used Technology at School	Support and Provisions at School	Technology Currently Supports Learning	Private / State School
Laura	Female	18	8	Home	Sciences	UG	Yes	Yes	Yes	Yes	Private/State
Liam	Male	20	20	Home	Arts and Humanities	UG	Yes	No	No	Yes	State
Peter	Male	22	7/8	EU	Sciences	PG	No	No	No	Yes	State
Richard	Male	22	6/8	EU	Sciences	UG	No	No	Yes (minimal)	Yes	State
Robin	Female	24	22	Home	Arts and Humanities	PG	No	No	No	Yes	Grammar
Rory	Male	20	20	Home	Sciences	UG	Applied	No	Yes (later years)	No	Private
Ryan	Male	19	19	Home	Arts and Humanities	UG	Applied	No	No	No	State
Sophia	Female	21	11	Home	Sciences	UG	Yes	Yes (minimal)	Yes	Neutral	State
Stephen	Male	21	20	Home	Sciences	UG	Yes	No	No	No	State/Private
Tim	Male	25	10/11	EU	Social Sciences	PG	University Funded	Yes	Yes	Yes	State
Tom	Male	19	17	Home	Sciences	UG	Yes	No	Yes	Yes	Private

Appendix G: Table 2

Owen University Participants

Table 2. Main characteristics and profiles of the Owen University students.

Pseudonym	Gender	Age	Age Formally Diagnosed	Status	Degree Subject	Level	Disabled Students' Allowance	Used Technology at School	Support and Provisions at School	Technology Currently Supports Learning	Private / State School
Amy	Female	19	18	Home	Social Sciences	UG	Yes	No	No	Yes	State
Aidan	Male	21	12	Home	Sciences	UG	Yes	Yes	Yes	Yes	State / Private
Diana	Female	21	19	Home	Sciences	UG	Yes	No	No	Yes	State
Dominic	Male	21	7/8	Home	Arts	UG	Yes	Yes	Yes	Yes	State
Emma	Female	38	38	Home	Social Sciences	UG	Yes	No	No	Yes	State
Erica	Female	20	19	Home	Social Sciences	UG	Yes	No	No	Yes	State
Garrett	Male	24	18	Home	Sciences	UG	Yes	No	Yes	Yes	State
Helen	Female	21	11	Home	Social Sciences	UG	Yes	No	No	Yes	State
Holly	Female	21	8	Home	Arts	UG	Yes	No	Yes (minimal)	Yes	State
Jackie	Female	19	7/8	Home	Engineering	UG	Applied	Yes	No	Yes	State

Pseudonym	Gender	Age	Age Diagnosed	Student Status	Degree Subject	Level	Disabled Students' Allowance	Used Technology at School	Support and Provisions at School	Technology Currently Supports Learning	Private / State School
Joe	Male	20	7/8	Home	Engineering	UG	Yes	Yes (minimal)	Yes	Yes	State
Lucas	Male	32	29	Home	Social Sciences	UG	Yes	No	No	Yes	State
Neil	Male	19	12	Home	Sciences	UG	Yes	Yes	Yes (minimal)	Yes	Private
Patricia	Female	19	17	Home	Sciences	UG	Yes	No	No	Yes	State
Ray	Male	35	25	Home	Social Sciences	PG	No	No	No	Yes	State
Sophia	Female	55	51	Home	Arts	PG	Yes	No	No	Yes	State
Stephen	Male	25	7/8	Home	Social Sciences	UG	Yes	No	No	Yes	State
Todd	Male	20	5/6	Home	Humanities	UG	Yes	No	No	Yes	Private
Vince	Male	55	52	Home	Social Sciences	UG	Yes	No	No	Yes	State
Yasmin	Female	35	32	Home	Social Sciences	UG	Yes	No	No	Yes	State

Appendix H: History of Special Education in Great Britain

Presenting key events of the history of special education in Great Britain from the mid-eighteenth century to the mid-twentieth century (adapted from DES, 1978; Tomlinson, 1982).

1760 - 1870	Several asylums and schools for the deaf and blind were established.
1862	The Lunacy (Scotland) Act recognised the needs of the mentally handicapped.
1886	Idiots Act introduced the first legislation to deal with learning disabilities.
1870	Education Act introduced the first legislation for national education provision.
1892	Leicester School Board established first special class for pupils.
1899	Elementary Education Act established to introduce better provision for Defective and Epileptic Children.
1902	Education Act dissolved school boards and created a two-tier system of LEAs for elementary and secondary education.
1913	Mental Deficiency (Scotland) Act gave local authorities the responsibility to determine which children were defective.
1913	First educational psychologist appointed, Cyril Burt, by London County Council.
1918	Education Act raised the school leaving age from 12 years to 14 years and abolished fees in state elementary schools.
1921	Education Act forced parents of handicapped children to be educated in special schools or special classes.
1929	Findings of the Wood Committee recommended the institutionalisation of 100,000 ‘mental defectives’.
1939	The number of children attending state special schools reached 17,000.

Appendix I: UK Disability Legislation and Government Reports from 1940s

1940 - 1970	*1944 Education Act.* Introduced significant changes in the access and control of secondary schools with the school leaving age raised to 15 years. The Act stated that 'provision is made for pupils who suffer from any disability of mind or body by providing, either in special schools or otherwise, special educational treatment, that is to say, education by special methods appropriate for persons suffering from that disability' (Ministry of Education, 1944, p. 5).
1970 - 1980	*1970 Education (Handicapped Children) Act.* Made education universal by transferring responsibility of severely handicapped children from health authorities to LEAs. *1970 The Chronically Sick and Disabled Persons Act.* First legislation in the world to recognise and give disabled individuals rights. The Act required authorities to provide welfare services to disabled people and provide special educational facilities to children who were both blind and deaf. The Act was also extended to include autism and dyslexia. *1978 Warnock Report.* Following an enquiry, the report introduced the phrase 'special educational needs' into the education system, aiming to create a social model of disability. The report highlighted that 20 per cent of children would experience 'special educational needs' at some point in their educational career (DES, 1978).
1980 - 1990	*1981 Education Act.* After abolishing the formal labels of 'handicap', the act was based on findings from the Warnock Report (1978) and determined new rights about 'special educational needs' of all pupils and suitable forms of instruction. *1986 Disabled Persons Act.* Aimed to improve services for individuals with disabilities by strengthening their voice and requiring local authorities to provide assessments to ensure the appropriate level of care is provided.

1990 - 2000	*1990 National Health Service (NHS) and Community Care Act.* First major reform of the NHS since its foundation in 1948. Following the publication of two white papers, 'Working for Patients' (Department of Health, 1989) and 'Caring for People' (Department of Health, 1989a), the Act was an attempt to connect health boards and local council social services. *1992 Further and Higher Education Act.* Established Further Education Funding Councils (FEFCs), removing further education and sixth form colleges from LEA control. The Higher Education Funding Council England (HEFCE) was established to administer funds from government to higher education. The Act strengthened post-school opportunities for some individuals with learning difficulties and disabilities (Macadam and Sutcliffe, 1996). *1995 Disability Discrimination Act.* Gave rights to disabled individuals to help prevent discrimination based on their disability. The Act referred to a disabled person as 'a physical or mental impairment which has a substantial and long-term adverse effect on his ability to carry out normal day-to-day activities'. *2001 Special Educational Needs Act (SENDA).* Extended disability rights to disabled students ensuring they were not discriminated against in education. Establishing legal rights for pre- and post-16 education.
2000 - 2010	*2005 Mental Capacity Act.* Created to safeguard and empower individuals over 16 years of age who are mentally incapable of making their own decisions about their care and treatment. *2010 Equality Act.* Established to protect individuals from discrimination in the workplace and wider society. Replacing anti-discrimination laws, the Act brings together over 116 separate sections of legislation that were introduced since the early 1990s into one single Act, including the Disability Discrimination Act (1995).

Appendix J: DSA Key Developments and Resources 1983-2014

An overview of the DSA key developments and resources from 1983 to 2014. Adapted from National Network of Assessment Centres (NNAC, 2015).

1983	Creation of a national network to share experiences and provide individuals supporting students with advice on the use of information technology.
1986	Formation of the National Federation of Access Centres (NFAC) with the first formal assessments of students with disabilities including 8 members. Introduction of non-means tested grant payment to help cover extra costs for higher education.
1988	Open University (OU Access Technology Loan Scheme) awarded assessment project, in addition to £500,000 UK government grant for establishing a pool of enabling technology.
1989	NFAC expanded to 38 members with £125,000 from the UK government to create the DSA. Approximately 500 students receive the allowance covering only physical and sensory disabilities and under 25 years.
1991	Introduction of the non-medical helpers and general allowance.
Introduction of the Disability Discrimination Act 1995.	
1996	DSA extended to include students with SpLDs and mental health impairments.
1999	DRC established.
2000	Government review of the DSA process following complaints about timescales. A complete overhaul of the DSA is process is called for.
Introduction of the Special Educational Needs and Disability Act 2001.	
2002	Central government publish expenditure of DSA totalling £80 million with £30 million the cost of specialist equipment.
2004	E.A. Draffan and Robbie Sloane (Southampton University) establish Emptech web-based database of Assistive Technology.
Disability Discrimination Act Updated 2005.	
2007	DRC transferred to Equality and Humans Rights Commission.
Equality Act (2010) replaces the Disability Discrimination Act.	
2014	Government postpones cuts to the DSA until 2016-17.

Appendix K: HESA Statistics

HESA statistics and categories of disability for first-year undergraduates in 1994/1995, 2002/2003 and 2015/2016.

Type of Disability	1994/1995	2002/2003	2015/2016
Dyslexia/SpLDs	**1,679 (15%)**	**10,380 (49%)**	**25,740 (43%)**
Blind/Visual Impairment	**446 (4%)**	**540 (3%)**	**640 (1%)**
Deaf/Hearing Impairment	**700 (6%)**	**935 (4%)**	**1,105 (2%)**
Physical/Mobility Impairment	**643 (6%)**	**745 (3%)**	**1,770 (3%)**
Personal Care Support	**21 (0.2%)**	**45 (0.2%)**	**-**
Mental Health Condition	**212 (2%)**	**775 (4%)**	**11,250 (19%)**
Unseen Disability (Health Condition)	**5,870 (53%)**	**4,280 (20%)**	**5,600 (9%)**
Autism Spectrum Disorder	**-**	**-**	**2,695 (4%)**
Multiple Disabilities	**526 (5%)**	**870 (4%)**	**5,805 (10%)**
Other Disability	**1,065 (10%)**	**2,725 (13%)**	**4,855 (8%)**
Total known to have a disability	**11,162 (3.5%)**	**21,285 (6.5%)**	**59,460 (13%)**
Total Number First Year UK Students	323,011	351,805	457,715
Total known to have Dyslexia/SpLDs	1,679 (0.52%)	10,380 (3%)	25,740 (5.6%)