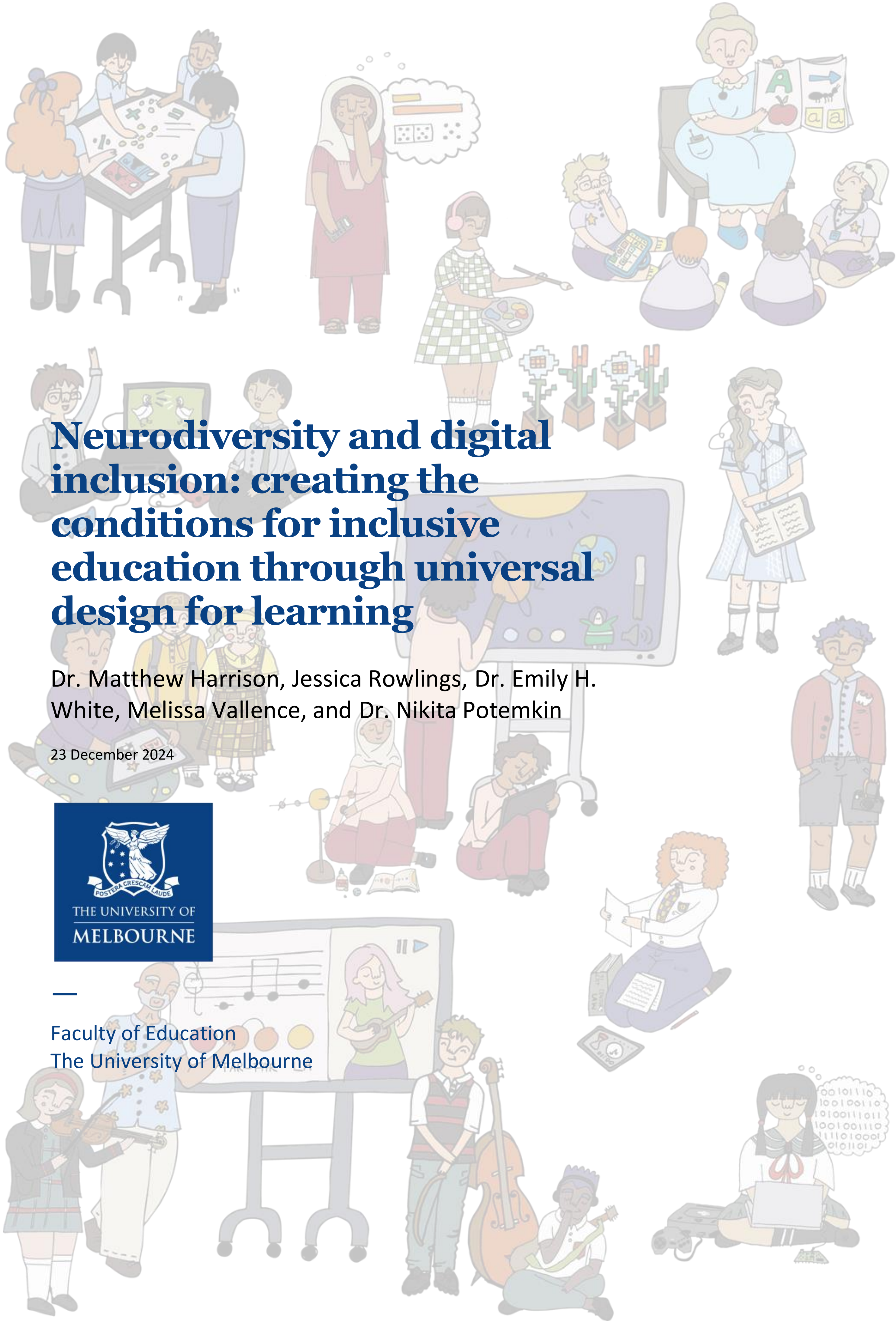


Neurodiversity and digital inclusion: creating the conditions for inclusive education through universal design for learning

Dr. Matthew Harrison, Jessica Rowlings, Dr. Emily H. White, Melissa Vallence, and Dr. Nikita Potemkin

23 December 2024

THE UNIVERSITY OF MELBOURNE

Faculty of Education
The University of Melbourne

Suggested citation

Harrison, M., Rowlings, J., White, E. H., Vallence, M., & Potemkin, N. (2024). *Neurodiversity and digital inclusion: creating the conditions for inclusive education through universal design for learning* [Commissioned report]. The University of Melbourne and SMART Technologies.

Acknowledgements

In the spirit of reconciliation, SMART Technologies and the University of Melbourne acknowledge the Traditional Custodians of country throughout Australia and their connections to the land, waters, and community. The researchers pay their respects to their Elders past and present and extend that respect to all Aboriginal and Torres Strait Islander peoples today. This is, was and always will be Aboriginal land.

The researchers would like to thank the six schools who have been their partners in this research. Their vision for inclusive education and support for the neurodivergent community led to the proposal for this research.

The researchers would also like to acknowledge SMART Technologies who provided the funding to conduct this research project. This funding has provided opportunities for neurodivergent researchers to undertake work that would otherwise not be possible. Beyond the primary SMART research partner, Rebecca Woolnough (SMART Oceania Manager), the University of Melbourne researchers would also like to highlight the support of Alex Cascianelli (SMART Education Consultant), Kris Astle (SMART Education Strategist), Katie Novak (SMART Strategic Tech Marketing Leader) and Jeff Lowe (SMART Executive Vice President and Chief Commercial Officer).

Accessibility considerations for this report

All images have been provided with alt text for people who use screen readers. All visual representations of data included in this report have been rendered using a colourblind-friendly colour palette.

Use of artwork in this report

Illustrations used in this report were created by a member of the research team, Melissa Vallence. The one exception to this is the ‘schoolhouse’ icon, which is used in this report under a Creative Commons licence from Alexander Kahlkopf (Iconmonstr.com) in line with the condition of use stipulated by the creator.

Executive Summary

The purpose of this project is to gain a better understanding of how technology is being used within inclusive classrooms to facilitate education and participation among neurodivergent students and students with disability. The authors of this review acknowledge that neurodivergence encompasses a breadth of neurotypes; however, for the purpose of the project, the researchers limited their scope to include students with diagnoses consistent with today's classification of autism, attention deficit hyperactivity disorder (ADHD), dyslexia, dysgraphia, and dyscalculia. This report uses strengths-based and affirmative language in line with the preferences of a growing voice of neurodivergent individuals (Kapp et al., 2013).

This project was co-designed with Matthew Harrison, PhD., Jessica Rowlings, Emily H. White, PhD., Melissa Vallence and Nikita Potemkin, PhD., and included conducting a rapid literature review of journal articles published between 2013 and 2023, exploring how, why, and to what effect neurodivergent children were using technology within the education system.

In designing this project, the researchers conceptualised a two-stage approach. In the initial stage of this study, the researchers conducted a rapid literature review employing qualitative thematic analysis. The themes generated from the review express a range of ways that technology is being used by neurodivergent students in inclusive classrooms.

The key two overarching themes and the respective subthemes identified through the rapid literature review were:

- *Theme 1*: Technology use within inclusive classrooms. Subthemes: technology use for curriculum delivery, social skills intervention, behavioural compliance, academic skills intervention, organisation and planning, sensory regulation and motor supports, educational data collection; technology use as a teacher support and a communication aid; and the use of digital games for inclusive education.

- *Theme 2*: Trends in research and practice. Subthemes: the neurodiversity paradigm, child-centred research and practice, and child voice.

Findings from this review provide insights into the degree to which current trends found in the literature are neurodiversity-affirming and how incorporating technology use into inclusive classroom settings can create or dismantle participation barriers for neurodivergent students. It also explored research evidence of the promotion of child agency and voice through the inclusion of participant perspectives, and investigated whether some current teaching practices that incorporate technology adhere to the principles of the Universal Design for Learning (UDL) framework (CAST, 2024a).

The second part of the research involved an exploratory case study of eight classrooms in four schools with different characteristics that reflect diversities within the community using the UDL framework to structure the analysis of the collected data. The researchers were interested in understanding how teachers and other school support staff, such as teaching assistants and allied health professionals, are using technologies in their classrooms to help students with disability/neurodivergence to fully participate in class alongside their peers.

Primary (elementary) and high schools were invited to participate, with a focus on classes from Foundation (typically with students aged five to six years old) to Year 10 (typically fifteen to sixteen years old) from six schools across Australia. The researchers sought to gain an understanding of the experiences of students and teachers in using digital technologies as tools for academic and social inclusion, and their perceptions of how technologies can best be positioned in their learning environments to remove barriers for learners. While this research project focused on removing barriers for neurodivergent students, the researchers were keen to hear the experiences of all students through the lens of UDL. The researchers also sought to understand the perspectives of school leaders in regard to policies on the use of technologies in their schools and the impacts of those policies on inclusive education.

The methods of data collection in the classroom case studies included:

- observational field notes describing researcher observations of sample lessons;

- small group interviews with children, including those with lived experiences of neurodivergence and those without neurodivergence;
- interviews with classroom teachers; and
- interviews with school leaders.

Two researchers collected observational data through field notes describing how students were working with and through technology, and the ways in which neurodivergent students appeared to be academically and socially included in classroom activities. Field notes also detailed the actions of the teachers in their efforts to support all students. This data provides a rich description of the events that occurred and nature of the interactions between the participants, and the interpretations of those events and interactions by the researchers as observers.

Interviews with students, teachers and school leaders generated data about their experiences of using technology in the classroom and how that use contributed to students' feelings of being included or excluded. To provide a collective viewpoint, the student interviews were conducted in small groups that included neurodivergent students. Both the student and teacher interviews used questions that focused on how all students experienced the use of technology and how the technologies used either helped them to feel included in or excluded from the classroom environment. Interviews with school leaders provided insights into understanding the policies that determined the nature and use of technologies in the classrooms.

Observational field notes and interview transcripts were qualitatively coded for themes and explored through the lens of the UDL framework. Connections were sought between researcher observations, the experiences of the students, teachers, and school leaders, and the UDL conceptualisations of *engagement*, *representation*, and *action and expression* (CAST, 2024a). The outcome of the project is the design of a set of 36 recommendations for teachers to help them leverage technology to support academic and social learning for all students through the UDL framework, with a particular emphasis on creating the conditions for supporting neurodivergent students across their schooling. These recommendations will be evaluated at scale in a future project.

Introduction to this research report

Positionality statement, language, and accessibility

This research project is informed by the lived experiences of the researchers. The research team is neurodiverse, including researchers who are neurodivergent and researchers who are neurotypical. It also includes people who identify across the gender spectrum and have a Western-centric understanding of knowledge and learning, bringing a range of perspectives to the work. The researchers are aware of potential subconscious biases and have consciously sought to critically engage with this project to minimise the privileging of their own lived experiences.

The authors have chosen to use identity-first language (for example, autistic children) throughout this report, reflecting the preferences of a growing number of neurodivergent people (Kapp et al., 2013). Despite this decision, the authors acknowledge that language is ever evolving and that individual preferences may differ. Several of this report's references include gender-binary categorisations and terminology. While the language present in these studies has been used to preserve the fidelity of the references, the authors of this report acknowledge and celebrate gender diversity beyond the binary biological sex categories found in the medical model.

The research team

Associate Professor **Matthew Harrison** (he/him) is an experienced teacher, researcher and digital creator who is an advocate for utilising technology to support social capacity building, belonging and inclusion in education. He has taught in Australia, South Korea and the United Kingdom at primary, secondary and tertiary levels. Matthew is currently a member of the University of Melbourne Faculty of Education Learning Intervention team, a project lead at the University of Melbourne Neurodiversity Project and co-founder of Next Level Collaboration, the first neurodivergent-led social enterprise to spin out of the University of Melbourne. He was awarded the Dyason Fellowship in 2020, and the GEM Scott Teaching Fellowship and the International Society for Technology in Education 'Making IT Happen' award in 2023.

Emily H. White, PhD (she/they) is a researcher and lecturer in the University of Melbourne Faculty of Education Learning Intervention team, and an experienced vision impairment specialist and physical education teacher for students with disability. Emily's work focuses on helping teachers understand and develop the capabilities of students with disability, particularly blindness and low vision, by leveraging assessment, technology, and inclusive pedagogy. Emily's research outcomes on digital literacy learning and teaching for students with disability are used in hundreds of schools across Australia as part of the 2023 Engagement Australia Excellence Award-winning ABLES/SWANs program, funded by an Australian Research Council Linkage Grant in partnership with the Department of Education Victoria. Emily serves as the President of the International Council for Education of People with Visual Impairment – Pacific Region.

Melissa Vallence (she/her) is a neurodivergent speech pathologist and emerging researcher. She has contributed to research critically analysing social and pragmatic language tools through a neurodiversity-affirming lens and has been invited to advise educators and speech pathologists on neurodiversity-affirming practice. Melissa has worked with children across speech pathology, music education, and inclusive gaming facilitation. Melissa's lived experience of autism and ADHD offers her a unique vantage point to contribute to research relating to the neurodivergent community.

Jess Rowlings (she/her) is a qualified speech pathologist and researcher at the University of Melbourne who specialises in video game-based intervention to build social capacity in neurodivergent children. Jess is also the co-founder and CEO of Next Level Collaboration, a social enterprise that runs strength-based programs supporting collaborative skill development and social connection for neurodivergent children using cooperative video games. Jess' work is informed by her lived experiences of autism and ADHD, along with her personal lifelong love of gaming. She has commenced her PhD investigating the experiences of neurodivergent women in gaming communities.

Nikita Potemkin, PhD (they/them) is passionate about working with data – big or small. They are currently a Bioinformatician for the Computational Sciences Initiative (CSI) at the Peter Doherty Institute in Melbourne, Australia and have extensive experience in both quantitative and qualitative research. They hold a BA from Oxford University in Psychology and an MA in Neuroscience from the University of Otago, New Zealand. Their PhD thesis, also at Otago, focused on the neurobiology of Alzheimer's disease.

Rebecca Woolnough (she/her) is a digital educator and is the Oceania Manager for SMART Technologies. She has 16 years of educational experience and excels in integrating digital technology into classrooms. She holds certifications as a SMART Ambassador, Seesaw Certified Educator, Microsoft Innovative Educator, and Apple Teacher. As the Senior Manager for Australia and New Zealand, she showcases leadership, problem-solving, and exceptional communication skills. Rebecca is pursuing a master's degree in cyber security, reflecting her dedication to privacy and security. She has presented at EduTech and the Inspire Greatness Conference, highlighting her commitment to professional development.

Key terms used in this report

The following list of keywords offers a concise explanation of some of the most used terms in this report. Beyond this introduction, each term is further explored throughout this report.

Action and expression

Action and expression is one of the three principles for access points to learning within the UDL framework. Action and expression refers to the variety of ways that diverse learners navigate learning and a learning environment and share their ideas and knowledge (CAST, 2024b).

Attention Deficit Hyperactivity Disorder (ADHD)

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental condition characterised by differences in how the brain's executive functioning system works. Executive functions are the mental processes that help the brain organise itself, including working memory, focus, planning, self-regulation, task switching, tasks maintenance, and impulse control (Baggetta & Alexander, 2016). ADHD is diagnostically categorised into three subtypes; hyperactivity, inattention, or a combined presentation that shows traits of both inattentive and hyperactive subtypes. People with ADHD have reported strengths in creativity, energetic communication styles, and the ability to focus intensely on a task for an extended period (Sedgwick et al., 2018; Schippers et al., 2024).

Autism

Autism is a lifelong neurodevelopmental spectrum condition characterised by persistent neurological, sensory, and behavioural nuances and patterns that are unique to the individual. Autistic people can experience a range of biological and functional differences across a spectrum of language, sensory, social, and emotional processing areas (Jeste, 2011), and may demonstrate strengths in pattern recognition, memory skills, attention to detail, artistic expression, and/or their ability to focus (Chow & Cooper, 2024; Meilleur et al., 2014;).

Autonomy

In relation to learning, *autonomy* refers to the sense a learner has that they can realise personally relevant learning goals.

Dyscalculia

Dyscalculia is a specific learning difference/difficulty/disability/disorder (SLD) that affects the development of numerical skills such as number identification, counting, arithmetic, estimation and magnitude processing (for example, comparing two numbers and identifying which is the largest) (Kucian & von Aster, 2014). People with dyscalculia are likely to have strengths in areas such as verbal communication and creative domains such as art, music, and design (University of Oxford, n.d.).

Dysgraphia

Dysgraphia is a specific learning difference/difficulty/disability/disorder (SLD) that affects the various processes of writing. This can include the physical act of holding a pencil ergonomically, producing legible handwriting, writing without increased effort, discomfort or fatigue, and written spatial planning of word spacing, letter size and capitalisation consistency (Chung et al., 2020). Drawing on anecdotal evidence from the grey literature, people with dysgraphia might also demonstrate exceptional listening and speaking skills, detail-oriented memory skills, highly engaging verbal language and storytelling skills, and efficient problem-solving abilities (Taylor, 2016).

Dyslexia

Dyslexia is a specific learning difference/difficulty/disability/disorder (SLD) characterised by difficulties with accurate and fluent word recognition, spelling, and decoding that arises from differences in how a person's brain is organised and how they process the phonological components of language. The structural differences in the brains of people with dyslexia that create challenges in reading and spelling also support cognitive strengths in areas including advanced global visual-spatial ability (in which the brain shows proficiency in processing visual images), strong episodic memory skills, creativity and a heightened ability to observe logical relationships and discrepancies in patterns (Taylor & Vestergaard, 2022).

Engagement

Engagement is one of the three principles for access points to learning within the UDL framework. Engagement concerns learners' individual experiences of motivation and enthusiasm for learning (CAST, 2024b).

Inclusive classroom environments

Inclusive classroom environments, as defined in this report, are those that cater to the diverse learning needs of all students, including those with specific learning disorders/differences/disabilities (SLDs), by providing multiple means of engagement, representation, and action and expression.

Inclusive education

According to the United Nations Children's Fund (UNICEF) and the United Nation's Convention on the Rights of Persons with Disabilities (2006), *inclusive education* means that children with disability, including neurodivergent children, should be able to fully participate in same learning activities in the same classrooms as their non-disabled/neurotypical peers. This includes providing reasonable accommodations and supports for all learners who require them to be safe, happy, and learning.

Inclusive education systems recognise and value the unique contributions that students from all backgrounds and with different abilities and needs bring to the classroom, fostering an environment where diverse groups can learn and grow together for the benefit of everyone. Around the world, inclusive education is a key priority for educators, school systems, and governments, who are working collaboratively to realise the vision outlined in Article 24 of the United Nations Convention on the Rights of Persons with Disabilities (2006).

Learner agency

Learner agency, for the purpose of this report, is, "the capacity to actively participate in making choices in service of learning goals" (CAST, 2024d, para. 1).

Neurodiverse/neurodiversity

Neurodiverse/neurodiversity refers to the presence of a range of neurotypes in a group of people.

Neurodivergent/neurodivergence

Neurodivergent/neurodivergence refers to people with neurological differences that impact how they experience and interact with the world around them. Neurological differences are natural variations in how a person processes, stores, and retrieves information. Neurodivergence is an umbrella term that includes many *neurotypes* originating from developmental and acquired brain differences such as autism, attention deficit hyperactivity disorder, dyslexia, and dyscalculia.

Neurotype

A *neurotype* is the characteristic way in which a person's brain interprets and interacts with the world around them. Humans comprise many neurotypes which tend to be categorised into groups organised by diagnostic labels.

Neurotypical

Neurotypical refers to individuals whose neurological development and functioning is considered typical by the conventions of their society and culture. The term refers to anyone without neurological or developmental differences. Many neurotypical people tend to process and navigate their sensory, social and communicative environments with relative comfort.

Specific learning differences/difficulties/disabilities/disorders (SLDs)

Specific differences/difficulties/disabilities/disorders (SLDs) refer to a group of neurotypes who experience lifelong challenges in learning in a specific domain (American Psychiatric Association, 2013). The incorporation of the different terms of *differences*, *difficulties*, *disabilities* and *disorders* here recognises the current discourse in the field regarding the nomenclature and the possible implications and preferences for the different terms by people who have SLDs. This group of neurotypes will be referred to as SLDs throughout the report. SLDs in reading are commonly known as dyslexia. SLDs in writing and written expression are commonly known as dysgraphia, and SLDs in mathematics are commonly known as dyscalculia.

Representation

Representation is one of the three principles for access points to learning within the UDL framework. Representation addresses how learners perceive and make sense of information depending on individual factors (CAST, 2024b).

Stimming

Self-stimulatory behaviour, or *stimming* refers to repetitive body movements, sounds, or actions that individuals, particularly those who are autistic, engage in for the purpose of self-regulation or to express emotions. Examples include rhythmic fidgeting, hand-flapping, rocking back and forth, hair-twirling, repetitive speech or sounds, and focusing intently on environmental patterns. Stimming is often used to manage sensory overload, to express emotions like anxiety or excitement, and to comfort or calm individuals. Stimming is a natural behaviour and is harmless in most cases. Sometimes, stimming can pose a risk of bodily harm (for example, head hitting, skin or nail picking), interfere with daily activities, or distract others, so individuals should be provided appropriate sensory regulation supports across environments.

Technology

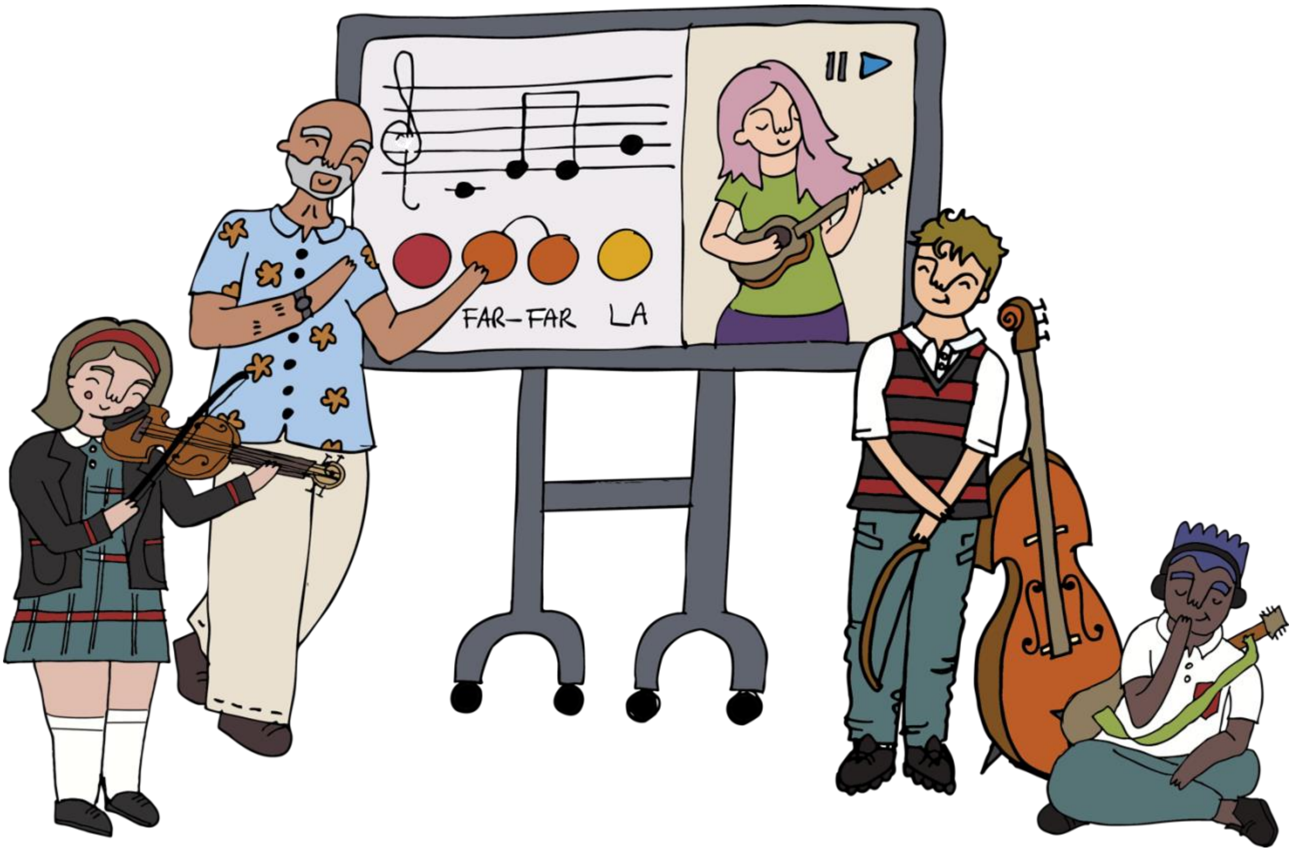
Technology, for the purpose of this report, is inclusive of educational technologies, assistive technologies, and therapeutic technologies. *Educational technologies* are products that either enhance the delivery of curriculum through digital technologies (for example, interactive digital displays, media players, online curriculum modules) or provide a digital medium through which targeted learning can be achieved (for example, games, apps, academic tutoring software). *Assistive technology* refers to any hardware or software with the potential to enhance access and outcomes for people with functional and learning support needs (for example, word prediction software, text-to-speech software, dictation software, adaptive hardware, communication devices) For the purpose of this report, *therapeutic technologies* refer to those technologies designed to target various neurodivergent behaviours that may be interpreted as off-task, disruptive or challenging in a classroom setting. These could include planning and organisational software, digital regulation supports, and social modelling robots.

The neurodiversity movement

The *neurodiversity movement* refers to the social justice movement that affirms the humanity, strengths, and contributions of neurodiverse people. Arising in the 1990s from a reaction to the violations of the human rights of neurodivergent people and shifts in understanding what it means to be neurodivergent, the movement seeks to challenge traditional deficit-based notions definitions of what it means to be neurodivergent (Singer, 1998). The movement advocates for affirmative, strengths-based language regarding neurodiversity; the inclusion of the neurodivergent community in society, discourse, and research; and the dismantling of practices and frameworks that cause harm to neurodivergent people. It seeks to ensure that the functional needs of neurodivergent individuals are supported in order to increase their autonomy and participation, and the celebration of differences through active allyship, policy and practices (Milton & Moon, 2012).

Universal Design for Learning

Universal Design for Learning (UDL) is an internationally used framework designed to optimise teaching and learning for all people based on scientific insights into how humans learn (CAST, 2024a). It aims to help with identifying and removing barriers to academic and social participation across learning environments. To do so, it seeks to help guide the co-design of “accessible, inclusive, equitable, and challenging” learning environments for a diverse range of learners (CAST, 2024b, para 1.). The UDL Guidelines 3.0 focuses on supporting learner access to three principles: *engagement*, *representation*, and *action and expression* (CAST, 2024b).



Introduction to this research project

This research report communicates the findings of a project that explored how digital technologies can be effectively positioned and optimised in classrooms to support academic and social inclusion. Grounded in the Universal Design for Learning (UDL) framework (CAST, 2024a), the study seeks to amplify the voices and experiences of students, teachers, and school leaders. It comprises two distinct components: a rapid review of global research on leveraging digital technologies to support neurodivergent students, and six case studies capturing the lived experiences of key stakeholders in using these tools to foster inclusive education. While the research was commissioned by SMART Technologies, it takes a broad perspective by exploring the potential of different digital technologies as enablers of or barriers to inclusive education for neurodivergent students and/or students with disability.

Background

Prevalence of neurodivergence

While neurodivergence includes a range of *neurotypes*, this review focuses primarily on autism, ADHD and specific differences/difficulties/disabilities/disorders (SLDs) such as dyslexia, dysgraphia, and dyscalculia. An estimated 10-20 percent of the world's population are neurodivergent (Doyle, 2020). The number of school-aged children with a formal diagnosis differs across countries. The global rate of neurodivergent children who progress through the education system undiagnosed is unknown.

While many neurodivergent conditions were not formally described until the 20th Century, colloquial evidence of neurodivergence stretches back through human history. It is a common misconception that neurodivergence has proliferated in recent decades. An increase in the prevalence rates of neurodivergence can more accurately be attributed to advances in identification and documentation (Harris, 2023).

Additionally, changing medical perspectives and societal attitudes toward behaviour and learning have begun to address the gender-based diagnostic skew that has traditionally described neuro-conformity and deviation from male-centric perspectives. In the past decade, both medical and societal understanding has progressed regarding how neurodivergence in women and gender-diverse individuals often presents differently than in males. As a result, the gender diagnostic gap is decreasing. Table 1 provides a brief snapshot of global neurodivergence prevalence.

Table 1. Snapshot of global neurodivergence prevalence.

Global Neurodivergence Prevalence Snapshot	Research Source
In the United States, around 9% of school-aged children are treated for ADHD and 14% of students receive some form of special education	U.S. Department of Health and Human Services, 2016-2017
The United Kingdom and Canada report that up to 1 in 5 students are impacted by mild, moderate, or severe dyslexia	Canadian Dyslexia Association, 2023; British Dyslexia Association, 2020
3.2% of Australian students are diagnosed as autistic. 85% of these students reported difficulty at school through the national Census.	Autism in Australia Report, ABS, 2015.
The incidence of dyscalculia in the Australian population is estimated to be between 6-7%	Callaway, 2013
Between 10%-30% of children experience difficulties with handwriting or written expression	Chung et al., 2020
Globally, an estimated 2.5 billion people need one or more assistive devices to support physical, communicative, or cognitive needs	World Health Organization, n.d.
1.2 million Australians have a communication disability that affects their ability to understand or be understood by others	Australian Bureau of Statistics, 2015

The medical model of disability

The framing of neurodivergence in this report has a long and evolving history shaped by a progressive shift in medical perspectives and societal attitudes towards behaviour and learning. To understand how neurodivergent people are often currently treated across social and educational settings, this report offers a historic perspective on the diagnostic categorisation of neurodivergence, with a focus on specific neurotypes discussed below, and the resultant development of therapies targeting these neurotypes that have, until recently, been widely accepted. The impact of the longstanding pathological treatment of neurodivergence cannot be understated, as it has informed much of how Western society has come to understand and relate to this heterogenous group of people. The *medical model* frames non-normative cognitive and behavioural traits as deficits and measures the progress of neurodivergent individuals by monitoring the reduction in traits associated with diagnostic criteria. This model has often been used to underpin frameworks for educating and treating neurodivergent children.

Autism

Historical understandings of autism

The term *autism* was first used in the early 1900s to describe what Bleuler termed 'self-centred thinking' seen in infantile schizophrenia (1911). The earliest clinical descriptions of autism as a stand-alone condition appeared in the 1940s, when psychologist Leo Kanner published his landmark paper describing a group of children who exhibited social isolation, repetitive behaviours and a preference for routine (Kanner, 1943). Around the same time, psychiatrist Hans Asperger described a condition characterised by social deficits and high intellectual functioning (Asperger, 1941/1991). Theories of autism that followed described behaviours that resembled a personality disorder, including the false belief that it was caused by cold and inattentive mothering (Bettelheim, 1967). These theories were eclipsed in the 1970s by biological models of autism that focussed on identifying regions of abnormal brain development.

In 1978, psychiatrist Michael Rutter proposed a formal definition of autism detailing deviant and delayed social and language abilities, restricted interests, and repetitive behaviours (Rutter, 1978). The American National Society for Autistic Children (NSAC) proposed its definition the same year, which included unusual developmental sequences and environmental sensitivities (American National Society for Autistic Children, 1978) The first definition of autism included in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM) was heavily influenced by Rutter's psychiatric description and did not include NSAC's neurodevelopmental definition (Rosen et al., 2021). Sensory differences were not included in the DSM until its most recent edition (Rosen et al., 2021). Current DSM-5 diagnostic criteria sub-categorises autism into three severity levels, determined by the impact of symptoms and the level of support required and outlines symptoms of pervasive social communication deficits and restricted behaviours that emerge in early childhood (American Psychiatric Association, 2013).

While The DSM-5 briefly mentions sensory sensitivities and neurodevelopmental differences, its classification frames autism primarily as a condition of psycho-social abnormalities and behavioural deficits. Interventions informed by the diagnostic criteria for autism overwhelmingly target differences in psycho-social behaviours. Traditional management approaches encourage autistic individuals to behave in neurotypical manners, an adaptive behaviour known as *masking* (Bottema-Beutel et al., 2017).

Historical therapeutic approaches to autism

The 1970s saw the birth of one of the most common and controversial therapies for autism, Applied Behavioural Analysis (ABA). Pioneered by Ole Ivar Lovaas at the University of California - Los Angeles, ABA hinged on the idea that unwanted societal behaviours could be modified through reinforcement and bio-psycho-social shaping techniques (Grabner & Grabner, 2023; Kirkham, 2017). Lovaas' program used the foundational theories of operant conditioning, including prompting, modelling, repetition, and reinforcers (for example, food, drink, touch, and verbal reinforcers) to train autistic children to reduce behaviours like *stimming*, *echolalia*, and a wandering eye gaze, and increase normative behaviours like sitting still, maintaining eye contact, and verbal turn-taking (Chapman & Bovell, 2020; Kirkham, 2017). One of the greatest controversies surrounding Lovaas's work concerns ABA's inclusion of negative reinforcement and punishment (for example, smacking, restraining, yelling, verbal scolding and removing or withholding food and preferred items). Under early ABA models, children experiencing states of sensory overwhelm, confusion and meltdowns were shouted at, smacked and restrained until they performed desirable behaviours, which were then rewarded with food, hugs, kisses, and verbal praise (Kirkham, 2017). It is the opinion of the research team that the ideology underpinning ABA has been largely rejected by the neurodivergent community.

The neurodiversity movement celebrates autistic traits as differences rather than deficits and provides a growing platform for autistic individuals to advocate for kinder and fairer treatment. While ABA as it is practiced today no longer involves the same level of negative reinforcement, critics argue that contemporary applications continue to train normative behaviours and prioritise compliance and conformity over the well-being and autonomy of the individual (Chapman & Bovell, 2020). The debate surrounding ABA is ongoing, with proponents emphasising its effectiveness in teaching essential skills and critics pointing to concerns about its potential to undermine autonomy, emotional health, and self-expression, especially when it is used to normalise behaviour in ways that do not respect neurodiversity.

Moving towards a new paradigm for autistic people

As the global movement toward inclusive education grows, many autistic children are joining their neurotypical peers in inclusive classrooms, in line with the United Nations Convention on the Rights of Persons with Disabilities (2006), instead of being taught in separate specialist education classrooms (Antoninis et al., 2020; Slee & Tait, 2022). Yet the impact of historical understandings of neurodiversity remains, including through the continued use of exclusionary approaches to address social differences and academic disengagement in autistic schoolchildren. The controversy surrounding such approaches reflects the increasing influence of the neurodiversity movement in highlighting the harm caused by simplistic and reactive approaches to understanding diverse ways of being. It has also helped shift the focus from the medical model of disability to the *social model*, which views environmental barriers as the main factors that prevent people with physical and neurological differences from fully participating in society.

Presently, there are few verified digital resources for teachers and other adults to understand and apply neurodiversity-affirming strategies to support autistic children to excel across different environments (see the findings of the rapid literature review in this report). While there is a growing conversation in online spaces regarding contemporary ways to support autistic children, there remains a gap in the evidence from academic and government literature about the efficacy of neurodiversity-affirming approaches (Mirfin-Veitch et al., 2020; Wood et al., 2022). As such, there is a pressing need for research to build an evidence base for incorporating neurodiversity-affirming practices into current medical and pedagogical frameworks. Research that includes the voices of autistic people would provide additional arguments for the validity of the outcomes to inform changes in knowledge, practice, and policy.

Attention Deficit Hyperactivity Disorder (ADHD)

Historical understandings of ADHD

The trait cluster of *Attention Deficit Hyperactivity Disorder* (ADHD) has been described in scientific literature since the mid-18th Century. Early theorists and physicians used various names including 'Minimal Brain Dysfunction' and 'Hyperkinetic Disease of Infancy' to describe children who exhibited hyperactivity, impulsivity, and inattention. (Lange et al., 2010). The neurological basis of ADHD remained poorly understood until the mid to late-20th century. The rise of stimulant medications used to manage symptoms of ADHD throughout the mid-20th Century increased scientific interest in the condition and contributed to advancements in research surrounding neurochemistry and neurophysiology. The diagnostic term Attention-Deficit Disorder (ADD) was introduced in the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-III) in 1980, later evolving into the more widely recognised ADHD in the DSM-IV in 1994. Over the past thirty years, research has focused on the role of neurotransmitters like dopamine and norepinephrine in regulating attention and behaviour, and differences in executive functions were linked to ADHD. Today, ADHD is considered a lifelong condition affecting children and adults. The DSM-5 now characterises ADHD as a neurodevelopmental disorder with a genetic basis that presents as symptoms of inattention, hyperactivity, and impulsivity. The global prevalence of ADHD is believed to be around 8% (Abdelnour et al., 2022).

Gender differences in ADHD presentation and diagnosis

Historically, ADHD has been diagnosed more frequently in males than females, with the disorder often perceived as primarily affecting boys and men. This diagnostic skew is due, in part, to differences in how ADHD manifests in different sexes (Abdelnour et al., 2022). Boys and men with ADHD are more likely to display the classic symptoms of hyperactivity and impulsivity, which are more easily recognised by parents, teachers, and clinicians. Contrary to what its name suggests, people with ADHD do not have a deficit of attention. Rather, their brain uses dopamine and noradrenaline in different ways to those who do not have ADHD. According to the state-regulation theory of ADHD, people with ADHD tend to need greater levels of informational and sensory input to sustain their dopamine levels, leading them to continuously seek stimuli in their environment, which manifests in behaviours that may appear hyperactive and/or inattentive (Isaac et al., 2024).

These outward, overt behaviours make ADHD in boys and men more conspicuous and more likely to be diagnosed at an early age. In contrast, girls and women with ADHD tend to exhibit more internalised and subtle traits, including inattention, daydreaming, anxiety, and low self-esteem. These less obvious symptoms are frequently overlooked or misattributed to emotional difficulties, leading to delays in diagnosis and support. Moreover, girls and women are often socialised to be more compliant and less disruptive in social environments, which may further mask the signs of ADHD in school-aged girls. As a result, many girls and women with ADHD go undiagnosed and untreated well into adulthood. In recent years, there has been a growing awareness of these gender differences, leading to a more nuanced understanding of ADHD. Research has shown that while boys are diagnosed more frequently in childhood, the gender gap narrows in adulthood, as many undiagnosed girls are identified later in life, often after experiencing tertiary or professional struggles (London & Landes, 2019). This shift has led to an increase in diagnoses among adult women, as well as a greater emphasis on gender-sensitive approaches to understanding and framing neurological differences.

Negative stereotypes and stigma surrounding ADHD

ADHD receives disproportionate negative media attention and social stigma. Critics argue that ADHD is used as a label to excuse bad behaviour and/or poor parenting and teaching (Faraone, 2005). Stimulant medication has been proven to be safe and effective in helping to manage some of challenges of having ADHD, yet its use can be misunderstood or misrepresented as being dangerous. Myths about ADHD and its treatment can create barriers to diagnosis, management, and supports, and harm the wellbeing of people living with ADHD by stigmatising the condition.

Students with ADHD face educational challenges that may go unaddressed, particularly for those with inattentive presentations who do not receive targeted classroom supports. Research highlights disproportionately high dropout rates among this population, compounded by factors such as unmet needs, stigma, and limited understanding of their experiences (Dvorsky et al., 2016; Sikirica et al., 2014). These are issues compounded by the paucity of studies that include students' perspectives. Historically, early theories linked ADHD to children’s use of technology, such as television and video games. When thoughtfully implemented, however, contemporary research demonstrates that technology can be a powerful tool in supporting these students’ learning and engagement.

Dyslexia

Historical understandings of dyslexia

Dyslexia is an SLD characterised by difficulties with accurate and fluent word recognition, spelling, and decoding that arises from differences in how a person’s brain is organised and how they process the phonological components of language. This report discusses the developmental form of dyslexia as opposed to acquired forms due to illness or injury (i.e., damage to the brain).

Early definitions emerging in the late 19th century referred to dyslexia as ‘word blindness’, which was incorrectly thought to stem from an ocular deficit (Kussmaul, 1877). While contemporary understandings have shifted towards acknowledging dyslexia as a distinct cognitive profile, there is ongoing academic and social debate surrounding the label. Critics of the current definition of dyslexia argue that the diagnostic category for dyslexia is too broad (Kirby, 2020). Such views have been exacerbated by media and social media and proliferated stigma framing dyslexia as an “excuse for bad behaviour, stupidity or parental neurosis” (Liddle, 2014). Proponents advocate that the label of dyslexia helps distinguish reading differences, motivates parents and legislators to provide effective support and protects children from being falsely labelled as “stupid or lazy” (Reading Well, 2014).

An estimated 5-15% of the population are dyslexic, making it one of the most common learning differences. Dyslexia is present in an estimated 10% of school-aged children, with variations across languages. Dyslexia prevalence is slightly lower in countries where the primary language has consistent sound-letter relationships, like Finnish or Italian, than where the primary language has greater inconsistency in sound-letter relationships, like English (Sprenger-Charolles et al., 2011).

Dyslexia is rooted in neurological differences, particularly in how the brain processes language. Neuroimaging studies reveal that individuals with dyslexia tend to rely more on right hemisphere processing during reading tasks, which is atypical compared to the left hemisphere dominance observed in neurotypical readers (Munzer et al., 2020). Additionally, there is an overreliance on Broca's area, a region of the brain associated with language production, rather than on areas specialised for fluent word recognition. This shift in neural processing results in a consistently higher cognitive load when trying to process the connections between letters, words, and sounds, making reading a labour-intensive activity for individuals with dyslexia (Habib, 2000).

For most of human history, reading was not a primary mode of learning or communication. Humans evolved to excel in narrative forms of learning, oral storytelling, and physically interacting with their environment. Written language is a relatively recent development in human history and became a necessity only after the invention of writing systems. As such, the human brain does not have a specific area designed for reading; instead, the brain adapts existing neural pathways to accommodate this skill. As reading leverages numerous brain regions and pathways across both hemispheres, how people are affected by dyslexia varies greatly. People with dyslexia tend to leverage more right-hemisphere brain regions when processing visual and auditory information than people who are neurotypical, meaning that those with dyslexia are often working with increased cognitive load (Habib, 2000).

Difficulties with reading can have profound consequences for educational achievement. In modern education systems, reading underpins nearly every subject, which presents a systemic barrier to access when a student has difficulty with reading. Current curriculum structures generally provide primary access to knowledge through text-heavy formats, which disproportionately disadvantages individuals with reading difficulties. Students with dyslexia often face challenges across all subjects, limiting their ability to demonstrate understanding and succeed academically (Zhou, 2022). This disadvantage can extend into adulthood, affecting employment opportunities and socioeconomic status. Individuals with dyslexia are overrepresented in unemployment statistics and are more likely to earn below-average incomes, highlighting the long-term impact of systemic barriers encountered in childhood (Wissell et al., 2022).

While extensive research exists on the neurological and cognitive aspects of dyslexia, less attention has been paid to practical, support-focused interventions. Assistive technologies, such as text-to-speech software and audiobooks, offer promising tools to access text in alternative formats. Barriers such as cost, lack of awareness, and institutional resistance, however, can prevent students from accessing these resources. Students with dyslexia have reported feeling stigmatised in educational settings (Doikou-Avlidou, 2015) which can impact self-esteem and reinforce feelings of inadequacy. Institutional frameworks often emphasise remediation over accommodation, framing dyslexia as a problem needing to be fixed rather than a difference to be supported. Greater emphasis on understanding student experiences and incorporating their perspectives into policy and practice is crucial for fostering inclusive learning environments.

Dysgraphia

Dysgraphia is an SLD that affects the transcription component of writing. This report discusses the developmental form of dysgraphia as opposed to acquired forms due to illness or injury (i.e., damage to the brain).

People with dysgraphia typically do not have difficulty forming ideas and expressing themselves verbally. Rather, they have difficulty with the process of putting their thoughts onto paper. Dysgraphia can also affect a person's writing processes and written expression. People with dysgraphia can experience challenges organising and expressing their thoughts in writing and may produce written grammatical errors that do not appear in their speech. Challenges may also extend to difficulty with spelling and copying written language (Chung et al., 2020). Dysgraphia is poorly understood and often goes undiagnosed. While different theories have been proposed regarding the mechanisms of dysgraphia over time, there is no single agreed-upon model describing this neurotype (Chung et al., 2020).

The term *dysgraphia* was first introduced in the early 20th century, though the phenomenon itself had been observed for much longer. Early academic accounts of writing difficulties date back to the late 19th Century, when physician Samuel Orton, known for his work on dyslexia, also described children with difficulties in motor control and handwriting (Orton, 1955). At this time, scientific inquiry had not yet developed an understanding that differences in written expression and organisation relate to various cognitive processes. Initial research on dysgraphia focussed on the physical aspects of writing (such as penmanship, handwriting legibility and muscle strength and coordination) and framed it primarily characterised by motor differences. It was not until the 1970s and 1980s that dysgraphia began to be systematically studied and was categorised as a distinct cognitive presentation. Around this time, psychiatrist and neurologist Norman Geschwind published pioneering work exploring the neurological underpinnings of language differences. He provided the first evidence that dysgraphia could result from both motor differences and differences in the organisation of higher-level cognitive processes responsible for translating organised thoughts into written form (Geschwind, 1974).

Today, dysgraphia is understood as multifaceted, but debate remains about whether it exists as a unified neurotype or as encompassing many subtypes, including *peripheral dysgraphia* (differences in motor control and proprioception), *spatial dysgraphia* (differences in spatial perception, organisation and drawing ability), *dysorthography* (difficulties with spelling and recalling letter-sound relationships), and *linguistic dysgraphia* (differences in written expression) (Chung et al., 2020). While such academic debates may seem semantic, accurate categorisation can help ensure that people with SLDs receive relevant interventions that target their specific needs, rather than generalised supports that may not.

Difficulty in writing is believed to be experienced by 10% to 30% of children, with the exact prevalence depending on the definition of dysgraphia, and is more common in males than females (Berninger & O'Malley May, 2011). The act of writing encompasses a spectrum of tasks discrete tasks that are learnt through a step-wise progression over time across the curriculum. This ranges from the foundational tasks, such as copying symbols, to the complex process of conceptualising, drafting, revising, and editing written assignments (Chung et al., 2020).

Writing is embedded into most components of school-based learning, so a late or missed diagnosis can cause students with dysgraphia to fall behind academically (Chung et al., 2020). Students who have difficulty with writing are often mislabelled as sloppy or lazy rather than offered alternative means to express what they have learnt. Handwriting difficulty has been associated with lower self-perception, lower self-esteem, and poorer social functioning (Feder et al., 2000). Increasing awareness about dysgraphia and providing early identification and effective, timely supports for students with dysgraphia is vital to ensure their academic and social participation and success.

Dyscalculia

Dyscalculia is an SLD that impacts a person's ability to process numerical information (University of Oxford, n.d.). This report discusses the developmental form of dyscalculia as opposed to acquired forms due to illness or injury (i.e., damage to the brain).

Dyscalculia can present as challenges with understanding, recalling or manipulating numbers, performing arithmetic skills like counting or multiplication, or translating between written and numerical representations of numbers. Kucian and von Aster (2014) highlight that a range of studies have shown that these difficulties may result from differences in numerical functioning at a behavioural level (e.g., mental calculation skills), cognitive level (e.g., symbolic number representation) and neuronal level (e.g., brain activity in the frontal-parietal network). Some studies have found that people with dyscalculia show differences in the brain areas responsible for number processing and in brain areas not directly associated with numerical skills (Kucian & von Aster, 2014). These findings may explain why many people with dyscalculia develop compensatory mechanisms that use other cognitive skills to help manage their challenges and may demonstrate strong capabilities in non-numerical cognitive skills including strategic thinking, lateral thinking, and problem-solving skills. While many of these differences can have a genetic component, research has also explored the influence of environmental factors such as educational experiences and teaching style on the presentation of dyscalculia (Kucian & von Aster, 2014).

An estimated 3-7% of all children, adolescents, and adults are believed to have dyscalculia, with high rates of co-occurrence in dyscalculia, dyslexia and ADHD (Haberstroh & Schulte-Körne, 2019). Studies have not yet found any clear gender differences in dyscalculia diagnosis rates (Lewis & Fisher, 2016). While many with dyscalculia are first identified at primary school-age when their challenges with numeracy and calculation become apparent, others' challenges with numeracy remain unrecognised (Kucian & von Aster, 2014). Without the supports they need, these students are more likely to develop low self-esteem resulting from ongoing challenges with mathematical tasks, and students with dyscalculia who do not receive support are often at greater risk of school non-attendance (Haberstroh & Schulte-Körne, 2019). People with dyscalculia may also have challenges with broader skills such as working memory or executive functioning, and visuo-spatial skills are often a particular area of challenge.

While likely cases of dyscalculia have been documented leading back to the 1800s, the term *dyscalculia* was first coined in 1974 by Czechoslovakian researcher Ladislav Kosc (Espina et al., 2022). Kosc (1974) originally described six types of dyscalculia; *verbal dyscalculia* (difficulty understanding mathematical terminology), *practognostic dyscalculia* (difficulties with mathematical representation of objects), *lexical dyscalculia* (difficulty reading mathematical symbols), *graphic dyscalculia* (difficulty writing mathematical symbols), *ideaognostic dyscalculia* (difficulty understanding mathematics concepts and ideas) and *operational dyscalculia* (difficulty performing mental arithmetic). Reeve and Waldecker (2017) highlight some key considerations in regard to the presentations described by Kosc (1974), aligned with progressive developments in the understanding of dyscalculia. Reeve and Waldecker (2017) note that Kosc's descriptions reflect commonly observed challenges with mathematics, which may also present in co-occurrence with other diagnoses (for example, dyslexia). Furthermore, Kosc (1974) does not describe any potential underlying causes for these dyscalculia subtypes, and it is possible that a consistent underlying area of challenge may be present across all six categories.

Historically, the body of research focusing on dyscalculia has been substantially smaller in comparison to studies focusing on other learning differences such as dyslexia and ADHD (Espina et al., 2022). Despite research interest in dyscalculia markedly increasing over the past 20 years, the outcomes of such research have not necessarily been integrated into educational practices (Haberstroh & Schulte-Körne, 2019). In the context of Australia, descriptions of SLDs, including dyscalculia notably differ between state education departments and their official documents (Reeve, 2019). While recent improvements in evidence-based supports for the assessment and teaching of students with difficulty in mathematics are encouraging (e.g., Balt et al., 2020; Strickland et al., 2020), teachers in Australia often do not receive formal training in how to identify and support students with SLDs including dyscalculia (Reeve, 2019). So, despite the range of interventions available to support students with dyscalculia, a lack of teacher knowledge about dyscalculia can also compromise the effective implementation of such interventions (Reeve & Waldecker, 2017).

Frameworks for supporting and educating children with learning differences

Global move towards inclusive education model

As of March 2024, 164 countries have signed the United Nations Convention on the Rights of Persons with Disabilities (CRPD), along with the European Union. Adopted in 2006 and opened for signatures in 2007, the CRPD entered into force in 2008 after being ratified by 20 state parties. This landmark treaty is the first human rights convention ratified by a regional integration organisation, underscoring the commitment of its signatories to upholding the rights and freedoms of persons with disabilities. The CRPD applies a broad definition of disability inclusive of neurodivergent people.

The CRPD identifies areas where the rights of people with disabilities have been violated or need further protection, with a significant focus on education. A critical component of the CRPD is Article 24, which asserts the right of all persons with disabilities, including neurodivergent individuals, to high-quality, inclusive education. This article stresses that inclusive education is not only a right but a fundamental principle underpinning equality in education. An inclusive system accommodates students of all abilities and requirements across all levels, from early childhood to lifelong learning. The CRPD mandates the provision of *reasonable accommodations* to support equitable access to education. These accommodations, such as tailored services or adaptations, must be determined collaboratively with students, and where appropriate, their families or caregivers, ensuring they are relevant, effective, and feasible. By emphasising these measures, the CRPD seeks to eliminate discrimination and foster genuine inclusion for all learners.

Resource: UNICEF has created a plain language guide that provides further information about inclusive education as defined in Article 24 of the Convention on the Rights of Persons with Disabilities.

Universal Design for Learning

Universal Design for Learning (UDL) is a framework for inclusive teaching and learning that aims to build learner agency that is:

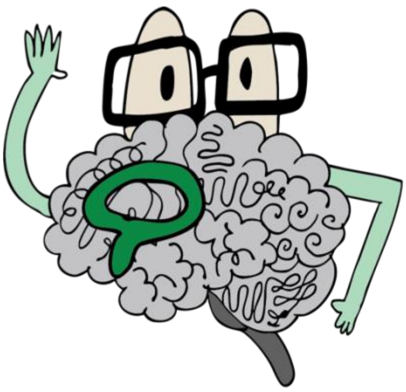
- purposeful and reflective,
- resourceful and authentic, and
- strategic and action-oriented (CAST, 2024a).

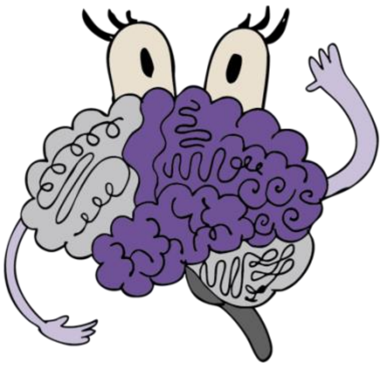
To do so, it seeks to make learning accessible for all through effective teaching and learning practices supported by neuroscientific research. The UDL framework can be applied to reduce barriers to learning for diverse learners by enacting the principles within the UDL Guidelines (CAST, 2024b). The UDL Guidelines act as a “living, dynamic tool” (CAST, 2024b, para. 4) for teachers and others involved in supporting diverse students to access and participate in learning by offering suggestions to improve teaching and learning regardless of discipline or domain.

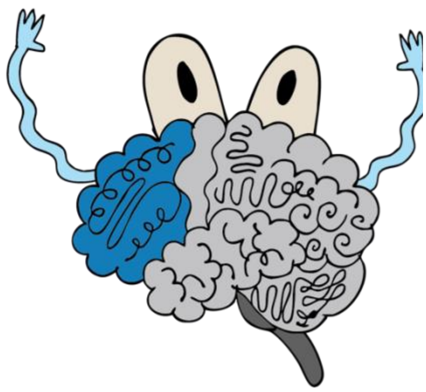
This advice includes information about how each to design a range of ways to support learner access to each principle for the purpose of reducing barriers to learning. By reducing these barriers, educators can better support diverse learners’ learning processes and executive functioning to help them reach their learning goals.

The three principles of UDL

To help teachers and school leaders in reducing barriers to learning, the UDL Guidelines (CAST, 2024b) draw on neuroscience about learning to provide advice on how teaching and learning can be designed to enact the three UDL principles of:







- Engagement
- Representation
- Action and expression

These three principles are central to the UDL Guidelines because they describe access points for inclusive learning that can be co-created between teachers and learners to build learner agency.

The principle of *engagement* places particular emphasis on an individual learner’s identities and how they interact with motivation and enthusiasm for learning depending on their interests and the context/s in which they learn. For example, a learner might have experienced childhood trauma and have low literacy skills. They find it difficult to learn in environments that make them feel unsafe, such as in a classroom with a teacher who calls on students to read passages aloud to the class, and fellow students who might taunt them if they make a mistake. Their engagement with literacy learning in that environment is therefore substantially challenged.

This same learner might also be a skilled and confident artist, however, so their engagement during a studio art class is wholly different. In that environment, they are a model student who seeks out teacher feedback and takes risks in trying new ideas and techniques. Preferences for how learning can happen can vary on the day, and with the wide variability in learner identities, there is no singular means of engagement that is ideal for all learners in all contexts, so the creation and provision of a range of means to engage in learning is critical for student success.

The principle of *representation* addresses the variety of ways in which individual learners perceive and make sense of information. These ways can be influenced by factors such as disability and/or neurodivergence, culture, language, and age, and how multiple factors interact within a learner. Providing different ways for information to be represented is important to support learning. Similarly, representing the rich diversity of "people, cultures, individual and collective identities, perspectives, and ways of knowing" (CAST, 2024c, para 1.) in content helps learners to contextualise and connect conceptual information to create new knowledge. There is no singular means of access to representation that will meet all needs of all learners.

The principle of *action and expression* speaks to the variation in how different learners navigate a learning environment, approach the process of learning, and convey their knowledge. The design of multiple means for learners to act on their learning and express what they know will allow for maximal learning by increasing interaction, encouraging communication, and applying strategies for successful learning. As for the other principles, there is also no singular means of access to action and expression that meets all needs of all learners.

Within the UDL Guidelines, each principle interacts with ways to:

- increase access to the learning goal;
- support the learning process; and
- support learners' executive functioning.

By looking at each principle through the lenses of access, support, and executive function, targeted guidance is provided which focuses on access to each of the three principles for the purpose of building learning agency.

The UDL Guidelines 3.0

Recently, the Guidelines were updated to version 3.0 (CAST, 2024b). This version integrates executive function throughout, drawing on neuroscientific understandings that executive function is more than strategy development. Rather, executive function relies on capabilities such as building knowledge and emotional capacity to support planning, attention focus, recall, task prioritisation, goal setting, and impulse control for learning. The goal of the UDL Guidelines 3.0 focuses on developing learner agency to reflect the notion of learning as a lifelong journey. Learner agency can be understood as the capacity for students to be self-aware and self-directed, supported by opportunities to co-create their learning environment with teachers and other educators. This capacity can help learners to adapt to shifting environments to continue to succeed in their learning and tasks; a key skill for learning and working in the 21st Century.

The idea of co-creating a learning environment aligns with another update within the UDL Guidelines 3.0: the focus on teachers designing learning opportunities with students, rather than simply providing them. To design such learning opportunities requires the teachers to work with students to develop multiple means of engagement, representation, and action and expression. To do so, the UDL Guidelines 3.0 centre the place of student voice and the importance of teachers and other educators recognising the barriers created by exclusionary practices and considering how they can be removed. This movement to a student-led approach can encourage a more authentic understanding of the impacts of exclusionary practices on learners and the types of inclusive practice that may be most effective for individuals to gain access to learning and participation. By explicitly seeking and valuing the voices of diverse learners, they gain opportunities to make meaningful choices about their learning, increasing their autonomy, ownership, and investment in their learning and success.

The role of technology within the UDL framework

With the UDL framework's focus on designing multiple modes of engagement, representation, and action and expression, technology can be leveraged in a range of ways to co-create inclusive learning opportunities and environments with diverse learners and their teachers. For neurodivergent students, technology is increasingly being viewed as a means of supporting their engagement with their learning. For example, a range of smart technologies have shown promise in helping students with dyslexia and dyscalculia to engage with literacy and numeracy learning respectively and represent their learning with increased autonomy (Berton et al., 2020; Erfurt et al., 2019). This kind of use of technology to support neurodivergent students to build their agency as learners clearly aligns with the goal of the UDL framework, demonstrating its potential for teachers and learners alike to increase access and participation in learning for these learners.

Not all uses of technology for neurodivergent learners, however, align with the UDL framework despite often being promoted as a means of improving social and/or academic inclusion. As with other approaches used to modify the behaviour of neurodivergent learners, some digital tools like the CoolCraig app (Doan et al., 2020) have been designed for adults to set behaviourally-based learning goals for a learner, who is then rewarded if they reach that goal. As the technology does not support the neurodivergent learner's agency or incorporate their voice, it is unsurprising that child users reported a range of concerns and fears with its use, including the infringement of their privacy and the potential for stigmatisation and embarrassment (Cibrian et al. 2020). Such findings indicate that not only would it be unlikely that such technology would have the desired impact on the learner, but that a learner may be harmed by the use of the technology due to being neurodivergent.

Using technology to modify the behaviour of neurodivergent learners, and/or using technology that does not affirm these learners' voices, identities, or self-identified needs as neurodivergent learners is in opposition to the goals and principles of the UDL framework: learner agency through the co-design of multiple means of engagement, representation and action and expression. Technology itself can be understood as a means to an end, but one that is neither neutral nor transparent in its use or impact on those who use it (Heidegger, 1977). In other words, most people rarely consider how using technology changes the way that they interact with information, each other, and the world around them, as they are focused on achieving the task they want it to do for them. To ensure that users remain in charge of the technology, and not the other way around, technology users must constantly ask questions about why they are using technology, and consider the many ways it impacts them and others to begin to understand the implications for using it.

Those charged with the inclusive education of diverse learners have an even greater responsibility to think critically about the use of technology. It is crucial that they carefully examine a technology's anticipated and actual effects on these learners, including the potential to harm, in order to understand the compromise of using a technology, even when it offers greater access to learning and participation. The UDL framework and UDL Guidelines 3.0 play a key role in helping educators and diverse learners to make good decisions about technology use for inclusion. Together, they provide a means to consider whether a technology promotes learner agency as a means of access to at least one of the three UDL principles that support learning: engagement, representation, and action and expression.

The need for this research project

Using inclusive digital technologies as learning tools in education presents a critical opportunity to dismantle barriers faced by neurodivergent students and support all learners to feel safe, happy and excited by the possibilities of being part of their local school community. However, much of the existing research in this area focuses on pre-test and post-test measures, offering limited insight into the lived experiences of students and teachers who navigate these environments daily. This gap underscores the need for complementary research that amplifies the voices of all stakeholders, particularly students, whose perspectives are often overlooked in favour of those of teachers, researchers, and parents. By prioritising student and teacher voices, this study presents a nuanced understanding of how digital technologies can be used to scaffold learning, foster inclusion, and enhance the overall school experience for neurodivergent learners.

Historically, the research literature has encouraged a deficit-focused conceptualisation of children with autism, ADHD and SLDs. Accordingly, clinical and teaching practices have followed suit (Sewell, 2022). There is an urgent need for ethical, person-centred research that shifts the focus from reducing non-normative behaviours to improving educational experiences and fostering environments where neurodivergent students can thrive. This approach aligns with the broader, global movement towards inclusive education and benefits teachers by providing them with practical frameworks and support for addressing diverse learning needs. Ultimately, this research can empower schools to cultivate neurodiversity-affirming practices that respect individual differences while enhancing teacher efficacy and student engagement.

The economic and societal rationale for this research is also compelling. Ensuring neurodivergent students can access quality education not only supports their immediate wellbeing but also has far-reaching implications for their ability to participate in the workforce and lead lives that are personally meaningful. Barriers to education can lead to significant economic costs, both for individuals and society, whereas inclusive practices unlock opportunities for these students to contribute to the workforce and society in innovative ways. Moreover, this research has the potential to inform the design of emerging technologies, steering industries toward creating solutions that are neurodiversity-affirming. As the global education community increasingly values inclusivity, findings from this study will hopefully shape the development of technologies that align with these priorities, ensuring sustainable, future-oriented progress in education and beyond.

Research objectives

The following set of objectives guided the development of this research project:

1. To develop a better understanding of how the principles of Universal Design for Learning (UDL) can be applied in inclusive classrooms to dismantle participation barriers for neurodivergent students.

2. To gain a better understanding of the nature in which technology is being used to scaffold neurodivergent education.

3. To better understand the benefits and challenges neurodivergent children face in inclusive classroom settings when engaging with technology by providing them space to have their experiences and opinions shared with researchers, educators and policy makers.

4. To assist in the development of appropriate resources and strategies to inform an achievable and dynamic model of neurodivergent participation within primary and secondary inclusive classrooms.

Primary research question and guiding questions

An overarching primary research question was developed in partnership with SMART Technologies to collectively address each research objective. Three guiding questions were then developed to help focus the data collection and analysis on the multiple components of the primary research question.

Primary research questions

- How can digital technologies be best utilised within primary and secondary school classrooms to create the conditions for inclusive engagement, representation, and action and expression for neurodivergent students?

Guiding research questions

1. Which features of digital technologies promote the social inclusion of neurodivergent students in their classrooms?

2. What are the enablers and barriers presented by digital technologies in facilitating inclusive teaching and learning?

3. How can teachers best support neurodivergent students to feel safe in participating in classroom learning activities alongside their peers?

The focus of these questions enabled the research to explore current trends of school-based technology usage among neurodivergent students, their teachers, and peers.

Rapid review method

A rapid literature review aims to provide a descriptive summary of recent literature, and a synthesis of meaning, perspectives and practices that define current customs and trends. This literature review employed a mixed methods approach to data analysis through qualitative and quantitative enquiry that included thematic analysis. Thematic analysis is a qualitative method for achieving a synthesis of recurring concepts that make up the dominant narratives and trends within a specific field of research and practice. Directed by the previously outlined research questions, the researchers took a deductive approach to theme generation guided by the framework set out by Braun and Clarke (2006); familiarisation, initial coding, theme search, theme review, determine theme significance, and report findings. Two overarching themes and thirteen sub-themes emerged from this analysis. Following the thematic analysis, Theme 2 was supplemented with quantitative inquiry to provide deeper insights into patterns within the data set. Chi-squared analyses were performed to explore whether neurotypes were represented equally across sub-themes. The review's search procedure, screening and inclusion criteria are outlined in Figure 1, with the studies included in this review listed in Table 2.

Figure 1. The search procedure for the rapid literature review.

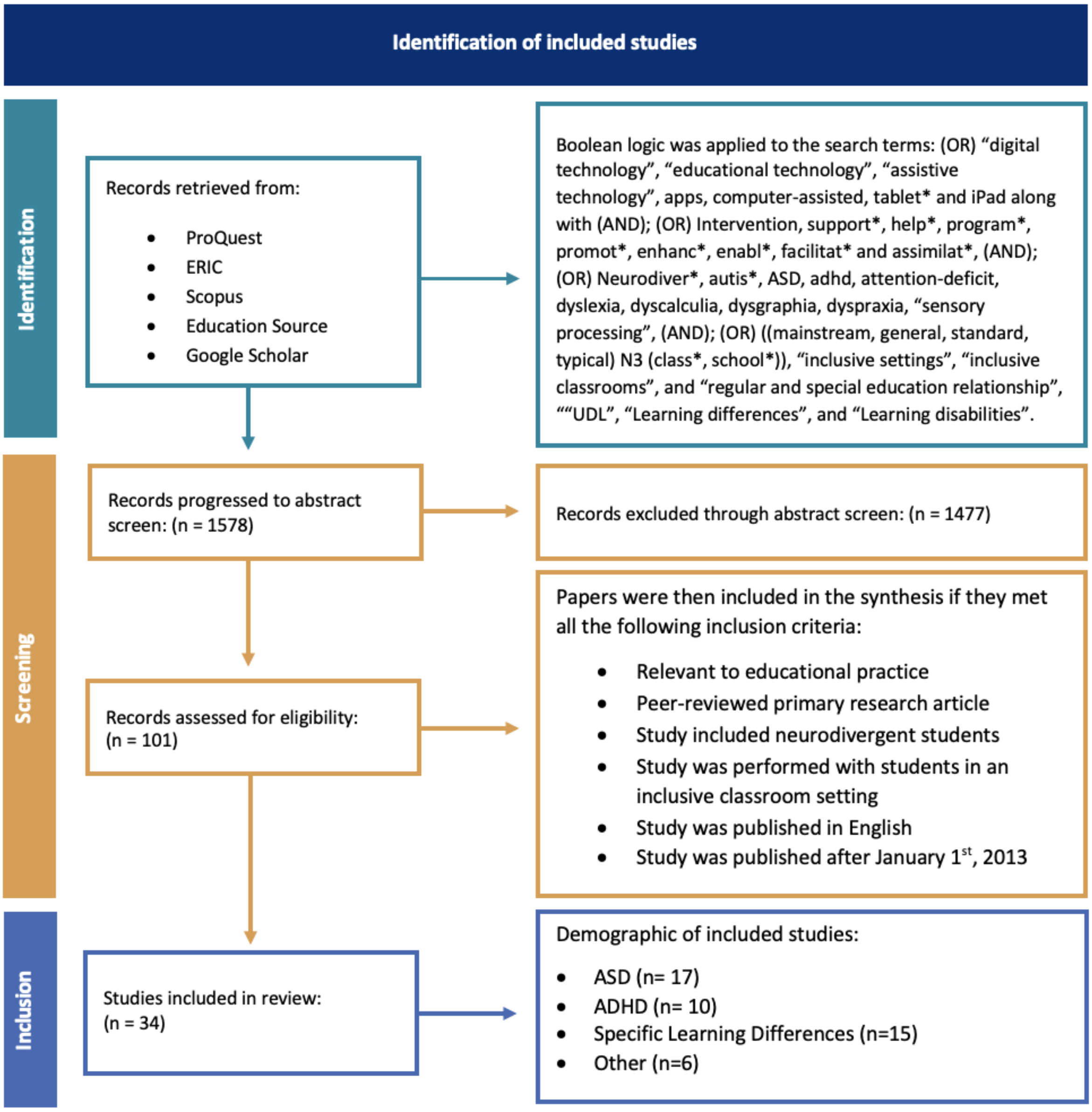


Table 2. Rapid Review Included Studies.

Article	Population	School Level	Technology
Exploring augmentative and alternative communication use through collaborative planning and peer modelling: a descriptive case-study (Young et al., 2021)	ASD & AAC users	Primary school	Tablet & speech generation software
Digital game making and game templates promotes learner engagement in non-computing-based classroom teaching (Hughes-Roberts et al., 2023)	Learning differences	Primary & secondary school	Tablet, games, & educational software

A preliminary investigation of sound-field amplification as an inclusive classroom adjustment for children with and ASD (Wilson et al., 2021)	Autism	Primary school	Microphone & speakers
Using assistive technology with SRSD to support students on the autism spectrum with persuasive writing (Ozdowska et al., 2021)	Autism	Primary school	Keyboard, tablet, writing support & instructional software
Beneficial effects of robot-mediated class activities on a child with ASD and his typical classmates (Faschantidis et al., 2019)	Autism	Primary school	Robotics & programming software
Expanding communication modalities and functions for preschoolers with autism spectrum disorder: Secondary analysis of a peer partner speech-generating device intervention (Bourque & Goldstein, 2019)	Autism	Preschool	Tablet & speech generating software
Effects of gesture-based match-to-sample instruction via virtual reality technology for Chinese students with autism spectrum disorders (Hu & Han, 2019)	Autism	Primary school	Laptop, VR, motion controller, games & instructional software
Effects of joint video modelling on unscripted play behavior of children with autism spectrum disorder (Dueñas et al., 2018)	Autism	Preschool	Go-Pro camera, video, tablet & headphones
Digital books with dynamic text and speech output: effects on sight word reading for preschoolers with autism spectrum disorder (Mandak et al., 2018.)	Autism	Preschool	Tablet, speech generating software & instructional software
Can cooperative video games encourage social and motivational inclusion of at-risk students? (Hanghøj, 2018)	Students considered at-risk & ADHD	Primary school	Games, laptop & LAN
Using peer-mediated instruction to support communication involving a student with autism during mathematics activities: A case study (Tan & Alant, 2016)	Autism & AAC users	Primary school	Tablet & speech generating software
Using an augmented reality enhanced tabletop system to promote learning of mathematics: A case study with students with special educational needs (Pérez-López et al., 2016)	ADHD, learning disabilities, intellectual disability, developmental delay, other	Primary school	Interactive tabletop, projector & camera

	learning difficulties		
A single-subject study of a technology-based self-monitoring intervention (Vogelgesang et al., 2016)	Students considered at-risk & ADHD	Primary school	Tablet & self-monitoring software
Visual cues using mobile technology to support in-class transition for all children (Kim et al., 2023)	Autism	Preschool	Smartphone
The impact of a computer-based activity program on the social functioning of children with autistic spectrum disorder (Dickinson & Place, 2016)	Autism	Primary school	Gaming console hardware, TV & games
Technology delivered self-monitoring application to promote successful inclusion of an elementary student with autism (Rosenbloom et al., 2015)	Autism	Primary school	Tablet & self-monitoring software
Learning to work together: Designing a multi-user virtual reality game for social collaboration and perspective-taking for children with autism (Parsons, 2015)	Autism	Primary & secondary school	Laptop, mouse & games
Incorporating a peer-mediated approach into speech-generating device intervention: Effects on communication of preschoolers with autism spectrum disorder (Thiemann-Bourque, 2018)	Autism & AAC users	Preschool	Tablet & speech generating software
Video modelling using classroom peers as models to increase social communication skills in children with ASD in an integrated preschool (Cardon et al., 2019)	Autism	Preschool	Tablet, media player & videos
UDL in the middle school science classroom: Can video games and alternative text heighten engagement and learning for students with learning disabilities? (Marino et al., 2013)	SLDs	Primary & secondary school	Computers, educational software & games
Virtual manipulative instruction to teach the concepts of area and perimeter to secondary students with learning disabilities (Satsangi & Bouck, 2014)	Dyscalculia	Secondary school	Laptop & virtual manipulatives website
Harnessing the power of technology: increasing academic engagement of elementary students with learning	ADHD & learning differences	Primary school	Laptop, tablet, educational & instructional software

disabilities and ADHD (Wells & Sheehey, 2013).			
MathFun: A mobile app for dyscalculia children (Rohizan et al., 2020)	Dyscalculia	Preschool & primary school	Smartphone, tablet & educational software
Supporting struggling writers with class-wide teacher implementation of a computer-based graphic organizer (Regan et al., 2017)	Learning differences	Secondary school	Computer, graphic organiser software
Effect of a virtual environment on the development of mathematical skills in children with dyscalculia (Castro et al., 2014)	Dyscalculia	Primary school	Computer, educational software & games
Inclusive dyslexia-friendly collaborative online learning environment: Malaysia case study (Pang & Jen, 2017)	Dyslexia	Secondary	Computer, forum board, chat function & video conferencing software
Assisting children with attention deficit hyperactivity disorder to reduce the hyperactive behavior of arbitrary standing in class with a Nintendo Wii remote controller through an active reminder and preferred reward stimulation (Shih et al., 2014)	ADHD & intellectual disability	Primary school	Gaming console hardware
Universal Design for Learning and elementary school science: Exploring the efficacy, use, and perceptions of a web-based science notebook (Rappolt-Schlichtmann et al., 2013)	Diverse students	Primary school	Computer, instructional, organisational, educational & speech generating software
Using evidence-based multimedia to improve vocabulary performance of adolescents with LD (Kennedy et al., 2013)	Learning difficulties	Secondary school	Multimedia
Technology as a vehicle for inclusion of learners with attention deficits in mainstream schools (Voldborg & Sorensen, 2016)	ADHD & ASD	Primary & secondary school	Various
Addressing learning disabilities with UDL and technology: Strategic Reader (Hall et al., 2014)	LD & ADHD	Primary & secondary school	Laptop, assistive, instructional & educational software
Digital technology and increasing engagement among students with disabilities: Interaction rituals and digital capital (Rizk & Hillier, 2022)	LD, ADHD & other disabilities	Primary & secondary school	Robotics, smartboard, laptop, assistive technology & organisational software

Designing real time assistive technologies (Sonne et al., 2015)	ADHD	Primary school	Wearable devices & smartphone
Personal FM systems for children with autism spectrum disorders (ASD) and/or attention-deficit hyperactivity disorder (ADHD): An initial investigation (Schafer et al., 2013)	ADHD, ASD, auditory processing disorder & learning difficulties	Primary school	Earpiece & microphone

Analysis of this data generated a range of key insights that assisted the researchers in understanding the current state of the research exploring inclusive education, digital technologies and neurodiversity, and the fundamental shifts in what is being valued in this field of study.

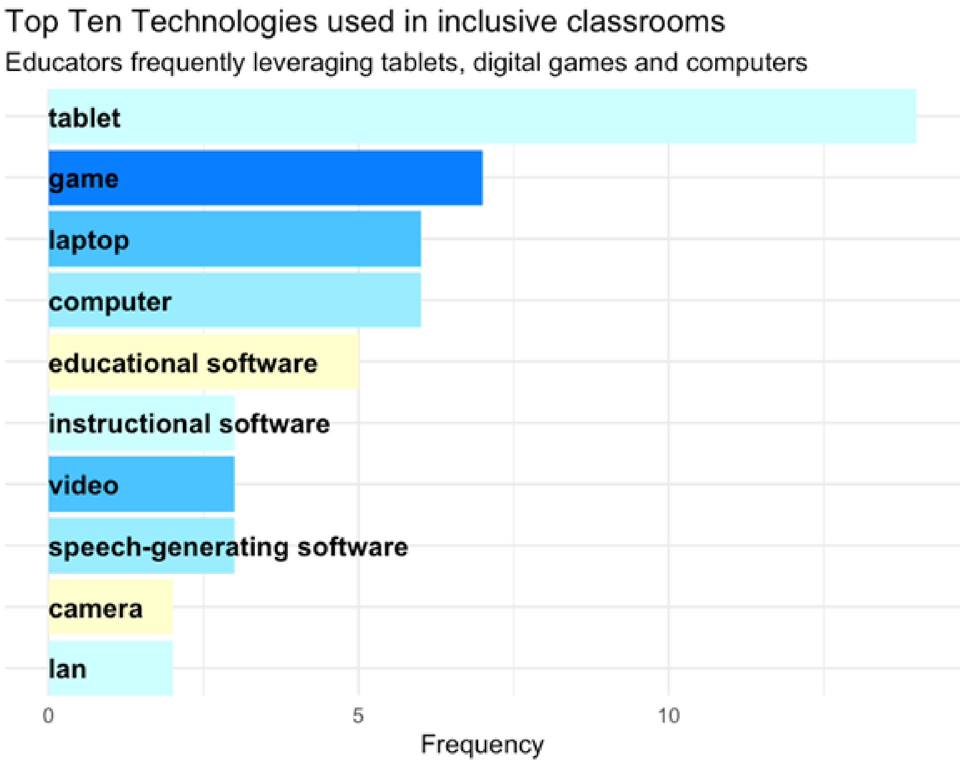
Rapid review findings

Overview of included studies

This review considers research spanning a decade from 2013 to 2023, pertaining to inclusive classrooms in kindergarten (7), primary (elementary) (24) and secondary (10) schools across eleven countries (USA, the UK, Denmark, Malaysia, Australia, Taiwan, Spain, New Zealand, Greece, China, Canada and Brazil). Sixteen studies included autistic students in their participant samples; nine studies included students with ADHD, and thirteen studies included students with SLDs (specifically dyslexia, dysgraphia, and/or dyscalculia).

> The literature review highlighted that tablets, laptops and computers were the most widely used hardware in inclusive classrooms, and that these devices were often used to run digital games, educational software, instructional software and videos.

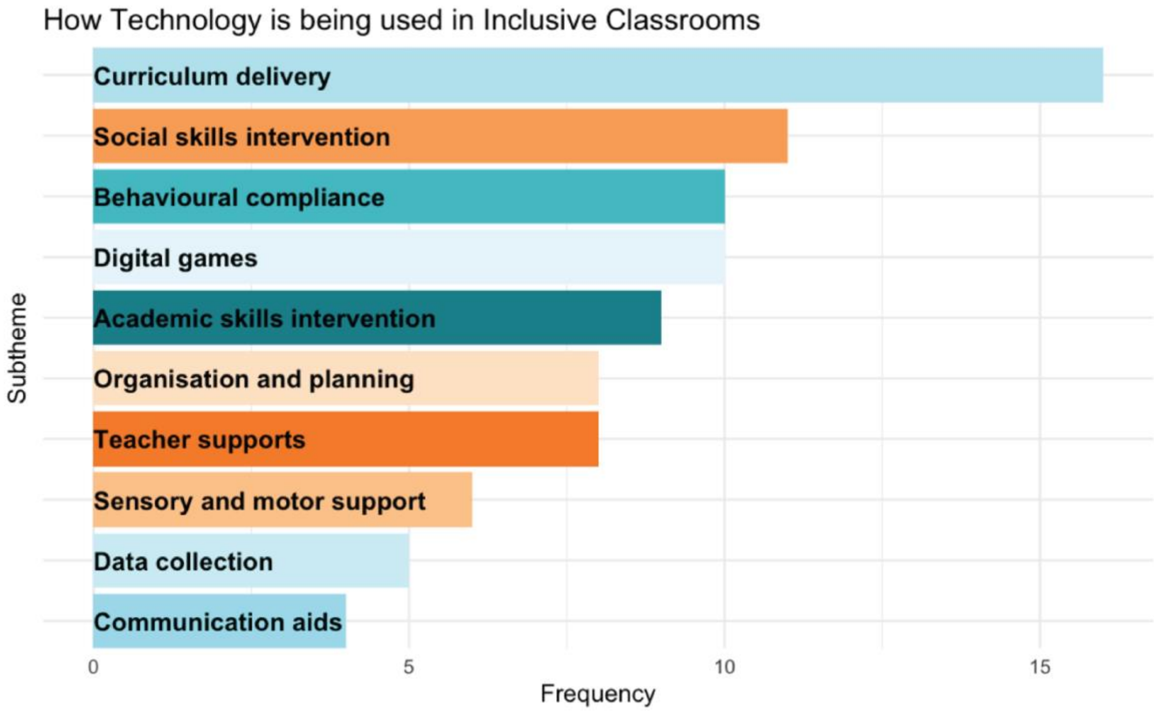
Figure 2. Technologies identified through the literature review.



Theme 1: Technology use within inclusive classrooms

This theme examines the types of technology interventions used in inclusive classrooms and explores how these strategies are being positioned to support diverse learners, and how the application of such technologies in inclusive classroom environments can dismantle or create participation barriers for neurodivergent students. The researchers identified ten subthemes across the papers included in this review: academic skills intervention, social skills intervention, behavioural compliance intervention, sensory and/or motor supports, digital curriculum delivery, curriculum adjacent games, data collection, teacher supports, AAC and digital communication aids, and organisation and planning aids.

Figure 3. Positioning of technologies identified in the literature review.



Curriculum delivery

The technology-based curriculum delivery methods examined in this review comprise diverse approaches to presenting and providing learning material. All sub-samples within the population received technology-based curriculum delivery. Within the literature review the researchers identified seventeen examples of technology being used to deliver curriculum in inclusive classrooms.

> Examples included:
>
> - Building a curriculum around video game components and culture.
> - Utilising tangibles and augment reality manipulatives.
> - Creating digital learning environments such as learning management systems.
> - Providing lessons through self-paced online learning modules.

Interestingly, there were no examples of digital curriculum delivery overtly creating participation barriers for neurodivergent students found within the sample. However, it remains possible to inadvertently create challenges for students with diverse learning needs by promoting a rigid model of digital curriculum delivery. Assistive technologies and access-enhancing software should be optional for all students in digital learning environments.

Some interventions used creative technologies to deliver the curriculum. Hughes-Roberts et al. (2023) used digital game-making as a teaching method for curriculum-based learning over eight weeks. Game templates were designed to scaffold learning in various topics covered over the term. The initial game design session promoted broad skills like creativity, problem-solving and programming logic. The game templates were designed to be inclusive and offered tailorable levels of freedom, scaffolding, and assistance. Once built, teachers implemented the children's games as tools for future lessons in history, geography, science, and life skills courses. Designing interactive digital curriculum components that include elements of gamification may dismantle participation barriers for students who find traditional teaching methods (e.g., lectures, reading, copying and memorising) challenging. Students with cognitive strengths in creativity, autonomy, problem-solving and game logic may also benefit from using these skills in the classroom.

Social skills intervention

Technology-based social skills interventions examined in this review were diverse in design and included robots, software programs, and static or interactive multimedia environments. Autistic children were the only sub-sample within the population to receive technology-based social skills interventions. The sample includes eleven examples of technology being leveraged to deliver social skills interventions in inclusive classrooms.

Examples included:

- Teaching or modelling 'pro-social' and interactional behaviours (for example, verbal reciprocity, sustained eye contact, initiating social interactions, orienting the body towards peers) through videos of neurotypical peer models, robots or digital avatars.
- Teaching behaviours explicitly through digital narrative approaches, such as video Social Stories.
- Leveraging games and robotics to facilitate collaboration and provide a space for children to practise social skills.

Some social skills interventions use technology to deliver applied behavioural therapies or teach normative social behaviours to autistic students. Dueñas et al. (2018) used videos of peers performing social scripts to teach play skills to preschool-aged autistic children. Autistic children were paired with neurotypical peers and shown videos of targeted play scripts alongside their partners. They were then told "It's time to play, do and say what you saw in the video." The study measured compliance to the social script and reduction of off-task behaviours and concluded that unscripted verbalisations during pretend play improved. Leveraging technology in this way may create participation barriers for autistic children by encouraging them to rely on social scripts to communicate with their peers and teachers and discouraging them from being themselves and engaging in spontaneous, self-led play. Further, masking and suppressing autistic traits increases cognitive load, sensory discomfort and anxiety and can lead to autistic burn-outburn-out and school avoidance (Chapman et al., 2022; Hamilton, 2024; Sproston et al., 2017 & Lei et al., 2023).

Some social skills interventions used technology to facilitate peer-to-peer learning and included measures of the interactional behaviours of neurotypical and autistic peers alike. In these studies, technology was a vessel through which peers practised and learned how to best interact with one another in a naturalistic setting of exposure and collaboration. Faschantidis et al. (2019) teamed neurotypical and autistic peers to build collaboratively and program 3D Lego robotics within an embedded curriculum activity. They found that educational robotics facilitated collaboration and positive peer interaction between neurotypical children and autistic peers while reducing 'behaviours of concern' (for example, hitting other students). Leveraging technology in this way dismantled participation barriers by providing a means for neurotypical peers to better engage with their autistic peers. Students gained opportunities for shared learning and collaboration within the classroom.

All of the studies within the sample measured interactions between neurodivergent children and neurotypical peers rather than investigating any interactions between pairs of neurodivergent children. The lack of evidence in the research we investigated about the nature of these kinds of interactions means that we do not know about the impact of technology on supporting social development in relationships between neurodivergent children. Yet a growing body of evidence highlights the pro-social strengths and differences in social relationships between neurodivergent people (Crompton et al., 2020; Cheang et al., 2024).

The theory of the *double empathy problem* suggests that people with different experiences of the world have difficulty empathising with each other (Milton et al., 2020). As such, this theory implies that neurodivergent people tend to share more positive social experiences with other neurodivergent people, while neurotypical people tend to share more positive social experiences with other neurotypicals. Communication breakdowns and social-relational differences are more likely to be noticed between neurodivergent and neurotypical individuals, implicating a difference in socialisation across neurotypes rather than a true neurodivergent social deficit (Milton et al., 2020). This gap in the literature sample highlights the need for more researchers to include neurodivergent pairs in social skills studies to ensure outcome measures do not skew toward reporting only neurotypical interactions.

Behavioural compliance

Technology-based behavioural compliance interventions examined in this review primarily target neurodivergent characteristics that many teachers and researchers would consider to be 'off-task' or disruptive. Targeted behaviours include stimming, a wandering eye gaze, short bursts of attention, leaving one's seat, speaking off-topic, or engaging in tasks other than what the teacher has allocated at that time. **Technologies intended to promote behavioural compliance often included design elements that targeted sensory regulation, organisation and planning.** Autistic children or children with ADHD were the main sub-samples within the population to receive technology-based behavioural compliance interventions. The sample includes ten examples of technology leveraged to address behaviour and compliance in inclusive classroom environments.

Examples included:

- Self-monitoring applications that use alarms and attention redirection prompts.
- Wearable devices that vibrate when the user is 'off task'.
- Designing academic content to be engaging through interactive multimedia
- Using interest-based technology to promote motivation and autonomous exploration to reduce behaviours that stem from disengagement before they arise.

Some studies used alarms and self-monitoring software to reduce unwanted classroom behaviours associated with neurological differences. Vogelgesang et al. (2016) provided an app that prompted participants to rate their behaviour every ten minutes during class. The intervention measured increased academic engagement through measures of attention to a task, following rules and expectations, and off-task behaviours such as wandering eye gaze, moving around the room without an explicit purpose or permission, and engaging in tasks other than the one assigned. It is important to note that these are neurotypically-normed measures.

Using technology for behavioural compliance can create participation barriers for neurodivergent students by singling them out from peers and treating neurodivergent processing and motor differences as poor behavioural choices. Invasive self-monitoring prompts can disadvantage individuals who find switching their attention between tasks challenging. Designing a curriculum with multiple means of representation and engagement, as per the UDL framework, and allowing sensory aids is a more inclusive way of increasing task engagement in children with attention differences. Interventions should be child-specific rather than chosen based on expected diagnostic presentations.

An example of the importance of child-specific interventions was found in the study by Vogelgesang et al. (2016) regarding approaches to target behaviours seen to be disruptive by the teachers in the study. In this study, children who were diagnosed with or flagged as at-risk for having ADHD were selected to participate in the self-monitoring study, yet their teacher reported that these students were rarely or never disruptive. Therefore, the decision to measure and target behaviours seen to be disruptive within this sample likely stemmed from researcher expectations of how ADHD might present rather than from a child's specific support needs.

Other studies measured the reduction in off-task behaviours using preventative rather than reactionary approaches, including considering the child's interests. These preventative approaches included the design of engaging academic content using interactive multimedia and incorporation of physical components into curriculum delivery to minimise the time students spent sitting. For example, Wells and Sheehey (2013) explored the presence of a functional relationship between on-task behaviour and embedding students' interests (technology) within curriculum instruction. They found that integrating interest-based technology increased academic engagement and eliminated the need for reactionary behavioural measures. Leveraging technology to provide multiple means of representation may dismantle participation barriers for some neurodivergent students by promoting engagement through dynamic interest-based learning, reducing the need for punitive responses to off-task behaviours. Such technology use should increase the means of representation, however, rather than replacing concrete learning formats altogether, as not all students will show the same levels of interest and engagement with technology.

Digital games and digital games-based learning

Digital games examined in this review include using purposefully designed educational games and leveraging widely available commercially developed games. All sub-samples within the population were included in studies that used curriculum-adjacent digital games, with autistic children receiving the most game-based interventions. The sample includes ten examples of digital curriculum-adjacent games being used within inclusive classrooms.

Examples included:

- Gaming as a means for children to practise and generalise skills learnt through traditional curricula such as mathematical reasoning and language.
- Gaming focused on targeting or facilitating global skills that the respective researchers contend will enable children to better access education (for example, developing social skills, problem solving skills, communication and teamwork skills).

Hanghøj et al. (2018) explored whether cooperative gaming facilitated classroom inclusion and engagement for socially excluded and academically disengaged students within inclusive classrooms. Students worked co-operatively through a popular fantasy role-playing game. The teaching staff guided the student groups to leverage skills in mathematics and language to solve in-game problems, such as choosing the correct potion to administer in response to their character being injured. In this context, gaming was used as a platform to repurpose and practice skills, including mathematical reasoning, language and cooperation, rather than as the primary mode for curriculum delivery. Interestingly, the study reported mixed results. Researchers found that positive motivations increased among at-risk and neurodivergent students but decreased among their typically performing peers. Such findings reinforce that learners are diverse and respond differently to different education approaches. Inclusive classrooms should use technology as one component of their dynamic content delivery to increase engagement for students motivated by technology while ensuring other modes of teaching and learning remain available to engage students who are not motivated by technology.

As a social skills intervention, Dickinson and Place (2016) encouraged autistic students to play the video game *Mario & Sonic at the Olympics* in addition to their routine physical education classes over nine months. They found that positive social behaviours and interests in social interactions increased among boys in their sample. The video game format fostered teamwork and collaboration in a manner similar to physical team sports. This approach to physical education and sporting education has the potential to dismantle some participation barriers for neurodivergent and neurotypical students alike by providing a medium through which engagement and success need not rely on athleticism. Students with motor differences and health conditions and those who do not enjoy playing physical sports but excel in game-logic, competition, strategy, statistics, teamwork, or video games may find renewed interest in a subject from which they otherwise may have disengaged. Video games should not be seen as a replacement for the health-promoting physical activity aspects of physical education and sport, but rather as another vehicle for the teaching and learning of social skills.

Academic skills intervention

Technology-based academic skills interventions examined in this review comprise purposefully designed software targeting foundational skills in core vocational subjects like mathematics and English. Children with SLDs such as dyscalculia and dyslexia were the main sub-samples within the population to receive technology-based academic skills interventions. The researchers found nine examples of technology scaffolding academic skills within inclusive classrooms in the sample.

Examples included:

- Using dynamic multimedia and text-to-speech features to scaffold early literacy skills.
- Supporting students learning to read and write by providing multiple means of representation.
- Using interactive software and games to present puzzles and tasks that embed learning within their game design.

Some interventions used tablets to provide individual or paired digital reading environments. Mandak et al. (2018) used shared digital book reading to improve sight word recognition in autistic preschool children. The digital book included text-to-speech, repetition, and interactive motion graphics. All children within this study successfully learned to recognise the target sight words. While this intervention successfully scaffolded the child's acquisition of sight words by providing them with multiple means of representation, it may also create unintended participation barriers by removing the human interaction of shared book reading. Individual tablet-based digital books can be read in a secluded area, reducing the time spent in communal story time. Implementing this strategy as a whole class activity by utilising tablets or digital displays to provide multiple means of representation during communal story time may be a more inclusive approach to support diverse levels of reading proficiency within classrooms.

Some interventions used games, software, and digital learning environments to deliver curriculum activities that support diverse learning needs to the entire class. Castro et al. (2014) embedded 18 virtual games that targeted different math elements (for example, counting, arithmetic, logical reasoning, memory, geometry, and pattern recognition) across a series of primary school math classes. The virtual environment helped children improve their academic performance in maths class. This approach to technology use within the classroom dismantled participation barriers for children with dyscalculia by including them in the same class activities as their peers while also removing the pressure and fear of answering math questions incorrectly in front of peers. All children within the inclusive classrooms had access to the same games but could progress at their own pace. The virtual environment gave students targeted feedback and praise as they solved problems, building their confidence as learners. The research found that most children contributed to class discussions about challenges and solutions within the games and that those with learning differences felt more empowered to join these discussions. The game-based virtual environment also encouraged higher levels of motivation among these students.

Organisation and planning

Organising and planning aids examined in this review include digital learning environments, digital notebooks, self-monitoring software and task-scheduling software. There was some crossover between organising and planning aids and behavioural compliance interventions, particularly within the autistic and ADHD sub-populations. Students who are autistic or have ADHD were the main sub-samples to receive self-monitoring and scheduling supports while all students equally received general planning and organisation supports. The researchers found eight examples of technology being used to assist organisation and planning within inclusive classroom environments within the sample.

Examples included:

- Self-monitoring applications that prompt students to reflect on whether they are 'on-task'.
- Web-based workbooks and learning environments designed and implemented using the UDL framework.
- Digitised visual activity schedules.
- Cloud-based file management and sharing systems.

Some self-monitoring planning aids provided an organisational framework for the student but also forced compliance and masking. Rosenbloom et al. (2015) provided an autistic student with a tablet and application that asked every thirty seconds, "Are you on task?" This intervention sought to promote task maintenance by increasing on-task behaviours (for example, orienting toward the teacher or relative task materials, responding verbally or non-verbally, and seeking help in an appropriate manner) and reducing 'off-task' behaviours such as facing away from his desk, engaging in *stimming* such as opening and closing his mouth, flexing his neck muscles, rolling his head, rocking in his chair, humming/singing and tapping/playing with objects.

Leveraging technology in this way creates participation barriers for neurodivergent students by singling them out among their peers, increasing cognitive load through repetitive prompting, and by forcing compliance and masking. Framing autistic self-regulatory behaviours as 'off-task' and prompting children with repetitive reminders to behave neurotypically can promote stigma and exclusion. Framing normative social behaviours as academic achievements can suggest to neurodivergent children and their peers that autistic mannerisms are problem behaviours and make it difficult for neurodivergent children to succeed in the classroom.

Other findings suggested that organising and planning aids that were designed and implemented using the UDL framework benefited neurodivergent students, neurotypical students, and teachers. Rappolt-Schlichtmann et al. (2013) explored the efficacy, use and perceptions of a web-based universally designed science notebook. The notebook included flexible scaffolding, accessible media features, organising and planning features, and guided reflection. The digital environment allowed students to work in whichever way best suited them, whether writing, dictating, drawing, or uploading images.

The researchers found that the use of this digital notebook improved science content learning outcomes and positively impacted student performance regardless of reading and writing proficiency and motivation for learning. Teachers reported being more able to observe students' original thinking, and students reported feeling a sense of ownership and competence. Providing multiple means of expression allowed diverse students to demonstrate their science knowledge through the most effective means. It provided teachers with a more productive platform to engage in recursive feedback and targeted support. Leveraging technology in this way dismantles participation barriers for diverse learners by providing flexible means of working through the curriculum and promoting autonomous learning journeys where they can explore various methods of organising their time, thoughts and work, leading to longer-lasting organisational behaviours.

Teacher supports

Most inclusive education technologies examined in this review did not include elements that supported teachers to position them for pedagogical use or implement them in the classroom. The researchers identified seven examples of technology with design features that provided support to teachers.

Examples included:

- Teacher microphone and student receivers.
- Digital learning environments that incorporate progress tracking and provide teachers with support in selecting scaffolding strategies for individual students.

Some studies explored whether using microphones and personalised FM receivers increased academic engagement in children with executive functioning and sensory processing differences. A secondary result of this technology was that teachers were supported to maintain a consistent speech volume, reducing burden and strain teachers commonly experience with excessive and loud daily vocal use. While this approach can support healthy voice habits for teachers, the studies reported mixed results regarding microphone and receiver effectiveness in increasing student's attention. While digital sound amplification devices can be effective in certain spaces, they require accurate set up and maintenance that may not be afforded to all teachers. Further, some students with sensory sensitivities may find poor or loud audio quality dysregulating, which may create unintended participation barriers. Utilising voice amplification has the potential to support teachers by increasing their audible presence when appropriately used, however, audio quality and the practical challenges of setting up microphones, speakers and radio receivers across learning environments should be taken into consideration.

Sensory regulation and motor supports

Technology-based sensory regulation and motor support interventions examined in this review were diverse in design and scope. Autistic children and children with dysgraphia were the main sub-samples within the population to receive technology-based sensory regulation and motor support interventions. Within the sample, the researchers found six examples of technology being used to aid sensory regulation and provide functional motor support within inclusive classroom environments.

Examples included:

- Physical and organisational interventions to reduce stimming.
- Digital visual activity schedules and transition aids/supports.
- Assistive hardware including keyboards and virtual and augmented reality manipulatives.
- Assistive software including writing support scaffolds, predictive text and speech-to-text.
- Using assistive technologies to deliver inclusive learning strategies to the entire class.

Some interventions used wearables to reduce stimming associated with neurological differences, such as fidgeting, standing, and moving around the classroom. Shih et al. (2014) programmed a wearable system (Nintendo Wii) controller known as a 'Wiimote', belt and headpiece) for children with ADHD/ASD to vibrate when it detected "arbitrary standing behaviours." Researchers chose to use a Wiimote because the two participants in their study enjoyed playing their Nintendo systems. Similarly, Sonne et al. (2015) designed a wearable device (the Child Activity Sensing and Training Tool) comprising an electroencephalogram headset and belt, which monitored stimming in ADHD students and sought to reduce them through prompting and conditioning.

While these examples report successful research outcomes through reducing off-task behaviours, the philosophy and methodology underpinning such interventions deserve scrutiny. Using technology in this way creates participation barriers as students with learning differences are singled out and equipped with conspicuous wearables. As discussed previously in this report, the neurodivergent community has widely rejected Applied Behavioural Analysis (ABA) techniques such as operant conditioning, reward and punishment as being dehumanising and psychologically damaging. Researchers and teachers are encouraged to consider the dignity of the children they are working with and to reflect on whether the strategies they are using to facilitate classroom participation support and motivate neurodivergent students or whether they primarily benefit other stakeholders through forced compliance. More inclusive strategies for promoting task engagement and providing sensory support for hyperactive learners include offering movement breaks, standing desks, fidget toys, visual schedules, interest-based learning opportunities, self-paced learning activities, and game-based curriculum activities.

Some interventions applied the principles found in the UDL Guidelines and used assistive technologies to deliver inclusive learning strategies to the whole class. Ozdowska et al. (2021) combined assistive technology with writing organisational framework software. This approach provided the entire class with access to motor adjustments to support differences in handwriting ability and a dynamic planning and organisational framework to support differences in executive functioning and written expression. By making these supports available to the whole class, individuals with and without disabilities can self-monitor their performance, cognitive load, and fatigue and seek support when needed. This approach dismantles participation barriers for neurodivergent students by providing a holistic environmental framework to benefit all students.

Some interventions provided neurodivergent students with helpful support but did not extend this to the whole class. Kim et al. (2023) converted transition aids to help kindergarten children move between activities and spaces from concrete to digital format. By having social stories and visual schedules on a mobile phone or tablet, the teacher could approach her neurodivergent students and provide one-on-one transition support where needed. While digitised transition aids offer many practical and functional benefits, they should not replace concrete aids displayed to the entire class. Instead, teachers should incorporate concrete and digital versions to normalise such displays and benefit all students.

Educational data collection

Educational data collection technologies examined in this review include digital learning environments, digital notebooks, and data collection for the sake of validating novel products. Within the literature, the researchers found five examples of technology being used to collect data on neurodivergent students within inclusive classrooms.

Examples included:

- Digital learning environments that included progress-tracking features.
- Digital textbooks, notebooks and web-based modules with progress tracking features.
- Software that provided scaffolding recommendations to teachers based on students in-app performance.

Data collection can be a powerful tool to ensure that students who need intervention supports are identified and provided with such supports so they can succeed. However, neurodivergent children have historically not been included when validating and creating population norms on academic, social and behavioural measures. As such, the nuances, strengths and difficulties they experience are often conflated, missed, or considered solely through a neurotypical lens.

Some interventions used data collection as a means identify where students would benefit from scaffolding, so that support could be tailored to individuals. Hall et al., (2014) explored whether digital learning environment aligned with the principles of UDL improved reading comprehension instruction. Curriculum books included assistive reading features that benefited all students. The *Strategic Reader* program was embedded with reciprocal questions and progress-tracking so that teachers could alter content for students. The program offered teachers solutions and strategies on how to modify content to offer multiple means of representation and engagement. This approach to collecting data can dismantle participation barriers for neurodivergent students by supporting educators to provide tailored scaffolding to all students.

Communication aids

The Augmentative and Alternative Communication (AAC) and digital communication aids examined in this review used speech-generating applications hosted on iPads and specialised devices. Autistic students with complex communication differences were the only sub-sample within the population using AAC and digital communication aids. Within the sample, the researchers found four examples of technology being used as AAC or to aid communication within inclusive classroom environments.

Examples included:

- Children’s personal AAC devices.
- School-owned tablets that hosted speech generating software.

In line with current recommendations around supporting AAC users through communication partner training, researchers looked at ways to increase classroom participation of AAC users by training their teachers and peers to use the communication aids. While these interventions addressed barriers in the AAC user's environment by educating and upskilling peers and teachers, nuanced differences in study design and classroom implementation presented questions as to whether or not the approaches were neurodiversity-affirming.

Thiemann-Bourque et al. (2018) used one-to-one peer modelling, pairing non-speaking or minimally-speaking autistic students with neurotypical peers who had been shown how to operate the autistic student's AAC device. Researchers directed the pair to share one device placed between them and to engage in a back-and-forth dialogue while facing each other and maintaining eye contact. This approach encroaches on the autistic child's autonomy by having them share their speech device and by incorporating normative outcome measures like scripting and enforced eye contact. Speech pathologists recommend that, wherever possible, all communication partners use a second AAC device or supplement their speech with other communication strategies. An AAC device should only be operated or removed by another person with the user's consent. This ensures that communication partners respect the device as an extension of the AAC user's body and do not treat it as a toy. This study aimed to increase speech acts among non-speaking and minimally speaking autistic students. Seeking to increase the amount of speech used by a child whose preferred communication modality is not speech can cause them discomfort and create additional participation barriers for them. Instead, designing classroom activities that adhere to UDL principles by offering multiple means of action/expression better allows diverse communicators to contribute to class discussions and engage in the curriculum in ways that best suit them.

Young et al. (2021) used peer modelling with speech-generating devices to improve an autistic AAC user's confidence in speaking to their classroom peers with their device. Researchers enlisted some of the AAC user's friends to become the classroom's ‘AAC experts’ and taught them how to use speech-generating software on iPads available in the classroom. The teacher then introduced the rest of the class to the communication devices. Students were encouraged to use the devices in their structured news-sharing show-and-tell activity or spontaneously in other classroom tasks. The classroom's AAC experts supported anyone who wanted to use the device socially or academically. The intervention successfully naturalised AAC use within the classroom, and the AAC user and his peers reported that they were happy and excited to share news with each other. Using technology in this way allowed neurotypical students to develop inclusive communication strategies and acceptance of different communication modalities. By teaching all students how to use a speech-generating device, the AAC user gained opportunities to communicate in their preferred modality and confidence to use their voice at school.

Theme 2: Trends in research and practice

This theme considers how research and practice trends noted across the included papers fit within the broader frameworks of neurodiversity-affirming and inclusive education. The researchers explored social and ethical imperatives across three sub-themes, *neurodiversity-affirming, child-centred, and child's voice.* This paper's qualitative considered how professional trends impact a boarder socio-cultural understanding of neurodiversity.

2.1 Neurodiversity paradigm

The researchers considered whether approaches used in research and practice are conducive to a neurodiversity-affirming paradigm. Neurodiversity-affirming research and practice rank order sub-themes included *affirming*, *fair*, *borderline*, and *poor*. Definitions for these sub-themes are outlined below, and categorical frequencies observed across the sample are represented visually in Figure 4.

Affirming

Studies coded with 'affirming' neurodiversity-affirming practice provide a holistic model of putting the agency and dignity of neurodivergent populations at the centre of their research. These studies and papers explicitly prescribe to a neurodiversity or social constructivist framework. They consistently adopt strengths-based language choices and highlight neurocognitive differences instead of pathological deficits. They incorporate person-centred outcomes and the child's voice into their methodology and study design.

Fair

Studies coded with 'fair' neurodiversity affirming practice are still working within a medical model paradigm. However, they show evidence of considering learning differences though a strengths-based lens within their research. These studies incorporate some person-centred outcomes into their methodology or include the child's voice in their study design.

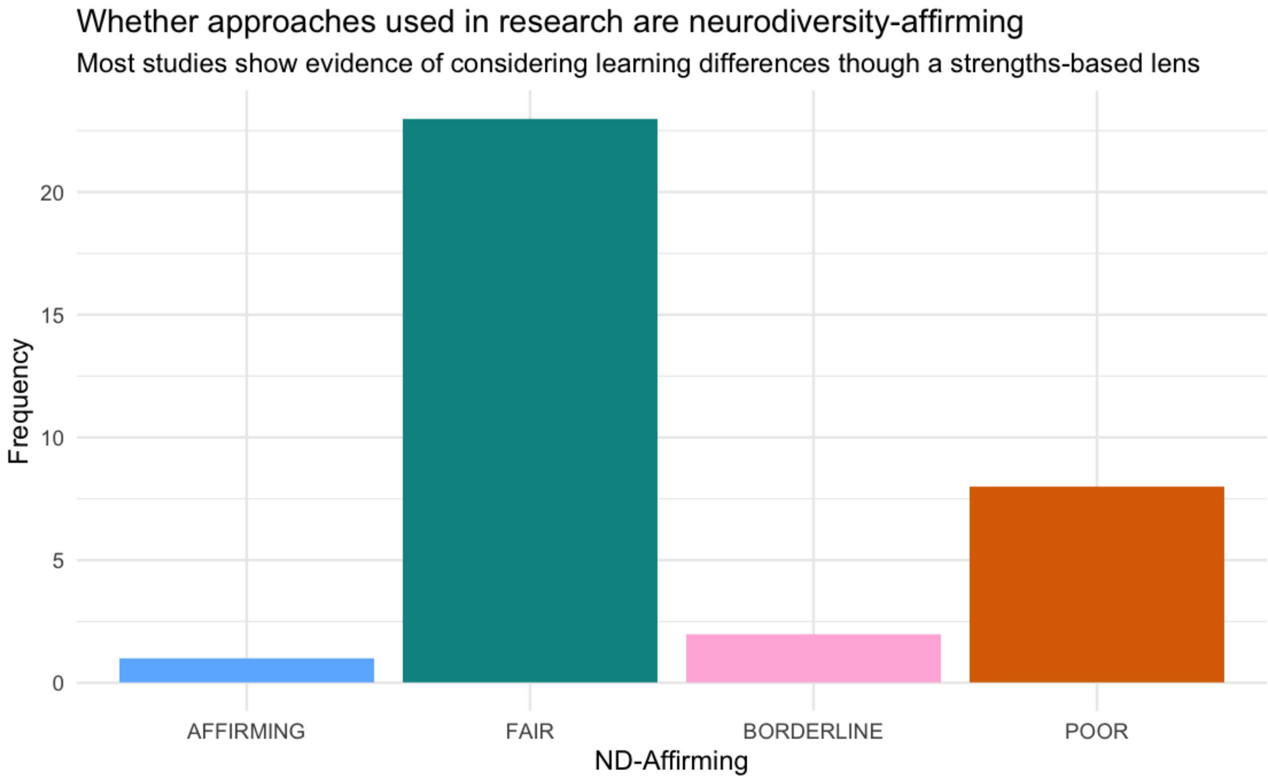
Borderline

Studies coded with 'borderline' neurodiversity-affirming practice are working within a medical model paradigm and show some examples of deficit-based or culturally outdated and rejected language. There are both pros and cons to their methodology. They adopt some reactive support models, including behavioural modification measures. Some papers coded as borderline simultaneously use strengths-based language while employing elements of culturally rejected therapies, showing a dissonance in theory and practice.

Poor

Studies coded with 'poor' neurodiversity-affirming practice consistently use deficit-based language throughout their paper or provide culturally rejected intervention strategies. These theories and practices take a highly medical, pathologising approach to framing learning differences and providing educational support. The voices and agency of participants and the wider disability community have not been duly considered or included within their study design. Interventions are reactionary and include a focus on teaching neurodivergent children to mask and adopt neurotypical behaviours.

Figure 4. Degree to which included studies are neurodiversity-affirming.

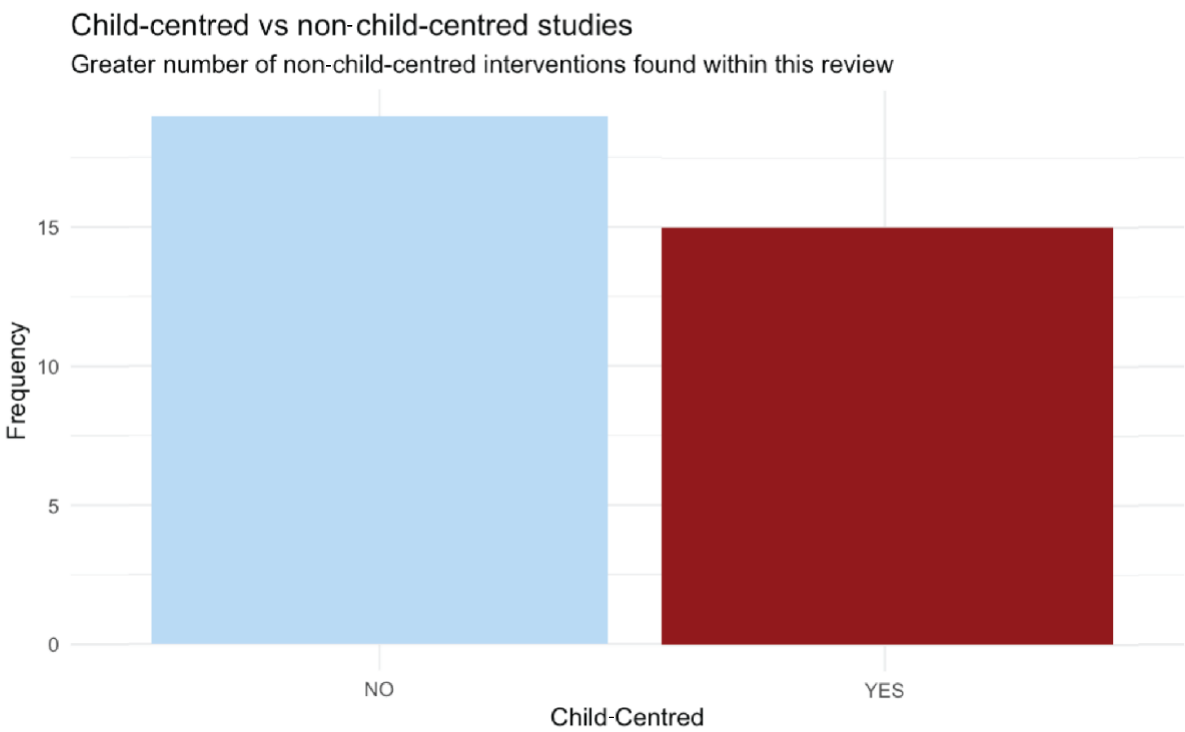


As shown in Figure 4, the vast majority of students were not clearly neurodiversity-affirming, with most research reporting very little agency in the design of the research for the voices of the intended end users of the interventions being studied. This paucity of child voice is particularly concerning given what is now known about the unintended consequences of well-intended but ultimately ableist practices in schools and other learning environments.

2.2 Child-centred research and practice

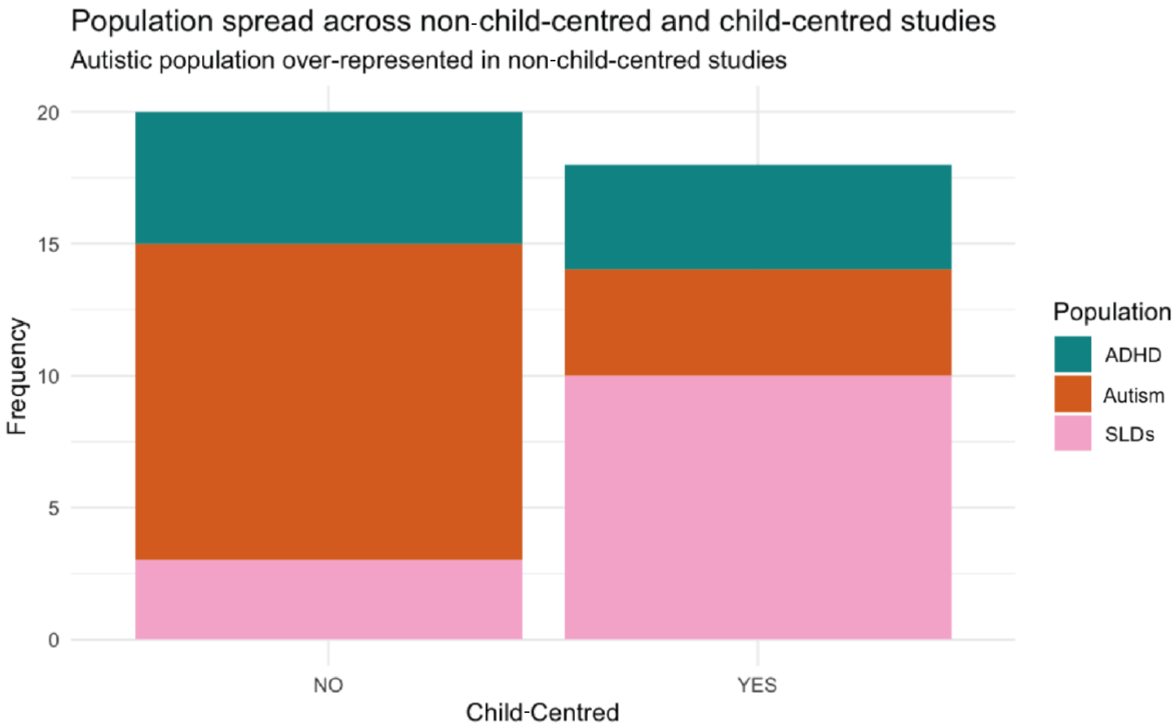
The researchers considered whether approaches used in research and practice across the sample are child-centred. To clarify the use of this term in the context of this research project, child-centred studies place the learner as a primary stakeholder in the technology-based intervention they are receiving. By contrast, studies that are not child-centred position neurodivergent children as agents to be acted upon for the benefit of those around them. Primary stakeholders in studies that are not child-centred include teachers, companies, researchers, parents, and peers. Interventions that are not child-centred aim to improve the experiences of those around the neurodivergent child instead of leveraging technology to improve the child's educational and social experiences. Of the 34 studies included in this review, 15 were deemed to have child-centred outcome measures, while 19 did not place neurodivergent children as primary stakeholders in their technology-based interventions. This is visualised below in Figure 5.

Figure 5. Comparison of child-centred and non-child-centred studies in the literature review.



A Chi squared test of independence was used to explore whether there was a relationship between a child's diagnosis, and whether the study they were included in was child-centred. The relationship between these variables was significant $\chi2$ (2, N=38) = 7.79, *p* = <.05. A visualisation of this relationship across three populations is shown below in Figure 6.

Figure 6. Relationship between diagnosis and whether a study is child-centred or non-child-centred.



There was a significant relationship between child-centred study design, and the inclusion of autistic children. Inclusive classroom technology interventions for autistic children tended to not be child-centred. The expected categorical frequency for the autism sub-sample within the population was 47.1%. Autistic children were significantly under-represented in child centred studies (26.7%), χ2 = 1.69, *p* = <.05, and were significantly over-represented in studies that were not child-centred (63.2%) χ2 = 1.52, *p* = <.05.

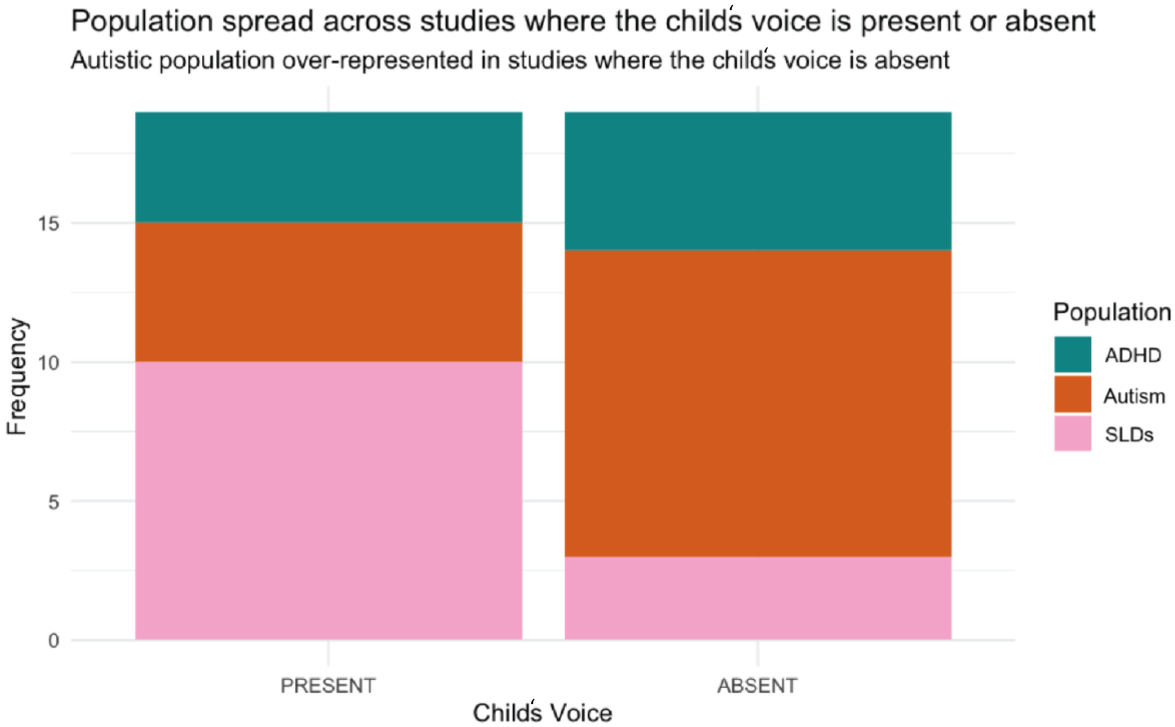
There was no relationship between child-centred study design, and the inclusion of children with ADHD. Inclusive classroom technology interventions for children with ADHD were equally child-centred, and not child-centred. The expected categorical frequency for the ADHD sub-sample within the population was 26.5%. Children with ADHD were represented as expected in child centred studies (27.6%) χ2 = 0.02, *p* = >.05, and in studies that were not child-centred (26.3%) χ2 = 0.01, *p* = >.05.

There was a significant relationship between child-centred study design and the inclusion of participants with SLDs. Inclusive classroom technology interventions for children with SLDs tended to be child-centred. The expected categorical frequency for the SLD subsample within the population (including dyslexia, dyscalculia, and dysgraphia) was 38.2%. Children with SLD were significantly over-represented in child-centred studies (66.7%) χ2 = 2.40, *p* = <.05 and were significantly under-represented in studies that were not child-centred (15.8%) χ2 = 2.16, *p* = <.05.

2.3 Child voice

The researchers considered whether research and practice approaches within the sample prioritised the agency of the children they were researching by including their voice. Half of the studies included in this review included the perspectives of their research participants. A chi-squared test of independence was used to explore whether there was a relationship between a child's diagnosis, and whether their voice and perspectives were included in the research they participated in. The relationship between these variables was significant χ2 (2, N=38) = 6.13, *p* = <.05. The relationship between diagnosis (population) and whether voice is present or absent is visualised below in Figure 7.

Figure 7. Relationship between diagnosis (population) and whether voice is present or absent.



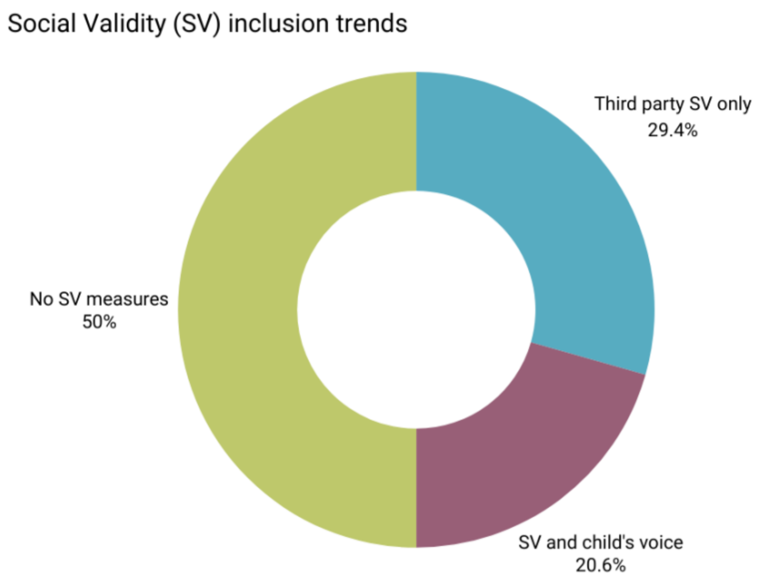
There was a significant relationship between a diagnosis of autism, and whether the child's voice was included in research. The studies included in the literature review tended to not include the voices of their autistic child participants. The expected categorical frequency for the autism sub-sample within the population was 42.11%. Autistic children were significantly under-represented in studies where the child's voice was present (32.25%), $\chi2$ = 1.12, *p* = <.05, and were significantly over-represented in studies where the child's voice was absent (68.75%) $\chi2$ = 1.12, *p* = <.05.

There was no relationship between a diagnosis of ADHD, and whether the child's voice was included in research. The studies included in the literature review included the voices of their child participants with ADHD as expected. The expected categorical frequency for the ADHD sub-sample within the population was 23.68%. The voices of children with ADHD were found to be present (21.05%) $\chi2$ = 0.06, *p* = >.05, and absent (26.32%) $\chi2$ = 0.06, *p* = >.05 across the studies included in the literature review.

There was a significant relationship a diagnosis of dyslexia, dysgraphia or dyscalculia and whether the child's voice was included in research. The studies included in the literature review tended to include the voices of child participants with SLDs. The expected categorical frequency for the SLD subsample within the population was 34.21%. Children with SLD were significantly over-represented in studies where the child's voice was present (52.63%) $\chi2$ = 1.88, *p* = <.05 and were significantly under-represented in studies where the child's voice was absent (15.79%) $\chi2$ = 1.88, *p* = <.05.

Some studies included social validity measures or third-party interviews, where in teachers, parents and/or peers were interviewed following behavioural interventions. Researchers use social validity interviews to ascertain whether changes in the research subject's behaviour are "beneficial for key stakeholders" (Huntington et al., 2022). Of the 17 papers that included third-party social validity questionnaires, only 7 also included interviews where the child participant was asked how they felt about the intervention and outcomes as visualised below in Figure 8.

Figure 8. Types of Social Validity measures included in identified research.



These findings indicate that there is a substantial change needed in future research projects to better included the views and values of the children and young adults receiving intervention. The inclusion of these largely missing voices is a central rationale for the completion of the case study component of this research project, with an emphasis on reporting the lived experiences of students with a range of academic and social access needs across multiple school contexts.

Rapid review conclusion

Key research takeaways from the literature review

- Approaches to managing neurodivergent children in classroom settings are often behaviourally based and position neurodivergent children as agents to be acted upon for the benefit of those around them rather than proactively designing curriculum and classroom infrastructure that promotes participation by leveraging interests, increasing motivation, fostering social connections and celebrating individual differences and strengths.
- Autistic children are rarely treated as collaborators or asked for their feedback on the technology based educational interventions that they are receiving.
- Children with SLDs are provided with significantly more child-centred and neurodiversity-affirming assistive technology and technology-based educational supports than other neurotypes.
- Most research done in this space over the past decade conforms to a medical model paradigm. However, research trends show evidence of considering learning differences through a strengths-based lens and incorporating some child-centred outcome measures.

Key practice takeaways from the literature review

Features of digital technologies that promote the social inclusion of neurodivergent students in their classrooms include:

- Leveraging digital games as a vessel for peers to work collaboratively, develop academic and general skills and strengthen peer relationships.
- Providing digital formats for students to anonymously answer questions to mitigate the stigma and anxiety that children with learning differences experience during question time.

- Replacing learning material that excludes neurodivergent students from social inclusion (for example, using instructional videos of peers and teachers, robots or avatars to teach students in a secluded area of the classroom) with universally designed curricula that incorporates assistive technology and multiple means of representation.

Some key enablers presented by digital technologies in facilitating inclusive teaching and learning include:

- Designing flexible digital learning environments with integrated supports that include assistive technology, organisational frameworks, scaffolding that can be increased or reduced as needed, and a platform for students to engage in recursive feedback with their teachers.

- Using digital mini-games and puzzles to reinforce previously learnt content through retrieval practice.

Some key barriers presented by digital technologies in facilitating inclusive teaching and learning include:

- Using technology in a manner that trains compliance and masking and increases cognitive burden for neurodivergent students (for example, invasive wearables and alarms that seek to monitor and reduce stimming behaviours).

- Generalising stereotypes of neurodivergent interests (for example, assuming all autistic children would prefer to be taught by a digital avatar of a teacher rather than by their human teacher, replacing all tangible visual schedules and task boards with digital versions because it is assumed all neurodivergent children would find digital screens more engaging than paper).

Teachers can support neurodivergent students to feel safe in participating in classroom learning activities alongside their peers by:

- Normalising assistive technology and self-regulation aids by ensuring these tools are accessible to all students.

- Supporting diverse learners to feel empowered in their strengths by normalising and encouraging different methods of expression.

Methods for conducting the case study research

To gain an understanding of how digital technologies are being used to support inclusion in Australian classrooms, this research employed a case study approach to gather information through interviews and classroom observations. Case studies are a form of qualitative research that allow researchers to, “explore in depth a program, event, activity, process, or one or more individuals. The case(s) are bound by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained period of time” (Creswell, 2014, p.241).

As a research strategy, case studies can encompass a variety of approaches to data collection, including different methods or techniques. Critically, case studies allow for a detailed study of the subject of interest situated within its environment to ensure that the data collected reflects the natural interaction between them. As such, several techniques are often used to provide a rich understanding of the phenomenon being explored, such as interviews, observations, and surveys (Priya, 2021).

Case studies can be descriptive, explanatory, or exploratory in nature, depending on the requirements of the research questions posed (Yin, 2014). This study used a descriptive approach. A descriptive approach allowed for an illustration of current practices and understandings of the use of digital technologies to support inclusive Australian classrooms, and the perception of such use as per the research questions.

Participants

Six schools participated in the case study component of this research project. In order to capture a diverse range of experiences and contexts, these schools were strategically selected from a short list of 50 schools. Geographically, the participating schools were strategically selected to include a range of urban, suburban and outer suburban populations in three states within Australia. To adhere to the conditions of the human ethics research committee approval and to avoid identifying the schools, the researchers have decided to minimise further details about these participating institutions.

School A	School B	School C
An urban secondary school in Victoria, Australia supporting students with complex mental health needs. Many of the students attending this school are neurodivergent.	A suburban primary (elementary) school in Queensland, Australia that serves a culturally diverse community.	A small primary (elementary) school in Victoria, Australia that is in the outer suburbs of a major city and works with families from diverse socio-economic backgrounds.
School D	**School E**	**School F**
A primary (elementary) and secondary urban school in urban New South Wales, Australia serving a multicultural school community.	An all-girls primary and secondary school in the inner suburbs of a large city in Queensland, Australia.	A co-education secondary school in an urban centre in Victoria, Australia.

Data collection and analysis: classroom observations

Classroom observations were conducted by two researchers who collaborated with the classroom teacher prior to each session to select a position in the room that minimised their presence and reduced potential distractions for students. Following ethical guidelines, the teacher discreetly identified students without consent from their legal guardians, ensuring the researchers avoided recording any information about these individuals. At the start of each class, the researchers briefly introduced themselves to the students but then aimed to limit further interactions. During the lesson, both researchers independently documented their observations using a structured template aligned with the primary research question and guiding questions. In addition to detailed observation notes, a record was maintained of the lesson sequence, the number of participating students, the roles and movements of teaching assistants, and the availability and use of digital technologies in the learning environment.

Analysis of classroom observations

The data collected through the classroom observation templates were analysed collaboratively by the two researchers who conducted the observations. Using an inductive thematic analysis approach, they reviewed each other's notes to identify areas of alignment as well as points of tension or disagreement. Through discussion, they refined their interpretations and worked towards an aligned understanding of the observed phenomena. It is important to note that the observing researchers remained the same across each of the school contexts and had an interdisciplinary professional background (respectively a teacher and a speech pathologist). The researchers then coded the observations and organised them into a series of agreed themes, ensuring these themes aligned with the primary research question and the three guiding questions. This process facilitated a systematic and rigorous analysis, capturing both the shared insights and the nuanced differences in their observations.

Data collection and analysis: interviews with students, teachers, and school leaders

Interviews with students, teachers, and school leaders from the six participating schools were conducted in line with the ethics approval provided by the University of Melbourne Human Research Committee and the permission from the Melbourne Archdiocese Catholic Schools Research Register and school principals. At a time of convenience to the classroom teacher and students, a sample of up to four students in each of the six schools was interviewed as a small group. Interviews occurred directly after the class or during a break to ensure that participating students does not miss any learning time. The participating classroom teacher was asked to select the participating students, including at least one student with disability, so to interview them together about their collective experiences of using technology within their classroom.

The classroom teacher did not need to be present as the Chief Investigator was present for all interviews and is a qualified teacher with a wealth of experience working with children. The classroom teacher was requested to be close by the interview location in case they were needed as per the requirements of the distress protocol in the ethics approval. To minimise the time burden on the classroom teacher, they were interviewed for up to 45 minutes at a time of their choosing. Interviews occurred before or after school, or at a time of their convenience during the school day to minimise disruptions to them or their students.

Selected school leaders were invited to be interviewed to develop an understanding of the schools' respective philosophy on inclusive education and key policies pertaining to the use of digital technologies to support inclusive education. They were interviewed for up to 45 minutes at a time that was most convenient to their schedules to minimise disruptions to their other responsibilities. Interviews were audio recorded and then transcribed using transcription software. All interview data was anonymised to protect the identities of participants and schools.

Analysis of interviews

The transcripts from each of the recorded interviews were qualitatively coded using an inductive approach. An inductive approach allows for the making of inferences and generalisations about the nature of a phenomenon through the discernment of patterns from many observations. In line with the nature of a descriptive case study and the research questions, an inductive approach enabled inferences to be made about the practices and perceptions of digital technology use to support inclusive classrooms through the comments by those most impacted by its use.

To address the research questions, a coding document was devised to address each aspect of these questions as coding categories. These categories were:

- the application of each of the three UDL principles through the lenses of access (to a learning goal), support (for the learning process), and executive function;
- the types and features of digital technology/ies discussed;
- whether the use of the digital technology/ies discussed enabled or hindered inclusive teaching;

- whether the use of the digital technology/ies discussed enabled or hindered inclusive learning;
- whether the use of the digital technology/ies discussed promoted social inclusion;
- whether the use of the digital technology/ies discussed enabled teachers to support inclusive participation; and
- the nature of student functional needs as relevant to the use of the digital technology/ies discussed.

Using a spreadsheet, the interview commentary was interposed against each of these aspects so that any mentions of them in each comment by the interviewee was coded. For example, if an interviewee mentioned that as a student with dyslexia, their iPad was helpful because it could speak a written word aloud to support their understanding of spelling, their comment was coded for 'Digital technology: iPad', 'Feature: text-to-speech', 'UDL principle: Engagement and support'; 'UDL principle: Action and expression and access'; 'UDL Principle: Representation and access'; 'UDL Principle: Representation and support'; 'UDL Principle: Representation and executive function'; 'Enabling inclusive learning' and 'Functional need: Dyslexia'. Notes were also collected for each of the interviews to highlight additional detail outside the parameters of the coding categories, such as quotes or contextual information to enrich the quality of the analysis.

Ethics approvals

Ethics approval to conduct these case studies was received from the University of Melbourne Human Research Ethics committee (Project ID: 26099). Permission to conduct the cases studies was documented on the Melbourne Archdiocese Catholic Schools Research Register (Application ID: 1402) and informed consent was received from each school leader and participant. A plain language statement and consent form was given to each potential participant, with school leaders first being approached, and then teachers and legal guardians of child participants. Legal guardians of potential child participants could nominate to consent to their child being observed, being observed and then possibly being interviewed or not participating in the project. Steps were taken to ensure that any non-participant could still fully participate in their regular lesson without any data being collected about them. Assent for child group interviews was sought through the classroom teacher with a clear distress protocol put in place before the beginning of each interview. No adverse incidents were reported during data collection.

Case studies results

Results of these six case studies are reported in this section of the report. Following an overview of the data collected, analysis of the data from the classroom observations and the interviews has been aligned with each of the research questions. In using this data to answer the research questions, this report seeks to highlight the voices and the experiences of the participants alongside the professional insights of the two researchers.

Maps of the collected data

In completing this research project, the researchers collected a wealth of data from the six schools, with the classroom observations being complemented by contextual background and perspective from participating students, teachers and school leaders. To help illustrate which sources of data were collected in which school, data maps of the classroom observations and the interviews with stakeholders are presented in the following sections.

Classroom observations data map – which classes did the researchers observe?

Directly observing classes in four schools across multiple classes provided the researchers with a rich array of examples of how digital technologies could be effectively used and positioned within an inclusive classroom. When discussing the 'positioning' of digital technologies in this report, it refers to the way that the teacher is presenting the technologies as part of their programme of learning and teaching. As shown below in Table 3, each observed lesson was unique and contained learnings that illustrate the strategic choices that students, teachers and school leaders can make to ensure that the technologies create the conditions for inclusive learning.

Table 3. A map of the key characteristic of each observed lesson in School C, School D, School E and School F.

School	Class focus	Length of time	Number of students	Digital technologies
C	Order of operations (Mathematics)	50 minutes	14	SMART interactive digital display (MX V3) Chromebooks Lumio software Neck microphone
C	Rhyming in poetry (English)	40 minutes	14	SMART interactive digital display (MX V3) Chromebooks Lumio software Neck microphone Handheld microphone
D	Cinematic techniques and themes (Media)	60 minutes	23	SMART interactive digital display (MX V2) Lumio software Kahoot Microsoft Teams Microsoft Surface tablets
D	Calculating a radius (Mathematics)	60 minutes	27	SMART interactive digital display (MX V2) Lumio software Microsoft Surface tablets
D	Order of adjectives (English)	60 minutes	32	SMART interactive digital display (MX V2) Lumio software Kahoot Microsoft OneNote Microsoft Surface tablets
E	The BFG (English) Federation of Australia (Humanities and Social Sciences)	70 minutes	32	SMART interactive digital display (MX V4) Lumio software iPads Microsoft Surface tablets MacBooks Windows laptops
F	Persuasive oral presentations (English)	50 minutes	19	SMART interactive digital display (MX V5) Microsoft Surface tablets MacBooks Windows laptops

F	Researching the digital divide (Science)	50 minutes	26	SMART interactive digital display (MX V5) Microsoft Surface tablets MacBooks Windows laptops

Data collected through these observations helped the researchers in identifying the practices in using digital technologies in the four different contexts, and was a key point of reference in addressing each of the research questions.

Interview data map – what data did the researchers collect?

Complementing the classroom observations was the series of interviews with carefully selected stakeholders. A map of this interview data is shown below in Table 4, including in which schools the research team conducted interviews with students, teachers and school leaders. Schools include either principals or leaders in either learning and teaching or inclusive education.

Table 4. A map of the interview data collected in the research project.

School	Student	Teacher	School leader	Notes
A	N/a	1	N/a	Consent only for teacher interview
B	N/a	1	N/a	Consent only for teacher interview
C	4 students	1 teacher	1 leader	
D	4 students	1 teacher	N/a	
E	5 students	1 teacher	1 leader	
F	4 students	1 teacher	1 leader	Interview with teacher and school leader occurred simultaneously

Insights from these interviews combined with the observations in four of the schools allowed the research team to address each of the research questions. Through this data analysis, the case studies provided a better understanding of the affordances of a range of technologies in classrooms used in real-time, and more importantly, the ways that these digital tools can be best positioned to support the learning and inclusion of neurodivergent students.

Creating the conditions for inclusive engagement, representation, and action and expression

Drawing on the analysed data, this section focuses on answering the primary research question at the centre of this report.

> *Primary research question*
>
> How can digital technologies be best utilised within primary and secondary school classrooms to create the conditions for inclusive engagement, representation, and action and expression for neurodivergent students?

To do this, the researchers synthesised insights into the practical and pedagogical strategies that leverage digital tools to foster inclusion. By examining the interplay between technology use and the principles of UDL, this analysis highlights the opportunities and challenges inherent in creating learning environments where all students can thrive. The reporting of this analysis is organised into the three overarching categories of engagement, representation and action and expression that underpin the UDL framework.

Engagement: Design options for welcoming interests and identities, effort and persistence, and emotional capacity

Welcoming interests and identities

There were numerous examples observed in all schools of practices that welcomed and celebrated students' interests and identities, a key foundation of engagement in an inclusive classroom. At School A, fostering positive relationships was central to their focus on trauma-informed practice, emphasising the importance of welcoming learners however they may present in any moment. Through using Lumio, the teacher slowly built participation by finding topics of interest to their students who have experienced trauma or complex mental health challenges and allowing them space to volunteer contributions either verbally or asynchronously through their device via a 'Shout It Out' activity. In a more direct approach, students at School E were given autonomy by being encouraged to approach the SMART interactive digital display (MX V4) to share their ideas or write freely, fostering a sense of collective ownership of the learning technologies in their classroom and affording active participation in their learning. This freedom to contribute created a more engaging and student-driven classroom dynamic. In terms of optimising relevance, value, and authenticity, School E began each day with date and time-related questions to orientate the class and immediately engage students in meaningful interactions. Similarly, at School C, whole-class activities displayed everyone's responses and ideas on the interactive digital display, promoting inclusivity and validating each student's contributions. The student from School C quoted below describes how routines were established for students to share their ideas and thoughts through think-pair-share activities.

> *"We just do it every day, so we get used to it a bit. Because we always have... Say before writing, we always have slides before writing, like getting ready for writing or getting ready for maths. And so it's like, yeah, we bring our whiteboards to the floor and we just do small activities and then we always have to sit with a partner to share our work with them."*
>
> **Student at School C**

These examples show how thoughtful integration of digital tools can affirm students' identities and foster inclusive, relevant, and engaging learning environments.

Schools A, C, D, and F provided insightful examples of how classrooms can welcome students' interests and identities by nurturing joy and play while addressing biases, threats, and distractions. Both School A and School C prioritised structured gamified activities that allowed students to demonstrate and apply their learning in an engaging and enjoyable manner, fostering a playful yet purposeful environment.

Despite having some concerns about excessive play, the teacher in School A described the appeal of a predictable environment that gaming can provide for many of his students who need some sense of control in their lives:

> *"Gaming becomes a really, really powerful thing for them because there's no variables. The variables are under their control. If I press that J, the character's going to jump if I press that button. And so they gravitate to that sort of element because it's predictable. It's much more in control. So that can be an amazingly powerful, engaging tool."*
>
> **Teacher at School A**

A student at School D described how in some classes time was afforded for sharing their favourite interests with their classmates and teachers, and connections were then made to the focus learning objective. The student provided an example of some of her teachers embracing the absolute joy that the virtual sandbox game Minecraft brings her.

> *"If someone sees me watching YouTube, they're going to see me watching Minecraft. That's it."*
>
> **Student at School D**

Drawing on such interest in gaming and gamified experiences, School D used quiz creation app Kahoot on the SMART interactive digital display (MX V2) in small table groups. The design of this software and positioning of it by the teacher encouraged collaboration and light-hearted competition. This sense of fun was also evident on the customisable screen savers on students' Surfaces, providing an outlet for individual self-expression and reinforcing a sense of individual personality and identity. To address biases, threats, and distractions, School F employed strategies to create a predictable and supportive learning environment, such as writing the schedule of upcoming tasks on the physical whiteboard to help students anticipate and prepare for each lesson. Additionally, School F used the interactive digital display to share key visuals, including learning outcomes, infographics, and tools like a noise level gauge and a regulation station icon, ensuring clarity and reducing potential stressors or distractions. These approaches highlight how joy, play, and thoughtful structure can harmonise to create inclusive and identity-affirming classrooms.

Sustaining effort and persistence

Sustaining effort and persistence in learning relies on clarifying the meaning and purpose of goals, and Schools C and F demonstrated how the integration of technology and pedagogy can achieve this. At School C, the teacher displayed clear stepped instructions on the SMART interactive digital display (MX V3) that visually broke down the required processes, assisting students to understand each step and its connection to the overall learning objectives. Similarly, School F used an interactive digital display to briefly display task description templates and provide clear, visual starting points. This was reinforced by teachers in both schools walking through the task rubrics, explaining how students could access them on platforms like OneNote (in School C) or their local learning management system (in School F) and outlining specific criteria for success. In School E, the use of the ink layer on the SMART interactive digital display (MX V4) was used to list tasks for the remainder of the lesson, offering ongoing visual and structured guide, helping students maintain focus and see the purpose of each activity within the broader context of their learning goals.

To optimise challenge and support, Schools C, D, and F effectively combined digital technologies with tailored pedagogical strategies. At School C, interactive digital displays were used to physically manipulate diagrams and incorporate colourful, engaging visual supports into lessons, making abstract concepts more accessible and visually stimulating. School D enhanced engagement by pairing digital tools with structured approaches and short bursts of explicit teaching, ensuring students received the necessary scaffolding to tackle challenging tasks. Meanwhile, School F created a supportive learning environment by displaying learning outcomes, infographics, and other helpful visuals such as calendars and regulation station icons on the digital display at the point of need. These tools provided clarity, reduced cognitive load, and ensured that students were equipped to meet appropriately challenging goals.

Fostering collaboration, interdependence, and collective learning is another essential aspect of sustaining effort, as demonstrated by Schools C, D, E, and F. At School C, students led example activities on the SMART interactive digital display (MX V3) while peers worked on similar tasks using physical whiteboards, promoting peer learning and active participation. Chromebooks were also integrated with the digital display, allowing students' responses to be shared collectively. A student in School F noted that they regularly used their digital display for collaborative note taking in one of their favourite classes:

> *"We use [the SMART interactive display] a lot for note-taking. In Italian, again, it's very hands-on, but we get to go write on the board and stuff like that, which I think a lot of us really enjoy."*
>
> **Student at School F**

In School D, learning extended beyond digital platforms as students collaborated on Surface tablets and participated in group discussions that culminated in mini-presentations, blending digital and physical interactions. School E further nurtured collective learning by inviting students to share ideas on the interactive display in various formats, such as drawings or written responses, fostering a sense of ownership and inclusion. Activities like 'Shout It Out' allowed for class-wide engagement, while tasks like 'See, Think, Wonder' collated communal responses, creating a visual representation of shared knowledge. At School F, individual laptop tasks were paired with verbal class discussions, integrating digital independence with collective reflection. These practices illustrate how technology, paired with thoughtful pedagogy, can strengthen collaboration and build a supportive learning community.

Fostering belonging and community can be significantly enhanced through the integration of technology and pedagogy, as illustrated by the use of Kahoot in School D. In one observed class, Kahoot was framed as a competitive exercise, with the leaderboard emphasised, creating an energised atmosphere that motivated some students but risked disengaging others less comfortable with competition. By contrast, another class in the same school used Kahoot to foster a deeper sense of belonging by downplaying the competitive elements. Instead, the teacher guided discussions about the reasoning behind the correct answers, encouraging collaborative exploration and mutual respect for diverse perspectives. This contrasting approach highlights how the same digital tool, when paired with nuanced pedagogy, can either prioritise individual competition or cultivate a shared sense of community through cooperative learning.

Offering action-oriented feedback further demonstrates the dynamic interplay of technology and pedagogy in sustaining effort and persistence. In School D, Kahoot activities at the end of lessons provided immediate, quantifiable feedback through quiz points and leaderboard rankings, helping students gauge their understanding and consolidate learning. At School E, polls conducted on the SMART interactive digital display (MX V4) showed anonymised class responses, creating a safe space for students to express their views. Creating a sense of safety in sharing responses and receiving feedback on the next steps for their learning was a clear priority for the teacher in School A, as demonstrated by his explanation for why his students were allowed to complete simple tasks in Minecraft on their devices while engaging in whole class discussion and receiving feedback:

> *"As long as they show it, I allow them to do it because I think the nature of neurodivergence is the students need to feel some sort of control, some sort of safety in the classroom for them to be able to even contemplate stepping with me outside of their comfort zone. So, I have to have a balance between giving them that opportunity while also pushing their learning."*
>
> **Teacher in School A**

For students in School A, being in the classroom and listening to feedback was a significant step. For other educators, there is a belief that students need to be constructively challenged. The teacher in School E extended their students beyond conducting straw polls and providing collective feedback by inviting individual students to explain their reasoning, fostering reflective thinking and dialogue. Additionally, the integration of Lumio allowed student work completed in individual portals to be displayed on the digital display for class-wide feedback. Teachers used this opportunity to provide targeted, actionable insights, ensuring students understood how to improve and build on their efforts. These examples underscore how technology, when used thoughtfully, can create meaningful opportunities for feedback that drives both individual and collective growth.

Developing and supporting emotional capacity

Developing and supporting emotional capacity within a neurodiversity framework requires recognising the expectations, beliefs, and motivations that underpin students' engagement and learning. At School C, the interaction between technology and pedagogy supported this by displaying individual student responses from Chromebooks on the SMART interactive display (MX V3). This practice not only ensured accountability for participation but also highlighted each student's contribution, fostering a sense of ownership and validation. Similarly, the teacher's use of the interactive display for whole-class instruction while students followed along on their Chromebooks created a structured environment that aligned with clear expectations, reducing potential anxiety and building confidence in their roles and responsibilities within the classroom.

Awareness of self and others was supported in School E through the use of consistent verbal cues paired with expected responses. For example, the teacher would say, "Hands on top," to which students would reply, "That means stop." This simple but effective strategy helped students develop self-regulation and situational awareness by recognising shared social cues. It was clear to the researchers that this was a well-established routine in the class, with very student understanding the expectation that they put their screens down on their individual devices and listen to the teacher. While not explicitly linked to digital technology, this practice is inherently connected to using digital tools as a responsible citizen of the classroom. The researchers noted this routine could be further enriched by integrating visual or auditory prompts through the digital display or classroom management software, creating multimodal reinforcement tailored to diverse learning needs.

Promoting individual and collective reflection is a critical component of developing emotional capacity, but no specific examples were observed or discussed in the participating schools. This gap highlights an area for further research and exploration. Future case studies could explore how schools are using cloud-based creative technologies, such as digital portfolios, collaborative reflection tools, or video recordings of classroom activities. These might be used to support neurodivergent students in processing their experiences, celebrating achievements, and identifying areas for growth both individually and as part of a group.

Cultivating empathy and restorative practices was evident in the examples from Schools A, D and F. In School D, the use of Lumio's feature of automatically transitioning students' screens to follow along with the teacher's presentation ensured that no student was inadvertently left behind. Using guided access in this way promoted inclusion by addressing potential challenges with focus or navigation that some neurodivergent students might experience. In School F, empathy and respect were fostered through a simple but powerful classroom routine: when a student shared their ideas, all other students closed their laptops, giving full attention to the speaker. This technology-supported approach, paired with a deliberate pedagogical strategy, reinforced the importance of valuing each student's voice, building a culture of mutual respect and understanding. Empathy was an explicit focus in the classroom of the teacher in School A, but as it takes time for most students to feel comfortable speaking in front of their peers and sharing their ideas, trust was being slowly established in this teacher's class through the explicit building of relationships.

> *"Some of them I still have to prompt. I've got a couple of students, it's not that they don't have necessarily confidence in their voice, but they haven't got the drive and the motivation to put their hand up, so I have to prompt them, which is fine. But they're getting there slowly, and once I prompt them, they're actually starting to voice their opinion. So, it starts off very quiet, but it does pivot. And like today's classroom, the discussion we were having, it was very dynamic."*
>
> **Teacher in School A**

Action & Expression: Design options for interaction, expression and communication, and strategy development

Facilitating interaction

Facilitating interaction through varied and flexible response methods was a notable feature in Schools D and E, where technology supported diverse ways of navigating tasks and expressing ideas. At School D, Surface tablets provided students with options for touch, stylus, or keyboard input, enabling them to choose the method that best suited their individual preferences and needs. This was noted by students in School E:

> *"I also like the SMART Board because I find it's quick and easy to log on and you can do all sorts of stuff, like polls, activities, worksheets. So, I find it really easy and fun."*
>
> **Student in School E**

This flexibility was further enhanced by features like customisable cursors; for instance, one student used a large pink cursor for easier visual distinction. Similarly, at School E, students worked on tasks using their individual devices in ways that aligned with their perceived strengths; some typed their responses, while others used tablet pens to handwrite. By honouring these varied methods of interaction, the schools created inclusive spaces where students could fully engage in learning without being constrained by a single mode of response.

Access to assistive and accessible technologies was thoughtfully integrated into classroom practices, supporting participation for students with diverse needs. At School C, the teacher used a neck microphone to ensure that their voice was evenly distributed throughout the room, while handheld microphones allowed students to share their ideas confidently during discussions. Beyond these universal tools, specialised assistive technologies were crucial for individual students, such as a student with cerebral palsy at School D who used customised tools to navigate their learning environment and a student at School F who employed text-to-speech software for their work. These examples highlight the critical role of accessible design in fostering interaction and participation, demonstrating how thoughtful integration of such digital tools can break down barriers and strengthen the sense of belonging within the classroom community.

Supporting expression and communication

Supporting expression and communication through multiple forms of media was evident in School F, where a task was designed for students to create a social media post. This format offered a dynamic way for students to engage with content and express their understanding through the use of shortform text, supporting static photos, infographics and artificial intelligence-generative images and video. By leveraging the conventions of Instagram, a platform familiar to many students, the task not only encouraged creativity but also highlighted how technology can bridge classroom activities with real-world communication practices. This approach allowed students to explore and present their ideas in flexible and personalised ways, affirming neurodiverse strengths in visual and digital communication. Likewise, the teacher at School A noted the power of technology to help him build trust in communication with an initially reluctant young adult in his class.

> *"And that's huge amount of growth. The connection with one of the students by using technology to get their voice into the classroom and to connect with me has meant that they have gone from being grunts like... to having conversations like we're talking now with just not myself, but with other students in the classroom. So, where they've actually moved to voicing, not just having noises, but voicing their ideas and their concerns and connecting with others and use the technology as the pivot point to do that."*
>
> **Teacher in School A**

The use of multiple tools for construction, composition, and creativity was prominent in Schools C and E, where interactive technologies were central to lesson delivery and student engagement. At School C, the SMART interactive digital display (MX V3) allowed for the physical manipulation of information by both the teacher and the students, allowing users to interact with diagrams and visuals to clarify and prompt each other as needed to check for understanding. The experience using the interactive display was paired with Chromebooks through Lumio, enabling a seamless transition from group instruction on the floor to individual application at desks. Similarly, at School E, students engaged with a guided class-wide activity using the Lumio portal, which allowed them to log in via their devices and participate in a shared learning experience. When students were sharing their creative solutions to a research prompt, they could easily their work from their personal device to the whole class on the interactive display. Through this shared digital ecosystem, these digital tools afforded the teachers and the students with varied and accessible ways to construct their understanding and communicate their ideas with each other.

Building fluencies with graduated support for practice and performance was observed in structured, incremental activities designed to scaffold learning effectively. At School C, students were encouraged to articulate their thought processes when working through tasks on the interactive digital display, a practice that supported both metacognitive development and verbal communication. The parallel use of physical mini whiteboards helped individual students mirror and internalise the group activity, maintaining engagement and reinforcing skills. School D also adopted this approach through short, interactive activities and quizzes in Lumio, which broke up instruction into manageable segments, allowing students to consolidate their understanding in steps. These strategies ensured that all learners, including neurodivergent students, had opportunities to build confidence and mastery over time.

Addressing biases related to modes of expression and communication was not observed in any of the lessons or mentioned in interviews, highlighting an area for further exploration. Research and practice in this domain could focus on identifying and mitigating potential biases that may arise from privileging certain modes of communication over others. Ensuring all students feel that their unique ways of expressing and communicating are equally valued and supported would contribute significantly to a neurodiversity-affirming classroom environment.

Assisting strategy development

Assisting strategy development through a neurodiversity-affirming framework was evident in School F, where meaningful goals were set by walking students through the task rubric available on their local learning management system (deliberately not named as to protect the anonymity of the school). The teacher provided clear instructions on the indicators of quality that students needed to demonstrate to achieve full marks, ensuring transparency and enabling students to understand the success criteria. This approach not only clarified expectations but also empowered students to take ownership of their learning by linking their actions to specific outcomes.

Anticipating and planning for challenges was exemplified in Schools C, D, E, and F, where visual and digital tools were used to structure activities and reduce uncertainty. At School C, a daily physical visual schedule was integrated with a digital weekly timetable displayed as a Google Doc on their interactive digital display, helping students remain organised and to be able to self-manage what they should be working on now and what needs to be done next.

Similarly, School E combined task instructions on the SMART interactive digital display (MX V4) with a visual activity schedule, detailing activity durations and explicitly linking the use of specific digital tools to activities within the lesson. In School F, a task list on the SMART interactive digital display (MX V5) included written descriptions, visual icons, and checkboxes for each task, offering multiple entry points for understanding. These strategies anticipated potential confusion and provided a clear roadmap for students to follow.

Organising information and resources was supported by the use of structured templates across Schools D and F. At School D, templates on Teams and Lumio incorporated visual scaffolding, enabling students to focus on the content rather than struggling with task structure. The classroom teacher ensured clarity by stating, “I have set everything up for you, and you just need to edit”, simplifying the task demands for students who experienced challenges with retaining multiple pieces of concurrent information in their working memory. Similarly, School F used task planning sheet templates in Word documents which students completed prior to the observed lesson. These tools facilitated a structured and accessible approach to task completion, enhancing the learning process for all students, including those with neurodivergent needs.

Enhancing the capacity for monitoring progress was evident in the interactive techniques employed by Schools C, E, and F. At School C, ‘Check-for-understanding’ tasks on the SMART interactive digital display (MX V3) helped students assess their achievement of success criteria in real-time. School E used an interactive class poll to ask, “Is learning about the past important?”, with visual representations of responses displayed on the digital display via a ‘Shout It Out’ activity, encouraging students to engage with peer perspectives and reflect on their contributions. Similarly, School F implemented a QR code check-in at the end of the task, fostering a sense of accountability and progress tracking. These practices provided students with immediate feedback and insights into their learning journey.

Challenging exclusionary practice was not observed in any of the lessons or mentioned in interviews, pointing to an area that warrants further exploration. Future research could investigate how to identify and address subtle exclusionary practices in classroom settings, particularly those that may arise in the integration of technology. Developing strategies to ensure all students feel included and respected in their modes of participation would significantly enhance the inclusivity of these learning environments.

Representation: Design options for perception, language and symbols, and building knowledge

Options for perception

Facilitating options for perception through a neurodiversity-affirming framework involves creating opportunities for students to customise how information is displayed to meet their individual needs. In School C, the interactive digital display offered flexibility in adjusting font size, colour, and style to enhance readability and accessibility for diverse learners. With a similar mindset of learner flexibility, lesson materials at School D were made available in both physical and digital formats, allowing students to choose the medium they found most comfortable or effective. The teacher in School E was also an advocate for bring together digital and non-digital resources to provide students with a range of modes of learning.

> *“I still like the old-school ways of reading a real book as well. And I think that's important we've got that too. We were using the SMART Boards, but they were also doing something in their book.”*
>
> **Teacher in School E**

The Lumio platform further supported this by enabling students to personalise text formatting, such as font size and style, tailoring the learning experience to their specific sensory preferences and processing needs. These practices illustrate how technology, when paired with thoughtful pedagogy, can empower students by giving them control over how they access and engage with information.

Supporting multiple ways to perceive information is another crucial element of representation, as demonstrated by examples from Schools C, D, E, and F. At School C, the SMART interactive digital display (MX V3) was used to visually distinguish between different types of information by employing unique background shapes and consistent colour-coding for problems, answers, and instructions in Lumio notebooks. A visual timetable on the digital display with colour-coded class activities helped students anticipate and prepare for their day. Similarly, School D used the visual timers on SMART interactive digital display (MX V2) to support time management, while School E employed visual cues like a "shhh" emoji to indicate quiet activities. Physical visual resources for language learning and journalling were also integrated to complement digital tools. At School F, task descriptions displayed on the SMART interactive digital display (MX V5) included a mix of contextual summaries, clear instructions, and examples, paired with verbal explanations to cater to different sensory preferences. These approaches highlight how combining multimodal resources with clear visual and auditory supports ensures information is accessible to all learners.

Representing a diversity of perspectives and identities in authentic ways was effectively demonstrated at School E through the integration of historical and artistic content. During a lesson on Federation, students were invited to study a famous Australian painting, Tom Robert's *Big Picture*, displayed on both the SMART interactive digital display (MX V4) and their individual devices, encouraging them to analyse both the whole artwork and the smaller details and consider the perspectives embedded in the artwork. This dual-platform approach not only supported accessibility but also fostered critical engagement with diverse narratives and cultural representations in analysing who was shown in this 1903 artwork depicting the first-ever sitting of the Australian Parliament. Students could enlarge the painted faces of the people depicted in the painting on their own devices, which led to a rich discussion of racial and gendered discrimination. Allowing students the space to have explore content and then facilitating such discussions exemplifies how digital tools can be used to engage in critical discourse and enable students to explore varied perspectives, enriching their understanding of complex social and historical contexts.

Supporting language and symbols

Supporting the clarification of vocabulary, symbols, and language structures was effectively demonstrated in Schools C and D through the integration of interactive technology with direct teaching methods. At School C, the teacher used digital ink layer on the SMART interactive digital display (MX V3) to highlight and annotate key information during lessons, such as features defining the structure of a poem, enhancing students' ability to connect words with their use in genre conventions. A student in C also described that through the use of Lumio, the teacher collated these collaborated with students on maintaining a vocabulary bank of key terms.

> *"We have when we're doing our reading with our pairs, it's fluency pairs, we have this vocab words daily review sort of thing. So, it tells us what we are do in reading that day. And it says our vocab words and the goal when we're reading, like accuracy or punctuation."*
>
> **Student in School C**

Similarly, at School D, teachers used the digital ink layer on their digital display to mark up and elaborate on a series worked examples in mathematics class, making abstract concepts pertaining to the circumference and the radius of a circle more concrete and accessible for students confused about what was being measured. These practices highlight how the affordances of digital ink can be used as part of pedagogical strategies to visually emphasise key points of learning, ensuring clarity and comprehension for all students including those with neurodivergent learning profiles.

The flexibility of the SMART interactive digital display (MX V3) to show both typed and handwritten symbols was particularly beneficial in School C for decoding mathematical notation and symbols. By incorporating both digital and manual inputs, the digital display enabled the teacher to model complex processes step-by-step, ensuring that students could follow the logic behind equations or problem-solving methods, with the teacher converting handwritten notes to an accessible Sans Serif font at the end of step. This approach is particularly advantageous for learners who struggle to decode text, who may benefit from seeing information presented in multiple forms to enhance understanding and require consistency in how letters are presented on a screen. The capacity to seamlessly switch between typed text and handwritten annotations also allowed teachers to tailor explanations to the specific needs of their class in real-time.

When interviewed, students in all schools held strong opinions about how they would like to interact with devices, particularly around writing. Older students were more aware of the affordances of a physical keyboard for writing long passages of text compared with preferring to using emojis or other symbols. This growing awareness is exemplified by the below quote from a Year 6 in School C.

> *"Probably a keyboard because sometimes it's easier using a keyboard, but if I want to use emojis or something like that, I would use the iPad."*
>
> **Student in School C**

No examples of cultivating understanding and respect across languages and dialects were observed in any of the lessons or mentioned in interviews with participants. This represents an important gap in practice and an area that warrants further research. Future investigations could explore how digital technologies, such as translation tools, multilingual content on interactive platforms, or culturally responsive multimedia resources, might support neurodivergent learners in engaging with and appreciating linguistic diversity.

Similarly, limited examples were observed or discussed regarding addressing biases in the use of language and symbols, with the previously noted example of the critical discussion of the painting in School F being the sole instance. This paucity underscores the need for research into how schools can integrate digital technologies and pedagogical strategies to identify and mitigate such biases. Tools like content analysis software, inclusive digital resources, and bias-checking algorithms could be explored to help educators design lessons that use language and symbols in ways that are equitable and affirming for all students, including those from neurodivergent and diverse cultural backgrounds.

The use of multiple media to illustrate concepts was a notable strength in Schools C, D, and E. For instance, in School C, mathematics lessons incorporated both Chromebooks and physical mini whiteboards, providing students with different modalities to engage with the material. At School D, a YouTube video explaining nouns, adjectives, and articles added a dynamic layer to traditional instruction, while Kahoot activities combined written text with visual symbols to differentiate answer options, making them more accessible to diverse learners. School E complemented tasks on the SMART interactive digital display (MX V4) with physical English skills books, enabling students to simultaneously engage with digital and tactile resources. These examples demonstrate how combining various media formats can enhance comprehension, engagement, and accessibility for neurodivergent students by catering to different sensory and cognitive preferences.

Building knowledge

Connecting prior knowledge to new content was a key feature of technology-enhanced lessons in School E. For example, the structured activity around Roald Dahl's text *The BFG* presented on the SMART interactive digital display (MX V4) provided an opportunity to revisit previous classwork, with handwritten notes summarising past activities to refresh students' memories before starting new chapters. Similarly, School C's class review tasks, commonly known as 'Daily Reviews', used their interactive digital display to consolidate earlier lessons, using annotations and visual summaries to link foundational ideas to upcoming topics. A student in School C describes this process in the below quote.

"And so yeah, it goes back to all the things that we've learnt in Maths and just making sure that we remember them and just yeah, practising them so it's stuck in our heads. We also have a daily review for Writing too. Probably mix, a mix of stuff. Once we just completely figure out about two plus two or something, just for an example, it just gets taken off there. Then we move over to something else."

Student in School C

When discussing the importance of explicit teaching in his classroom, the teacher in School A highlighted an important affordance of using technology to support a trauma-informed pedagogy.

"And when I'm doing explicit teaching, I stand at the SMART Board, I annotate PowerPoints. The other great thing about that is I unpack that SMART Lumio element as well because of the nature of my students' ASD and because of their confidence, a lot of them hide behind their screen. So, getting them to look at the board to even connect with me and inadvertently connect with people around them can be quite threatening. So, using the Hello Smart or Lumio platform allows the students to also have my presentation that's on the SMART Board on their screen as well. So that means that then the students, I can be annotating on the board, and it comes up on their screen, whatever they write or anybody else writes on the class comes up on their screen."

Teacher in School A

These approaches highlight how neurodiversity-affirming teaching strategies, combined with interactive technologies, can effectively scaffold learning by contextualising new material within familiar frameworks and reducing cognitive load for neurodivergent students and/or students with disability.

In Schools C and D, technology was pivotal in helping students identify patterns and relationships in their learning. At School C, the SMART interactive digital display (MX V3) supported the visual explanation of rhyming patterns and syllables, enabling students to differentiate rhythm and rhyme through annotated examples. Collaborative activities, such as building a rhyming word bank on the large screen at the front of the classroom, further reinforced these concepts. Meanwhile, at School D, Lumio activities used visual structures to chunk the components of noun phrases into clear, digestible groups. A scaffolding table in the Lumio workbook organised the order of nouns, fostering comprehension of grammatical relationships. These strategies illustrate how interactive tools can provide neurodivergent learners with accessible and structured opportunities to engage with complex ideas.

Multiple modalities were integrated into lessons to support diverse ways of making and demonstrating meaning, particularly in Schools B, D, E, and F. At School D, lessons combined physical resources with digital tools, offering students varied avenues for understanding and engagement. In School E, digital display-based reading activities included pauses to explain unfamiliar vocabulary and terminology like 'patriotism', promoting real-time clarification and deeper comprehension. Similarly, at School F, writing tasks such as developing engaging hooks were scaffolded with handwritten examples using the ink layer on their SMART interactive digital display (MX V5). These approaches enabled students to access content through different sensory and cognitive pathways, affirming the value of varied ways of knowing for neurodivergent learners. In School B, the teacher described how they used video and audio recordings to support demonstrating their understanding of the core concepts of measurement and capacity.

"This week for capacity, I've had all of the different measuring tools out. And in the iPad, it's had little frames, so that when they've compared them they've taken photos to show, and then recorded their voice over the top."

Teacher in School B

At School F, the teacher's use of a Federation (Australian historical period)-themed research template in Lumio exemplified a neurodiversity-affirming approach to creating clear task expectations and a predictable space for students to provide their responses. While designed to scaffold a specific research task, the template also taught broader skills like task delegation during collaborative activities, which students could apply across subjects. By embedding transferable competencies into lesson structures, educators equipped students with tools to generalise their learning beyond the immediate task. In discussing the use of templates that scaffold their learning in School C, a student commented on the ease of access of these templates in Lumio, and how this accessibility meant that they were often used in their class.

> *"It could also bring up ready-made templates for you to draw and add images too. And the fact that it is also in Lumio is just good as well."*
>
> **Student in School C**

As the teacher in School A emphasises in the quote below, these strategies underscore the potential of interactive technologies when paired with intentional pedagogy to support neurodivergent learners in applying knowledge and skills across varied contexts. The positioning of technology in the classroom by the teacher plays a significant role in how effective it will be in supporting academic and social inclusion.

> *"I think it's about making sure that… whatever [the type of technology] is, we always identify it as a tool and as the tool is to provide a particular function and whether or not that function is best suited for that student, whether or not it gives the student the power to have their own voice, have some autonomy, have some efficacy, those ideas for students to be able to use the technology to connect to their learning, to take control of their learning. I think it's important that we don't get students to rely particularly exclusively on technology, which is what I find in my classroom."*
>
> **Teacher in School A**

Features of digital technologies that promote the social inclusion of students with disability and neurological differences in their classrooms

The first guiding question in this research project is concerned with the design of the technologies used in the case study schools, with a particular interest in the affordances that design can bring to social inclusion.

> *Guiding question 1*
>
> Which features of digital technologies promote the social inclusion of neurodivergent students in their classrooms?

In analysing date to address this question, several subthemes emerged that focus on the types of features that students, teachers and school leaders believed are important in creating the conditions for an inclusive learning environment.

Assistive technologies and accessibility features for access

Assistive technologies and accessibility features in classrooms play a vital role in promoting the social inclusion of students with differences manifesting from neurodivergence by enabling equitable participation in learning activities.

The teacher in School B highlighted the importance of assistive technologies in implementing the Universal Design for Learning principles in her classroom.

> *"So, when we have our planning days and we're planning assessment tasks, we'll quite often talk around the UDL Universal Design of Learning, to have those conversations around, okay, well what's the barrier for this child, how can we fix it? And so sometimes it will be using the assistive tech. So quite a few of our prep classes will get the students to speak their sentence into the iPad, and then have it speak it back to them, so that then they can write it down and they're not having to hold the sentence in their head to write it. So, we use a few of those strategies as well."*
>
> **Teacher in School B**

At School C, the use of neck microphones to broadcast teachers' voices supported neurodivergent students with auditory processing differences during whole-class instruction by ensuring they could process information effectively. Similarly, handheld microphones were provided to students during a poetry reading activity, fostering confidence and inclusion in group discussions. At School F, a student recognised the transformative impact of assistive technology on inclusion, stating, "But [technology] also helps some of them if they can't [do certain things]... Someone in the classroom next door to us, she has dysgraphia, which means she can't write, so she uses a laptop for most of her things, which is, I think it's good." This observation highlights the importance of normalising assistive tools, enabling all students—regardless of their abilities—to engage in the same tasks as their peers, fostering an inclusive and supportive classroom environment. While there may be a fear that assistive technologies can sidestep the need for students to develop the fundamental literacy and numeracy skills that every person needs to develop, the teacher in School B was impressed by how they observed students using assistive features to in fact support the development of these skills.

> *"… I didn't realise that we could take photos of the students' work and have it read their writing back to them. So, I've been using that in my class, and you can see their little brains just go, "Oh my gosh, I didn't want it to say that." So, I love that it can read their handwriting, and that it's reading exactly what's on the page. Because if I read it, they're just like, "Yeah." But when they hear the iPad read it back, they're like, "No, that's not what I wrote." And so, then we can go through and go, "Look, it is." So, then they're fixing it. I think that's been one of the best things that we've used for ages."*
>
> **Teacher in School B**

By embedding these technologies into pedagogy and fostering positive relationships, these schools demonstrated that assistive technology can become a bridge to participation rather than a barrier.

Software that balances guided access and autonomy

Software platforms like Lumio can provide a balance between guided access and autonomy, fostering the social inclusion of students with disabilities and neurological differences by creating shared and adaptable learning experiences. The teacher in School E explained how he begins to teach a lesson using Lumio by guiding the students, and as they demonstrated an understanding of the core content and skills, he began to provide them with more freedom to explore the Lumio workbooks and work at their own speeds.

> *"I find using the lesson pacing option is wonderful. I can control what they're looking at. And sometimes, if we are looking at the big screen, you can see these tables [pointing to an example of a template used in the lesson], and when it's in front of them, it's great. And then for kids that need to go ahead, I can click that lesson pacing and then they can find where they need to go in the lesson."*
>
> **Teacher in School E**

At School C, the integration of Lumio with Chromebooks allowed students to engage individually while maintaining a sense of collective participation, as the platform enabled personalised adjustments to support diverse needs. In School D, the large digital display served as a focal point for class discussions, with the teacher using Lumio to present quizzes and guide the entire class through answering questions about the content. This collaborative use of technology created opportunities for students to engage at their own pace while feeling connected to their peers, reinforcing positive relationships and mutual understanding. By combining the adaptability of individual devices with whole-class interactions on the SMART interactive digital display (MX V2), the use of a shared platform such as Lumio supported all students to contribute meaningfully to shared learning activities.

Using digital displays to model positive culture as well as learning routines

When used with care and forethought, interactive digital displays can support teachers in modelling positive culture and establishing inclusive learning routines, which in turn promote the social inclusion of neurodivergent students. At School E, reviewing individual responses on their SMART interactive digital display (MX V4) facilitated whole-class understanding without judgment or correction, encouraging a culture of openness and curiosity. The teacher used these displays to prompt discussions, asking thoughtful questions to help students elaborate on their thinking, creating a low-pressure environment for sharing ideas. Similarly, at School F, their interactive digital display served as a central hub for information, seamlessly blending digital projection with the tactile interaction of a physical whiteboard. This dual functionality supported clarity and consistency in learning routines, ensuring all students could follow and participate. When describing their use of their interactive digital display, the teacher from School A agreed that building routines based around this central device created positive expectations about staying engaged in the lesson. Perhaps more importantly, it also provided a means by which to slowly build learner confidence in his classroom.

> *"At the start of the year, they'll be quite staring at a screen like you and I staring at each other right now, however, and we will be quite quiet, and they will use the platform like "Shout It Out" or they'll use their single page, like the individual tasks. I then use them to move that into a classroom discussion type. So, if you had an activity in front of you and it was an individual task, you'd be writing on it. And then I might say, "Matt, can I use yours as an example?" And terror will go into your eyes, but then you'll give me this nod because you know that I've built up the safe space. Then I click on your name on my SMART Board and your work pops up in front of the class and I start talking about this awesome stuff, "Look at this little Matt's done. This is really great. I love how Matt's approached this. I've never even thought about, Matt. That's a really great approach." And suddenly using that approach with positive regard, suddenly I'm focusing on building that student's confidence."*
>
> **Teacher in School A**

These practices demonstrate how large interactive digital displays, when positioned thoughtfully, can build a classroom culture rooted in respect, discussion, and student self-efficacy.

The careful use of media

The careful use of diverse media formats can support the social inclusion of neurodivergent students by catering to varied learning needs while maintaining a supportive and inclusive environment. At School C, students had access to multisensory forms of information, including visual, auditory, and tactile, empowering them to choose the resources that best suited their individual preferences and needs. Clear expectations around the use of these options ensured that students could use tools like audio explanations or visual aids to support their learning without disrupting others' participation. This thoughtful integration of media highlights how technology, when paired with strong pedagogical frameworks, can build an inclusive classroom culture where all students feel valued and capable.

Gamification

Gamification and gamified-instruction can create engaging opportunities for the social inclusion of students with disabilities and neurological differences by fostering collaboration and shared interests in a structured environment. At School C, gamified challenges on the interactive digital display allowed students to work in pairs, using the whiteboard as a neutral and accessible tool for joint problem-solving without requiring extensive conversation. This setup reduced social pressure while still encouraging interaction and teamwork. Similarly, at School F, games facilitated spontaneous peer connections, with one student who typically worked alone choosing to join a group gaming activity at the end of the lesson. When describing her use of games, the teacher in School B explains that in her classroom it is not just playing games. She has taught her students in her early years class to collaborate to create their own gamified experiences that demonstrate their understandings of core concepts.

> *"I've started off teaching them the gamification side of things. So, making the games, but then also showing them how to embed the videos, how to use the workspaces. So, teaching them how to use the collaboration side so that the students are working together, even though they've got different devices."*
>
> **Teacher in School B**

While the interviewed teachers were more cautious about gamification and games-based learning, there were many enthusiastic endorsements for these pedagogical approaches from the students.

> *"It's like DOORS but bad. Well, I'm making a 'DOORS but bad' update before the actual update game. Yeah, I learned how to animate and build."*
>
> *[A student with complex communication needs describing their favourite project in Minecraft]*
>
> **Student in School D**

> *"Points? So, it's a class leaderboard. We find it as a competition, that's fun. And you get stars if you get questions right, and your points go up if you do it during the week. It doesn't interest me. I'm not interested in math, I don't really like math, but if we had something else better, like ... We don't use textbooks in maths because Mathspace is our textbook, but I would rather actual physical textbooks, worksheets, stuff like that."*
>
> **Student in School F**

One student expressed frustration when gamified instruction limited their creativity in solving problems, which highlights the risk of introducing gaming experiences into learning that do not meet the expectations of students who play games as a recreational activity outside of school.

> *"The Mathspace, it's questions, and they go to ... you got to answer the questions, but sometimes when doing it, there's a couple of ways to figure it out, and Mathspace only accepts that one way. So, we're all doing it and it gets confusing, and then we have to skip it, which means our points don't go up and stuff like that."*
>
> **Student in School C**

These examples illustrate how the strategic use of gamification and harnessing an interest in gaming can combine technology and pedagogy to build positive relationships and promote inclusion.

The importance of interface design

The importance of accessible interface design was exemplified by Lumio's role in fostering inclusion and engagement in classrooms. In School C, students confidently interacted with the platform on the interactive digital display, with its intuitive design allowing easy access to features using simple clicks. Such design facilitated access by minimising the amount of effort and knowledge needed to interact with the technology, and encouraged active participation as students eagerly demonstrated tasks to their peers.

> *"I definitely like the touchscreen computers. It makes it a lot more convenient, and you can touch the screen. Instead of having to use the mouse cursor for a lot of things, it just makes it a lot easier to drag things around."*
>
> **Student in School C**

In a similar observation at School F, students showcased fluency with Lumio's interface, seamlessly navigating its tools without hesitation despite students in the interview reporting that they had no formal instruction in using the suite of tools. A student from School F was particularly impressed with the interface of the Education Perfect online suite of software due to the design of the user interface and the affordances it offered in supporting their learning:

> *"…I like [Education Perfect] in English as well because we do verbs and making sentences. I like how the layout is, it helps me make the sentences."*
>
> **Student in School F**

For the teacher in School A, the affordances of a touch interface that can be remotely accessed through a personal device, such as a phone enabled much more than convenient access. In the trauma-informed educational environment in which he worked, the greatest value of the intuitive interface design and ability to remotely participate was that it helped reduce the barrier of students' anxiety about participating in whole class activities.

> *"The touch feature for me, I don't get students up at the board very often. They've all got devices, they're all connected to my board through Lumio and they're all doing their work through OneNote or through Minecraft or whatever other tools that I'm using, and I'm never going to ask them to come to the board unless they want to because particularly the nature of the students that I look after, it's a very, very threatening environment for them, the front of the classroom. For me, it's not about the touch sensitivity of their engagement that way. It's about the tool not breaking the flow of what I'm delivering so that they can stay engaged. Because any neurodivergent student, getting them engaged is the first step, but keeping the engagement is the next one. If the engagement is broken, that student has to start all over again. And that can be really disturbing to their learning."*
>
> **Teacher in School A**

These examples highlighted how thoughtful interface design can empower all learners, including those with heightened social anxiety, by reducing cognitive load and removing social barriers.

Combining the affordances of digital and non-digital learning tools

Combining digital and non-digital learning tools further enhances opportunities for collaboration and inclusion by leveraging the unique affordances of each medium. In School C, the integration of physical mini whiteboards with digital tools created a dynamic learning experience. Students rehearsed responses on their mini whiteboards while seated on the floor, shared ideas with a partner, and then presented their answers using the interactive digital display, which could also be linked to Chromebooks. This structured yet flexible approach encouraged interaction across modalities, allowing students to choose formats that suited their strengths. It was apparent in School E that students had been taught the affordances of both digital and non-digital learning tools because they could articulate what they liked about each and when they thought that digital tools were preferable to non-digital tools. For example, the student quoted below discussed their love of physical books but also acknowledged the advantages of typing their homework.

> *"I love books, but... I love them. I love reading books and writing, but sometimes when I do homework, a lot of the stuff that I do is online and I feel like I only have my spelling in my book now, but I like it better online because in Prep when we learnt how to write, I learnt wrong. And now whenever I write for too long, I get this red patch on my thumb, and it gets really sore and so I have to take a break when I write for too long. So, I like doing it better, online devices."*
>
> **Student in School E**

By normalising the use of both digital and physical tools, classrooms created inclusive environments where all students, regardless of their abilities or differences, could engage meaningfully in learning and collaboration.

Software design that supports collaboration

Through the observations of the research team, it became apparent across the various classroom contexts that well-designed software can support collaboration and promote the social inclusion of students with disability and neurological differences. It was seemingly small features that appeared to have a significant positive impact. At School C, team-based challenges were facilitated through Lumio, with the software assigning groups and visually displaying team assignments on the interactive digital display. This approach provided a structured and transparent process for forming teams, reducing social barriers and fostering equitable participation. During these tasks, students naturally adopted roles, delegating or independently assigning responsibilities, which encouraged both teamwork and individual accountability.

When it came to allocating partners or groups, some students preferred consistent partners whilst others preferred random allocation through the Lumio group creation tool. From the student interviews, the researchers noted that the more extroverted students sometimes defied stereotypes and said that they preferred to know who they were going to work with in advance of the class. Based on the below quote from a student in School C, the teacher in this context seems to have accounted for these differing preferences by allowing flexibility with group allocation.

> *"Some people normally do have the same partner every time. Most people normally change the partner every time."*
>
> **Student in School C**

In School D, SMART Lumio was used to structure paired and small-group activities that encouraged collaborative learning. For instance, students were prompted to turn to their peers and explain concepts like noun groups, ensuring dialogue and shared understanding. Collaborative group tasks on the interactive digital display, such as responding to Kahoot questions, further enhanced engagement. These activities demonstrated equal participation among neurodivergent and neurotypical students, with Surface tablets also supporting collaboration as students shared screens and worked together rather than completing tasks in isolation. When supporting learners who struggle with confidence and experience significant social anxiety, the teacher in School A appreciates the ability to anonymise contributions.

> *"So, I run [Shout It Out] in my class or I embed it in my curriculum, in my curriculum delivery, and they then type something on their screen, and I remove the option for their names to be shown. So, a little tab with the dot comes up and then suddenly there's a little Post-it note on the SMART Board where I can then click on it and discuss what people are sharing. So, it gives the students the confidence to have their voice heard without actually having to put them in the awkward position where they have to voice it, where they can actually use the technology to be able to put their voice into the classroom and have the teacher build and capitalise on their ideas, which then in turn builds up their self-confidence. So over time, students who are neurodivergent who have got those mental health challenges are starting to pivot away from hiding behind the screen and starting to take the risk of putting their hand up and sharing or shouting out if the impulse control is gone."*
>
> **Teacher in School A**

At School E, Lumio provided a platform for collective idea sharing, with students contributing to a class-wide discussion by writing directly on the interactive digital display. This visual representation of shared learning encouraged collaboration and feedback, fostering a sense of inclusion as students corrected or built on each other's contributions. The system's use of random group assignments added a layer of fairness, providing opportunities for interactions with a range of students in the class while maintaining a structured approach to group work. Together with the teacher's strong emphasis on trust, respect, and friendship, Lumio's features complemented the broader pedagogical and relational strategies to promote inclusion.

> *"Sometimes I let them choose. So last week, I made it a bit of a challenge. They were given a feature of an animal, and they had to do a search through Lumio, of an animal that had that feature. So, we did it in a collaborative workspace. But I had said to them, "As soon as somebody else's picture goes up, you can't choose that animal. So, then you've got to do a quick rethink and change the animal." So, they were having to type the animal's names into a search engine. And a lot of them are not quite at the spelling stage yet, so I paired them up with a strong student and a weaker student, so that they could work together. And I made sure that they were taking turns. "So, if you've done that one, the next person gets the iPad to do that, but you can help them spell it." Yeah, so that blew me away, that activity. It was absolutely phenomenal, and they have asked every day since if they can do it again."*
>
> **Teacher in School B**

Enablers and barriers presented by digital technologies in facilitating inclusive teaching and learning

Both digital technologies and the environments in which they are used present a wide range of enablers and barriers in creating the conditions for inclusive education. This section of the report focuses on identifying these enablers and barriers, as articulated in the second guiding research question.

> *Guiding question 2*
>
> What are the enablers and barriers presented by digital technologies in facilitating inclusive teaching and learning?

Technical enablers

Observations across Schools C, D, E, and F revealed key technical enablers that enhanced accessibility, adaptability, and engagement in classroom settings. At School C, the strategic location of Wi-Fi routers in the classroom ceiling ensured consistent connectivity, allowing a student to efficiently set up the whole class activity schedule prior to the bell. This proactive scheduling, facilitated by the reliable network, supported smoother transitions and a clear start to lessons. Furthermore, the use of interactive digital displays allowed for a range of options for recreating physical resources digitally, enabling students to build their own visual schedules by translating their physical timetables into digital formats that they could take with them from class to class. The touch-screen capabilities of these whiteboards were especially beneficial for students with motor skill differences, ensuring equitable access to learning tools, with the teacher in School B discussing how touch was a natural starting point for her students to engage with technology in the early years of school.

> *""Yeah, [touch is inclusive for early years learning], because they're always using their hands anyway. Once we put a mouse in their hand, they struggle really hard to control the computer. So, we do have access to laptops, and we teach them how to log in and how to use the mouse to control them or use a touch pad. And even in that situation, that hand-eye coordination is not quite there. But I think also they're using these technologies at home. So, they are using the iPads all the time at home. And so, once they're in the classroom, it just comes naturally to them, because they've done it for so long, unfortunately."*
>
> **Teacher in School B**

Similarly, audio support on Chromebooks helped cater to varied learning needs, with potential disruptions mitigated by clear instructions to use headphones, which highlighted the importance of balancing individual accommodations within a shared learning environment. The teacher in School A was impressed by how the Lumio software allowed students to use their preferred device:

> *"What I love about [the SMART interactive display] is it's also an amazing multi-platform device. Students can sit there with their phones with an iPad, with a computer, anything that has an internet browser, which means that the sensory needs for some of my students with... My ASD students will be sitting there in the classroom who'll have their phone with them, and they'll be doing this and you're like, "Get off your phone." But if you looked at it, the screen is actually black. It's a sensory element. So the great part is, [with] having a tool like Shout It Out!, students can access it on their phones. They can actually have that sensory need while also connecting to the learning."*
>
> **Teacher in School A**

In School F, students demonstrated a capacity for personalising their digital interfaces by adjusting their laptops to light or dark modes, reflecting their individual preferences and needs. While most students retained the default light mode, the subset who switched to dark mode likely did so independently, showcasing their digital literacy and self-advocacy skills. These choices underline the significance of offering adjustable settings to empower students to create comfortable learning environments.

The organisation of digital resources was also highlighted by both participating students and teachers as an important consideration. Cloud-based services such as OneNote were popular in most schools due to their ability to help with version control and to remove the organisational burden of remembering where files has been stored.

> *"Having a file structure with different subjects, which is what I did last year, didn't work, and I ended up with students downloading multiple copies of the same project, doing half in that copy and half in that one and not uploading the right thing. And it all becoming quite overwhelming for them. So, I pivoted to using OneNote this year where I pushed the work out, they do the work in OneNote and it automatically submits it to me has been a game changer."*
>
> **Teacher in School A**

Finally, the ease of use of devices was seen as a key technical enabler by both teachers and students in School E. 'Plug and play' technology where the digital tools consistently worked as expected by the members of the class was greatly appreciated by all interviewees, as time is a limited resource in all schools.

> *"Yeah, to navigate through stuff. And then I also like the SMART Board because I find it's quick and easy to log on and you can do all sorts of stuff, like polls, activities, worksheets. So, I find it really easy and fun."*
>
> **Student in School E**

> *"Yeah, all you have to do is just search up Lumio and then you tap on it and then you press join the lesson. And I think if you've done it before, it automatically connects to the classroom."*
>
> **Another student in School E**

Together, these examples demonstrate how thoughtful integration of digital technologies and user-focused design can enable differentiated and inclusive learning experiences, with technical tools acting as critical enablers of student agency and engagement.

Pedagogical enablers

Pedagogical practices that emphasised clarity and accessibility played a pivotal role in supporting neurodivergent students while benefiting all learners. At School C, visually highlighting key information on interactive digital displayers reduced reliance on auditory explanations, ensuring accessibility for students with varied processing speeds. Additionally, structured slides with consistent visual cues, such as those used at School E, enhanced readability and comprehension. Providing explicit instructions about lesson requirements and outcomes at School C helped create a clear roadmap for students, supporting organisation and reducing anxiety for neurodivergent learners. These practices fostered a universally accessible learning environment where all students could easily engage and understand the material.

The integration of multimedia and multimodal resources enabled students to interact with content in diverse ways, catering to different learning preferences. At School D, multimedia content incorporated visual, text, and audio elements, offering multiple entry points to understanding. Similarly, at School C, 'how-to' videos and archived Lumio workbooks provided opportunities for students to revisit and reinforce foundational knowledge at their own pace. These resources proved particularly beneficial for neurodivergent students who may require repetition or alternative explanations but also empowered all learners by offering flexibility in how they absorbed information.

Providing opportunities for choice and differentiation empowered students to engage in ways that aligned with their strengths and needs. At School C, students could select mathematics problems from a digital repository that best suited their understanding, guided by teacher support when needed. This approach, along with additional tasks for early finishers, accommodated diverse learning abilities within the classroom. Likewise, School D paired individual Surface tablets with digital repositories to ensure that students could access resources even if they struggled with managing physical materials. This technology-supported scaffolding allowed for differentiated support that addressed individual needs while enhancing the learning experience for everyone. School E's use of digital displays as a central focus point provided interactive guidance for class activities, while School C's combination of digital displays and physical mini whiteboards allowed students to complete tasks at their own pace. By combining these tools with one-on-one teacher support, students of all abilities had opportunities to deepen their understanding in a supportive and inclusive setting. The individualisation of tasks encouraged autonomy and self-efficacy, creating a differentiated environment with the flexibility required for neurodivergent students to have their needs addressed.

Collaboration and peer interaction were structured to promote engagement and social learning. At School C, paired math activities where students checked each other's work facilitated meaningful interactions and peer feedback. The use of digital displays as a shared repository at School E encouraged students to collectively refine ideas under teacher guidance, creating a collaborative learning culture. These structured activities not only supported social communication for neurodivergent students but also enriched the overall classroom dynamic by fostering a sense of community and collective achievement. When discussing collaboration, the teacher in School B discussed the importance of explicitly teaching students how to work together effectively and the importance of a series of routines around group work.

> *"Usually when I'm using Lumio, we're sharing the device with a partner, so they're having to collaborate with that person and work together. And so we've gone through all of those procedures and how you have to share the iPad, and how you work together, and how you take turns, and all those kind of things. Which has been a challenge for some of them who want to just take over and do it all. But yeah, I feel like seven months in, we've got a pretty good routine happening with all that kind of stuff now."*
>
> **Teacher in School B**

All of the interviewed teachers emphasised that they believe that a priority for their students, regardless of age or neurotype, was supporting them to develop the fundamental collaboration skills in a way that allowed them to be effective members but also respected who they were as individuals.

Cultural enablers

When asked about school culture, participating staff at School D shared their belief the culture is built over time through consistent routines, shared values, and practices that foster inclusivity and mutual respect. This focus on a positive digital learning culture was observed in all of the schools visited by the researchers. In School C, structured morning routines, including a welcome, roll call, announcements, and prayer, established a predictable start to the day, creating a sense of stability for all students. Practices like whole-class roll call participation and morning announcements, where students share their activities or plans, encouraged everyone to contribute in a safe, low-pressure environment. Likewise, the teacher in School B described the importance of a consistent routine for all of her students to feel safe in classroom through the creation of a predictable environment.

> *"So, right from the beginning of the year, on the SMART Board, we had a daily check-in. So, they'd come and they'd move their name. And so right from the start we were teaching them that they had to take turns, so they'd stand there with their partner and share that. And then for all of term two, I actually had them using the iPads in little groups at the table. So, they'd come in the morning, they'd set themselves up, they'd have the iPads on their tables, and they would have to take a photo of themselves, and then select what category of how they were feeling. So, on the screen it showed the pictures and had numbers. And then within the iPad, they just had to select which number matched them. And so, they'd sit there and talk to their friend, and they'd be saying, "Oh, I've come in this morning, I'm feeling a bit cranky. Which one do I... " And they'd work together to be able to put their photo in and put it up there. And then slowly we've started to then do a bit more partner work."*
>
> **Teacher in School B**

These routines not only supported neurodivergent students by reducing uncertainty and promoting safe social interaction using their preferred modes of communication but also nurtured a classroom community where every voice was valued and included.

A shared understanding of fairness and equitable participation was evident in the inclusive use of interactive tasks perceived to be fun by the students. At School C, teachers ensured that all students had a chance to engage in interactive activities, promoting enthusiasm and maintaining fairness. By asking for student consent before performing tasks and ensuring everyone had an opportunity to participate, the teacher demonstrated respect for individual preferences and comfort levels. These approaches supported neurodivergent students who might need additional encouragement to participate while benefiting all learners by fostering an environment of equity and mutual respect. Fairness and structure within the classroom as also a consideration for the teacher in School C.

""I think with some of the [Lumio] tools, like the Shout It Out!, I mean actually because it only brings up while it might have everybody's Post-it notes in the background, when I click on one, it highlights it. So that gives me the opportunity to say, "All right, we're going to talk about Matt's idea first. Now we're going to talk about Prue's idea. Then we're going to talk about..." It actually creates a structure, hierarchical structure, not about a hierarchy, but it's like who's first, who's second, who's third. And then I use that to base a discussion off I've gone. And quite blunt at times and I have to be because of the nature of some of my ASD students, they get very caught up in the emotion and just start talking and want to share it. Just go, "Hang on a second, just wait. It's my turn to talk at the moment. Your turn will be next." And those sort of things. So, you use it as a sort of a model. I use the technology as a model to then unpack it and discuss it."

Teacher in School A

Consistency and clarity in classroom expectations contributed to a culture of trust and predictability. In School E, clear rules around digital technology use, such as when screens should remain closed or guidelines for specific activities, created a structured environment where students understood what was expected. Visual timers in Schools D and F provided predictable structures for activities, helping students manage their time and transitions effectively. These strategies were particularly beneficial for neurodivergent students who may rely on clear, consistent cues to navigate their day, while also promoting focus and engagement for the entire class.

The seamless integration of adaptive tools and supports further reflected an inclusive school culture. In School D, assistive technologies, such as a Surface tablet for a student with physical access needs, were incorporated naturally into classroom activities. It was notable that it was not only fully socially accepted but the other students spoke to this student as they did any other student in the class. This social normalisation of individualised supports demonstrated a shared value of community that looked beyond labels of disability, ensuring that all students had access to the tools they needed to succeed. Combined with teacher-led individualised support, these practices reinforced a broader cultural understanding that diversity in learning needs is not just accommodated but embraced as part of the school's identity, benefiting all students by modelling inclusivity and flexibility.

Policy enablers

A positive policy environment, cultivated over time, establishes the foundation for teachers to implement evidence-based practices while maintaining the flexibility to exercise professional judgment when addressing the needs of neurodivergent students. At School F, clear expectations, such as explaining why music was not permitted during a particular lesson, exemplified how explaining the rationale behind policies can guide consistent classroom practices while allowing teachers the autonomy to adapt to specific contexts. Effective policy extends to teacher development as well. At School C, school leaders demonstrated their commitment to inclusivity through a policy allocating time for ongoing professional learning in using technology effectively in the classroom, encouraging staff to engage with innovative practices from other schools and industry. Some of the interviewed teachers, including the teacher at School B, noted that they had taken the initiative to seek out professional learning opportunities that would help them to more effectively use the technologies in their learning environments.

"And we have done a few PDs around [the use of accessibility features and assistive technology]. So, we've had some Apple specialists come out and work through some of those assistive techs. Yeah, and then a couple of us will go and source out those PDs ourselves as well, to get a little bit more."

Teacher in School B

This drive for developing knowledge and skills through professional learning reflected a shared recognition that inclusive education is an ongoing process that requires more than simply attending a professional learning opportunity. In trying to build a sustainable culture of inclusive pedagogy through technology, the teachers in both School B and School C noted that sustainable learning requires ongoing coaching and a community of practice through which to share experiences.

Technical barriers

The reliability of digital technologies in the classroom is crucial for supporting neurodivergent students' full participation in lessons, as technical barriers can disrupt learning and increase frustration for both students and teachers. At School F, one student whose laptop was not working was redirected to share a device with a peer. While this initially worked during collaborative tasks, the arrangement broke down during independent work, leading to distractions and repeated reminders to stay on task. This situation highlights how unreliable technology can hinder both individual engagement and classroom management. As one student at School F noted, "No laptop does not mean you have a free pass to not do work," reflecting a recognition among students of the importance of functioning tools for maintaining accountability and focus. Similar challenges were reported in Schools A, C and D, underscoring a shared need across schools for dependable technology to ensure equitable learning experiences.

> *"I think that with the nature of neurodivergence and autism and ADHD, you have a very, very narrow window for catching a student's attention. And I think anything that's going to be a barrier that's going to break that attention is going to be an issue. So, I said if I've got to stand there and turn my back and open things and "Oh, my mouse isn't working," or "My touchpad isn't working," or whatever, if that's an issue, that's actually going to break the flow of learning for the students, which is actually the lesson's going to fall apart. The touch feature for me, I don't get students up at the board very often. They've all got devices, they're all connected to my board through Lumio and they're all doing their work through OneNote or through Minecraft or whatever other tools that I'm using, and I'm never going to ask them to come to the board unless they want to because particularly the nature of the students that I look after, it's a very, very threatening environment for them, the front of the classroom."*
>
> **Teacher in School A**

Technical barriers also exacerbate the inherent difficulties some students experience when navigating digital tools, as shown in the below quotes.

> *"Well, with my laptop, it happened last week. I just opened my laptop. I don't know what I was doing, but I opened it and I used my mouse and I clicked on the search bar, but it wasn't working and so I tried clicking on any apps, but the apps weren't working. It wouldn't take me into the apps. And then I closed it down and I restarted it and then it still wouldn't work. So, I just did something else and then I came back an hour later and it started working again. But it was a bit glitchy when I first opened it up. One time it took me 15 minutes to try to open it and turn it on."*
>
> **Student in School E**

> *"I feel like sometimes they have technical issues sometimes. The Wi-Fi ... Sometimes ... Because our school homepage has got all our work that's due, timetables, some time once that went out of order, so that was annoying. But our school's Wi-Fi's pretty good. We have a really good IT team."*
>
> **Student in School F**

Another student at School F expressed a preference for physical textbooks over digital versions, describing the frustration of "swiping in and out" while juggling multiple tasks on a laptop. This feedback illustrates the cognitive load associated with managing less intuitive or overly complex digital interfaces, which can be particularly taxing for neurodivergent learners. When technology fails or becomes cumbersome, the implications extend beyond the individual student to disrupt the teacher's ability to deliver inclusive, effective lessons.

Across Schools C, D, E and F, the consistent sentiment from students and teachers was that reliable and user-friendly technology is essential not only for supporting neurodivergent students but also for ensuring smooth and productive classroom dynamics. The teacher in School E commented on how having too many different types of devices in a single learning environment could create complications with device compatibility. As a digital leader in his school, he advocated for narrowing the range of devices students could use in his classroom, but he was also aware of the 'bring your own device' model used in the Senior School of School E, so his Year 6 students were preparing for that transition.

Finally, some students reported that the use of Internet filtering software was problematic for their learning. While providing a safe online environment is obviously necessary for every school, the fidelity with which websites are being blocked was reported as an issue by a student in School D.

> *"Sometimes when I'm trying to do research for maybe math or science, I find a good website and it's blocked and I get so annoyed."*
>
> **Student in School D**

Interestingly, another student at School D expressed appreciation for the controlled access to the Internet, highlighting that implementing restricted access allowed students to better focus on learning by minimising the possibility of digital distractions.

> *"Not really. Everything's perfect the way it is because I am really learning and it's safe. Even when they use Linewize to block the stuff so people don't play games and all that, yeah, it's really good because people actually can learn."*
>
> **Another student in School D**

Cultural barriers

While schools have made significant progress in leveraging digital technologies to support neurodivergent students, there remain areas for further development to ensure full participation in lessons. Data for this section has been deliberately completely deidentified, as these challenges are not unique to a single school but likely reflect common barriers across many schools. For example, unclear audio in multimedia content and the lack of subtitles present challenges for students who experience difficulties processing auditory information, limiting their ability to engage effectively with lesson materials. Addressing such issues requires a commitment to making all digital resources accessible, ensuring they meet the diverse needs of students and align with inclusive practices.

Additionally, managing technology use in the classroom emerged as a significant area for growth. Instances were observed where students used their laptops for off-task activities, such as playing games or chatting, requiring repeated reminders from teachers to refocus. Teachers noted challenges in monitoring all students' digital behaviour, particularly in the absence of tools to oversee or control individual devices. This reliance on direct observation leaves gaps in ensuring appropriate use of technology, as distractions can occur outside the teacher's view. Students were aware of the role of the teacher in helping to keep students on track and recognised that access to digital technologies can be both a barrier and an enabler for learning based on how it is positioned in the classroom and being used by the learners.

"Sometimes teacher's not looking, they just hop into games sometimes. But it also helps some of them if they can't ... Someone in the classroom next door to us, she has dysgraphia, which means she can't write, so she uses a laptop for most of her things, which is, I think it's good."

Student [School deidentified]

Finally, the students in School C and School F highlighted challenges when another teacher, who is not familiar with either the learning routines or the technology, attempted to teach in a learning environment where digital learning is a regular experience for the students.

"We actually use it every day. Unless we have an emergency teacher because no offence to them, but they don't know what to do. Normally, they do need a little bit of help. I think they do use it. It's just it's a bit hard for them to adapt to it, and so it takes a little while and yeah, like [Name of student] said, if they need help, we would help them. Other than that, the... What do they call it? Substitute teachers probably have used it quite a bit enough to know how it works a bit."

Student [School deidentified]

"We figured it out. We were helping the teachers to figure it out as well. So, the Art teacher didn't know how to use it because she wasn't there for the weeks they got it [describing a class that was covered by the Art teacher]. So, we were all pitching in to try to help her and stuff like that."

Student [School deidentified]

These examples underline the importance of developing whole school strategies and policies that support both student engagement and effective classroom management, fostering a more inclusive and structured digital learning environment.

Supporting neurodivergent students to participate in classroom learning activities

While the previous guiding questions focused on the tools and the conditions in which they were used, the third guiding question was specifically focused on the experiences of neurodivergent students and ways in which teachers use inclusive technologies can promote social inclusion within the learning environment.

> *Guiding question 3*
>
> How can teachers best support neurodivergent students to feel safe in participating in classroom learning activities alongside their peers?

Consistent welcome and transition routines

The researchers observed the importance of establishing consistent welcome and transition routines in supporting neurodivergent students' participation in classroom learning. In School C, the morning routine fostered a predictable and inclusive start to the day. It began with a collective roll call where everyone spoke or communicated, "hello", establishing a sense of belonging. This was followed by structured announcements that encouraged participation through low stakes, accessible questions, such as asking about dinner, lowering the cognitive demands for students uncertain about how to respond. The teacher further reinforced their high expectations for all learners regardless of neurotype by reminding students that participation was expected, setting a clear and consistent tone for engagement. Similarly, School E enhanced predictability by explicitly discussing the visual schedule at the start of the day, ensuring students were aware of transitions, such as when to pack up. These practices reduce anxiety around ambiguity, creating a safe and supportive learning environment.

Explicit and consistent communication around transitions was equally critical, as seen in Schools C and F. At School C, the teacher communicated clear learning outcomes at the start of each lesson, providing neurodivergent students with a structured framework that reduced uncertainty about expectations. This approach was complemented at School F, where the teacher provided timed warnings, such as a two-minute notice before transitions. These strategies enabled students to mentally prepare for changes, minimising disruptions to their focus and participation. By pairing structured routines with clear, advance communication, both schools ensured that neurodivergent students could navigate the learning environment with greater confidence and ease. These examples highlighted how thoughtful integration of routines and communication supports can contribute to a more inclusive and effective classroom experience.

Clearly modelling worked examples

Clearly modelling worked examples can be a key strategy in supporting neurodivergent students' participation, as evidenced in the observations from Schools C and D. At School C, teachers provided explicit instructions at the beginning of lessons, listing required items and explaining their purposes while also detailing what students could expect after completing their tasks. This practice helped to clarify expectations, reducing cognitive load and providing a roadmap for engagement. Additionally, students worked through examples individually on physical whiteboards with teacher support. This one-on-one interaction allowed teachers to observe student understanding in real-time, addressing misconceptions and tailoring guidance to individual needs. These strategies ensured that neurodivergent students were provided with concrete, scaffolded steps to approach learning tasks effectively.

The integration of digital technologies further enhanced the effectiveness of modelling worked examples, particularly in School D. Lesson content was presented on individual Surface tablets and the SMART interactive digital display (MX V2), allowing students to follow along with teacher-led demonstrations. Teachers used this technology to guide the class through examples while answering questions verbally, creating a dynamic and interactive learning environment. By combining digital tools with live instruction, teachers ensured that all students, including neurodivergent learners, could visually and audibly engage with the material. This approach reinforced understanding and encouraged participation, demonstrating how digital platforms can complement explicit teaching methods to make learning more accessible and inclusive.

Student agency, voice and consent

Facilitating student agency was a prominent feature in the classrooms observed, as teachers provided opportunities for neurodivergent students to make choices and exercise control over their learning. Students at both School C and School F were offered different options for completing tasks, allowing them to select activities based on their self-assessed understanding of the material. This approach supported autonomy while catering to individual strengths and needs. Similarly, students who finished early were provided with additional tasks through Lumio, giving them the freedom to further demonstrate mastery in ways that resonated with their interests and abilities. In the below quote, a student describes how personalised learning provides them with a sense of pride through using a gamified 'level' system for differentiating work in their Italian class.

> *"I think everyone started at level one, but we all moved off to our separate spaces. A lot of them at the classes, Level Three to Level Four but I'm at Level Five."*
>
> **Student at School F**

In addition to this reported experience by the student, the researchers also observed students at School F exercising agency in managing their sensory environments, such as using headphones or AirPods during independent work to maintain focus. These practices highlighted the importance of enabling neurodivergent students to tailor their learning experiences to suit their preferences and needs.

Promoting student voice was also emphasised, ensuring that neurodivergent students had opportunities to contribute and be heard in the classroom. At School C, teachers consistently checked for consent before inviting students to perform or share, ensuring that participation was voluntary. Similarly, at School E, teachers encouraged students to share their work on the SMART interactive digital display (MX V5) but only after explicitly seeking permission. Prompts were also used to invite additional ideas, fostering an environment where students felt comfortable contributing. Additionally, the explicit indication of transitions, such as announcing when the last student would provide an answer, helped students anticipate the shift in activities, reducing anxiety and empowering them to engage on their terms. These strategies ensured that all students, including those who are neurodivergent, could share their perspectives without pressure.

Respecting consent was integrated into classroom routines alongside clear boundaries, striking a balance between student voice and teacher guidance. For example, at School F, teachers used an interactive noise gauge displayed on the digital display to set expectations for acceptable noise levels, providing real-time audio cues when the classroom exceeded the threshold. This approach empowered students to self-regulate while maintaining a structured environment conducive to learning. Moreover, the use of varied seating and movement options acknowledged the diverse physical and sensory needs of students, allowing them to engage in ways that respected their comfort. These examples demonstrate how facilitating student agency, voice, and consent can collectively create a more inclusive and supportive learning environment for neurodivergent students.

Multiple ways of offering and asking for help

Providing multiple ways of offering help was a recurring practice in the observed classrooms, highlighting its importance in supporting neurodivergent students' participation. At School C, teachers used visual resources to display strategies for asking for help, ensuring that students had clear, accessible reminders of how to seek assistance. Individual support was also readily available, particularly during digital tasks where teachers worked one-on-one with students to build their knowledge and scaffold their learning. Another option provided was audio support, such as recordings that explained mathematical algorithms, which catered to diverse information-processing needs while maintaining clear boundaries to minimise disruption for others. At School D, teachers consistently moved between small groups during activities, providing guidance, scaffolding, and feedback tailored to individual and group needs. Similarly, at School F, the teacher circulated during a hook-writing task, offering personalised assistance while the task instructions were displayed on the SMART interactive digital display (MX V5) to ensure clarity. These varied methods of offering help created an inclusive learning environment, meeting the diverse needs of neurodivergent students without singling them out.

Facilitating multiple ways for students to ask for help was equally critical in supporting participation and fostering independence. At School C, structured peer interactions during mathematics instruction enabled students to check each other's work in pairs, offering a supportive and low-pressure avenue for seeking clarification. This was reinforced at School D, where pair and small group activities encouraged students to engage with peers as part of the learning process, making it easier for neurodivergent students to ask for help in a collaborative setting. Assistive technologies further enhanced students' ability to seek support, allowing for discreet and individualised avenues of communication. The emphasis on fostering a culture where seeking help was normalised ensured that students could access assistance in ways that suited their preferences and comfort levels.

One student also suggested that a virtual teaching assistant could support their learning through providing personalised assistance and would complement the learning and teaching program designed by their teacher.

> *"I feel like it could go very wrong and dangerous, but a robot would be really cool. Like an assistant teacher sort of robot. But it would be really cool, and it could just give you lots of activities to do and I guess you'd have to charge it, but it would be really fun and it would give you stuff like information easily right off the top of its head."*
>
> **Student at School E**

These ideas for offering and asking for help demonstrate how thoughtful, multimodal approaches facilitated by the teacher (or perhaps a robot) can empower neurodivergent students to engage more fully in classroom learning.

Safe spaces for contributions to class discussion

Facilitating safe spaces for contributions to class discussions was demonstrated through various practices aimed at reducing anxiety and fostering inclusivity in the observed classrooms. At School D, teachers encouraged the class to answer questions as a whole, which alleviated the pressure of being singled out and allowed neurodivergent students to participate without fear of making mistakes in front of their peers. This approach was complemented by the use of small group and paired activities, where students with disabilities or neurological differences actively took on roles and contributed ideas. Other group members supported and encouraged one another, creating a collaborative environment that normalised diverse participation. Teachers played an active role in facilitating these interactions, ensuring that all students felt included and respected in discussions. This emphasis on social inclusion provided neurodivergent students with opportunities to share their perspectives in settings that felt safer and more supportive than large, whole-class scenarios.

Classroom strategies at School E further exemplified how teachers and school leaders could create safe and supportive environments for discussion. Autonomy in participation was a key feature, with students encouraged to contribute by sharing ideas on the interactive digital display or engaging in group tasks. Clear behavioural expectations, such as contributing quietly and respectfully when sharing during lessons, provided structure while promoting inclusivity. A supportive class culture was evident in the way students helped one another stay on task and encouraged equitable participation during activities, such as reading aloud or following along on the digital display. Small group tasks using individual devices allowed students to work collaboratively in physically chosen spaces that suited their needs, with explicit guidance to demonstrate cooperation. The teacher in School A was again very passionate in discussing the affordances of the interactive digital display and Lumio in building confidence for the students.

> *"So [the SMART interactive display] gives the students the confidence to have their voice heard without actually having to put them in the awkward position where they have to voice it, where they can actually use the technology to be able to put their voice into the classroom and have the teacher build and capitalise on their ideas, which then in turn builds up their self-confidence. So over time, students who are neurodivergent who have got those mental health challenges are starting to pivot away from hiding behind the screen and starting to take the risk of putting their hand up and sharing or shouting out if the impulse control is gone. But it allows them to develop that confidence in their voice, a confidence that unfortunately due to their circumstances hasn't been nurtured or supported in the past."*
>
> **Teacher in School A**

These practices highlighted the importance of combining autonomy with communication options and peer support, creating a classroom environment where neurodivergent students felt empowered to engage meaningfully in discussions in a way that meets their individual needs.

High impact recommendations

Using the findings from the analysis of the rapid literature review and the six case study schools, the researchers have identified 36 high impact recommendations for teachers and school leaders on the effective use of digital technologies in removing barriers for neurodivergent students. These recommendations have been grouped into twelve overarching themes that support planning, teaching and assessment and school policy development.

Interactive explicit teaching aligning with the principles of UDL

Over the past ten years there has been a growing recognition in education research of the importance of the Science of Learning, with school leaders looking to apply what is known about how students learn to their school-level instructional models. To strengthen pedagogical practices across the school, it is recommended that schools develop a shared understanding of effective teaching strategies that incorporate modelling worked examples and then provide opportunities for students to apply their learning in diverse contexts. This instructional sequencing aligns closely with the 'Design options for building knowledge' principles of the UDL Guidelines 3.0 (CAST, 2024b). Utilising this approach involves providing worked examples that break processes or problems into clear, manageable steps and explicitly teaching each step to ensure students build a solid foundation of understanding. Teachers should actively check for comprehension at each stage, using questioning and formative assessment to confirm students grasp the material before progressing. Additionally, educators are encouraged to help students consider the relevance of the learning material to other areas, such as its application in other subjects or practical, real-world scenarios. By embedding these practices consistently across classrooms, the school can foster deeper engagement, transferable skills, and more meaningful connections between students' learning and their broader interests.

Providing regular opportunities for students to interact with peers during instruction in a way comfortable for them is also a key principle in the 'Design Options for Interaction' of the UDL Guidelines 3.0 (CAST, 2024b). This requires teachers to both foster engagement and to create multiple pathways for participation and skill development. Structured peer interactions in pairs or small groups (three to four students) are particularly effective, as they offer a supportive environment that is less anxiety-inducing than larger group settings. Any more than four students can create social and sensory environments that can create barriers for students with social anxieties or sensory processing differences. To maximise the benefits of these interactions, it is essential to provide clear instructions and expectations, ensuring students understand their roles and the goals of the activity. Keeping these opportunities concise, such as focusing on the discussion of a couple of key concepts, helps maintain students' attention and reduces the risk of distractions or off-topic conversations. Incorporating these practices into explicit teaching strategies promotes collaborative learning, strengthens students' understanding of content, and enhances their ability to demonstrate and apply their skills in a socially supportive context.

It is also important to recognise that teachers are busy professionals. More than just encouragement, teachers need time to engage in collaborative planning that focuses on developing high-quality resources responsive to local culture and context. Collaborative planning with other school staff allows educators to gain a deeper understanding of students' needs across the school day and identify universal resources or supports that can enhance their learning experiences in different environments. This approach encourages the integration of technologies that promote inclusive teaching and learning, tailored to the specific needs and context of the school. Sharing success stories of engaging and effective learning activities provides valuable insights into strategies that have worked well for students, fostering opportunities for these approaches to be adapted across different classes and subjects. By pooling collective expertise and embracing shared planning, schools can create a cohesive and responsive learning environment that supports neurodivergent students to thrive.

Recommendations relating to interactive explicit teaching aligning with the principles of UDL

1. Develop a shared understanding across the school of pedagogical practices that focus on modelling worked examples for students and then providing opportunities for students to apply their learning to other contexts of interest.

2. Plan regular opportunities during instruction for students to interact with peers, actively discuss knowledge and demonstrate their skills.

3. Provide time and space for teachers to share planning to allow the development of high-quality resources that are responsive to local culture and context.

Supporting executive functioning through digital tools and supports

Providing digital scaffolds and graphic organisers to help students organise information and their thinking in a structured and systematic way is an effective strategy for supporting executive functioning through digital tools. Visually based resources, such as graphic organisers, enable students to plan and structure their approach to tasks, breaking down complex processes into manageable steps. Including visuals alongside text supports diverse information processing needs, making content more accessible and reducing cognitive load for students with differing learning profiles. To maximise their effectiveness, digital scaffolds should be carefully adapted to the specific task context, ensuring they are fit for purpose and directly aligned with learning goals. Teachers play a crucial role in explicitly teaching students how to use these tools, using worked examples to demonstrate their application and guiding students in embedding these strategies into their learning routines. By incorporating these approaches, schools can foster greater independence and confidence in students' ability to manage and complete tasks.

Explicitly teaching new vocabulary and providing students with access to an ongoing digital vocabulary database is a powerful strategy for supporting executive functioning through digital tools. By explicitly teaching the meaning of new terms and discussing their relevance to broader learning content, teachers help students build deeper connections between concepts and develop their academic language skills. A centralised, easily accessible digital vocabulary database enhances this process by providing a structured and organised repository of terms that students can reference independently. Ensuring the database is clearly structured and user-friendly allows students to quickly locate and use the information they need, reducing cognitive load and fostering self-reliance. This approach not only supports vocabulary acquisition but also equips students with tools to manage their learning more effectively across subjects.

Optimising the amount of information displayed on a screen by presenting it in manageable chunks and integrating text with supporting visuals is an effective strategy for enhancing comprehension and reducing cognitive overload. Breaking down key information into smaller, focused sections helps students process content more effectively, particularly for those who may struggle with working memory or information organisation. The integration of visuals alongside text further supports understanding by providing multiple ways to access and interpret the material, catering to diverse learning needs. This approach not only enhances clarity and engagement but also supports students' ability to retain and apply information. By leveraging these digital tools and supports, educators can create learning environments that foster improved executive functioning and greater independence in navigating and managing complex tasks.

Recommendations for supporting executive functioning through digital tools and supports

4. Provide digital scaffolds and graphic organisers to help students to organise information and their thinking in a structured and systematic way.

5. Explicitly teach new vocabulary and provide students with access to an ongoing digital vocabulary database.

6. Optimise the amount of information displayed on a screen at once by providing chunks of key information and integrating text with supporting visuals.

Integrating the targeted activation of prior knowledge and daily reviews

Introducing new topics with clear connections to prior learning is a powerful strategy for activating students' prior knowledge and reinforcing daily reviews. By clearly defining the new topic and explicitly linking it to previous learning, teachers help students recognise continuity in their educational journey, building a strong foundation for deeper understanding. Encouraging students to discuss their prior knowledge and consider how it informs their grasp of the new material promotes active engagement and critical thinking. Asking students to elaborate on and explain their ideas further deepens their comprehension and encourages metacognition. Regular check-ins to assess students' understanding of the new topic and the connections they have made can help identify areas that may require clarification or reinforcement. This approach fosters meaningful learning experiences and ensures students can effectively integrate new knowledge into their existing conceptual frameworks.

Allowing students to access prior learning materials and resources as needed to revise foundational concepts or knowledge is essential for supporting their ongoing learning and executive functioning skills. To ensure effectiveness, these materials should be clearly structured and stored in a centralised, easily accessible location, enabling students to find and use them independently. Teachers should explicitly identify which prior learning materials are relevant to the current task, such as referencing a visual chart on the order of adjectives to support a descriptive writing activity. Providing both physical and digital versions of these resources, where possible, further enhances accessibility and reduces cognitive load by minimising the need for task-switching. For instance, a physical printout of foundational materials can be placed on a student's desk while they engage with the current task digitally. This approach empowers students to build on their existing knowledge with confidence, fostering a more seamless and efficient learning experience.

Conducting a daily review at the beginning or conclusion of a lesson that revises both recent and historical knowledge and skills is a key strategy for consolidating learning and fostering connections to new content. A well-structured daily review should be kept relatively short to maintain student engagement and might include several interactive activities, such as a quick quiz or a matching game, to make the process enjoyable and dynamic. Encouraging students to actively participate in the review within a supportive, judgement-free environment helps build their confidence and promotes a culture of collaborative learning. Although not directly observed in any of the case study schools, the rapid literature review did find positive evidence of using digital mini-games and puzzles to reinforce previously learnt content through retrieval practice. Clear, constructive feedback during the review ensures students understand their progress and areas for improvement, while explicit links between the review and the new topic reinforce the relevance of prior knowledge to current learning. The findings from this research project underlines the central importance of integrating the targeted activation of prior knowledge and implementing daily reviews into programs of learning.

Recommendations for integrating the targeted activation of prior knowledge and daily reviews

7. Introduce new topics with clear connections to previous learning to build from prior understandings.

8. Allow students to be able to access prior learning materials and resources as required to revise foundational concepts or knowledge.

9. Conduct a daily review at the beginning or conclusion of a lesson that revises both recently and historical knowledge and skills.

Developing self-regulation in the use of technology through the gradual release of responsibility

Supporting students with differences in executive functioning and sensory processing to self-regulate can be a challenging task for teachers, as individual support needs are so diverse. Neurodiversity-affirming self-regulation tools should respect the bodily and cognitive autonomy of students and provide discreet and flexible prompts while also minimising disruption to other students in the classroom. Technology-based supports should focus on helping students with time management and task engagement and should not be used to replace other self-regulation behaviours like stimming. Leveraging technology to incorporate engaging and interest-based elements into curricula can proactively reduce the need for reactionary self-regulation prompts as student on-task engagement increases with motivation. Once an appropriate individually tailored self-regulation strategy is chosen, guided access can diminish over time with a focus on building capacity towards independence. Once the student has gained proficiency in using their self-regulation tools, it should continue to be made available to them with flexible design options so that they can increase or decrease the amount of self-regulation support they feel they need on a given day, as such support needs will remain in-flux across the lifespan.

Positioning students as collaborators in decision-making when selecting and trialling self-regulation software tools ensures that chosen strategies are tailored to individual differences and interests. For example, while some students may respond positively to pop-up notifications and alarms, others may find the pressure, demand and sudden sound of alarms overwhelming and counterintuitively dysregulating. This was evident in the analysis of the literature identified through the rapid review. Such students may instead benefit from tangible self-regulation supports including fidget tools, visual time-tracking devices or visual schedules with a task completion reward component (for example, having the child celebrate completing a task by removing it from a digital or non-digital visual schedule and transferring it to the ‘completed’ section). Collaborating with students to learn about their specific self-regulation challenges and preferences is a more neurodiversity-affirming approach than prescribing a one-size-fits all application.

While developing the skills to learn about non-interest-based topics is important for all students, neurodivergent students also require dedicated time to have a deep dive into their areas of interest. In both the findings of the rapid literature review and in the interviews with the students in the case study schools, celebrating these interests and providing space for them was found to be an important motivator for active participation in school. From Minecraft clubs to learning about the Korean War, harnessing these interests provided valuable opportunities for social connection between peers around areas in which these students had strong oral language foundations and natural points of connection. Allocating time for students to engage in their passions should be scheduled during the school week. As these are so important to many neurodivergent students, the researchers strongly advise positioning these blocks of time as a regular part of the learning programme rather than as a reward.

Recommendations for developing self-regulation in the use of technology through the gradual release of responsibility

10. Gradually release responsibility from the teacher to the learner by using guided access digital tools.

11. Explicitly teach self-regulation strategies to remain on task while using technology.

12. Provide time for students to explore their interests through technology.

Establishing routines and systems to create clear expectations

Providing predictable locations for daily schedules and task-lists can support students with planning their day, ensuring that surprises and abrupt task switching demands are minimised. Visual activity schedules should be available in both digital and non-digital versions so that all students can access and benefit from these supports in their preferred format. Digitising activity schedules and other transition aids supports teachers in flexibly using these tools with their students (for example, having visual transition aids accessible on a teacher's smartphone or tablet so they may provide support to students in the playground).

Breaking classroom activities down into activity cycles and scheduling regular movement breaks can provide more manageable task chunks for students. While some students may respond positively to breaking tasks down into timed chunks, other students with spatial and proprioceptive differences may struggle to conceptualise and track time described in numbers. These students might instead benefit from visual methods of tracking time (such as tangible or digital hourglasses or similar visual representations of time). Such visuals can be easily displayed to the entire class on a digital display, benefiting the whole class, including students who may not feel empowered to request self-regulation support.

Utilising digital working environments can support students with organising their digital work. Providing a consistent location where students can find their task rubric, access learning content, and store and submit their work diminishes the cognitive and time burden of tracking and organising and potentially losing work. Digital learning environments that incorporate UDL design principles also afford students the opportunity to learn and work in their preferred modality (for example, by offering assistive features, organisational frameworks and a platform to request and receive feedback from the teacher). Additionally, such digital learning environments can provide teachers with insight into how their students organise their time and workflow (rather than only having access to a finished piece of work), allowing for timely scaffolding and support.

Recommendations for establishing routines and systems to create clear expectations

13. Use either a digital or non-digital visual activity schedule to create a predictable and safe structure for the class.

14. Use visual timers and ongoing cycles of activity and whole class check-ins during independent work.

15. Provide a single, consistent method for students to submit their digital work.

Integrating physical and digital resources

Normalising the use of non-digital resources alongside digital ones by explaining their affordances and the rationale for their use supports a balanced and versatile approach to learning. By placing equal emphasis on both types of resources, teachers convey that physical and digital tools are equally valuable and complementary, depending on the context of the learning activity. Building a sense of structure and predictability is key; clearly stating which resources will be used before starting an activity allows students to prepare, minimising disruptions and fostering a focused learning environment. Providing clear instructions for using non-digital resources ensures students understand how to effectively integrate them into their tasks and reinforces the purpose behind their use. This balanced approach helps students appreciate the unique strengths of different tools, equipping them with the skills to adapt to varied learning contexts and promoting their overall engagement and understanding.

Providing students with access to personal whiteboards, whether physical or digital, in every lesson and explicitly teaching their use as a concrete support can significantly reduce cognitive load and enhance engagement. Individual mini whiteboards offer students a private space to rehearse their responses before sharing, which can alleviate anxiety and build confidence. Students can record their thoughts and answers on their whiteboards, enabling teachers to move around the room, observe their responses, and provide tailored feedback or redirection where needed. This approach supports differentiated instruction by addressing individual learning needs in real time. Mini whiteboards are also a cost-effective and versatile tool that accommodates communication differences, such as allowing an autistic student to write down a question if they are uncomfortable speaking aloud. By integrating personal whiteboards into daily lessons, teachers create a flexible, inclusive environment that supports diverse learners while fostering active participation and skill development.

Providing both physical and digital copies of textbooks and other learning materials accommodates diverse student learning preferences and information processing needs, creating a more inclusive educational environment. Some students find it easier to navigate and engage with physical textbooks, as flipping through pages can feel more intuitive than scrolling through a digital version. Additionally, switching attention between a physical book and a screen is often less cognitively demanding than managing multiple windows on a single screen, particularly for students with executive functioning challenges. Physical books also allow students to use tools such as sticky notes for annotation, helping them to highlight and organise key content. For students who benefit from visual supports, these annotations provide a tangible way to structure their learning and locate important information quickly. Offering both formats ensures all students have access to resources in the way that best supports their individual needs, enhancing their learning experience and overall academic success.

Recommendations for integrating physical and digital resources

16. Normalise the use of non-digital resources alongside digital resources by explaining to learners the affordances of each and the rationale for why the teacher is requesting the use of each tool at a particular point in the lesson.

17. Allow students to access their own personal whiteboard, either physical or digital, for every lesson and explicitly teach them to use these as a concrete support for reducing cognitive load.

18. Provide both physical and digital copies of textbooks and other learning materials to accommodate student learning preferences and information processing needs.

Creating a safe culture for active participation and constructive feedback

For students with learning differences participating in public question time, discussions or reading aloud in front of peers can be exceptionally stressful. Practicing and modelling a culture that respects individual strengths and challenges contributes to creating a safe culture for diverse methods of active participation by students. Prioritising individual strengths when delegating public roles to students in place of relying on randomisation methods (for example, random number generators selecting who reads next, or, moving sequentially around the room to ask students to share their answer to a maths problem) creates a sense of assurance for students with learning differences that they can actively participate in class in roles that suit them best, and diminishes normative expectations around what classroom participation can look like. Using technology that includes anonymous response options can empower students to share their ideas without fear of losing face in front of their peers in case their ideas are interpreted as wrong or silly. Individual ideas can then be displayed to the class on a digital display to supplement or drive group discussion amongst students who enjoy contributing to public group discussions.

Digital learning environments that incorporate flexible assistive features and data-tracking can be an effective tool for teachers to observe learners as they work and provide students with timely recursive feedback and early scaffolding before a piece of work has been submitted. Including features like digital whiteboards, thought maps and mood boards can support students to jot down, preserve and organise their thoughts, while providing consistent access to personal non-digital mini whiteboards can provide similar support to students who prefer physically writing and drawing their ideas down. Such drawings or notes can then either be photographed and stored digitally, or used as a transient idea generator as students require. By providing means for students to organise and express their ideas visually (e.g., through art or mind-mapping), teachers can learn how their students' unique minds work throughout the learning process and provide more targeted feedback that integrates different means of expression.

Recommendations creating a safe culture for active participation and constructive feedback

19. Allow anonymous contributions during class brainstorming activities with clear expectations in place around responding to shared ideas.

20. Provide consistent options for multimodal contributions to class discussions where students can contribute via their preferred mode of communication.

21. Use talking partners to rehearse responses to prompts before calling on students in front of the class.

Supporting collaboration through structure, capacity building, and clear targeted outcomes

Scaffolding collaborative group tasks is essential for supporting neurodivergent students to engage meaningfully and successfully with their peers in a neurodiversity-affirming way. Providing a clear structure and setting explicit expectations for group tasks is a foundational step, as it ensures all students understand their roles and responsibilities. Teaching group work skills such as delegation, negotiation, and compromise are crucial, with scaffolding strategies like visual planners helping students organise and allocate tasks effectively. Systems for dispute resolution and conflict management should be in place to address potential challenges, particularly for neurodivergent students who may struggle with self-advocacy or feel anxious about reporting issues to teachers. By proactively addressing these needs and promoting fair workload distribution, educators can create an inclusive environment where all students feel supported in developing their collaborative teamwork skills.

Through the analysis of the both the literature review and the classroom observations data, it was clear that small-group activities need to provide a clearly defined task outcome that students are required to achieve as a group. Outcomes could be a product, such as a presentation on a historical figure or a series of completed algebra problems, or a process such as building towards a group consensus on a political issue like climate change policy. If the learning objective is developing collaboration skills, a key focus in many modern capabilities-focused curriculums, then playful activities can provide a powerful context with clear objectives. Play-based embedded curriculum activities can be a powerful tool for students to practise collaborative skills, social communication, planning and role delegation and problem solving. Leveraging children's powerful learning mode of play can provide a safe framework for children with learning differences to hone their skills in a highly motivating environment. By leveraging activities like collaborative gaming, robotics, coding, esports, and digital design activities, students can practise teamwork skills that are translatable to other shared tasks like traditional academic group assignments. Play-based activities also provide opportunities for neurodivergent students to play with unfamiliar and neurotypical peers in a structured activity with a clear objective, promoting opportunities for social connection that may not be instigated during unstructured break times when many children gravitate to their friends.

Assessing individual contributions to group assignments, rather than assigning a collective grade, is a key strategy for supporting neurodivergent students in a neurodiversity-affirming way. Defying unfortunate stereotypes, many neurodivergent students hold themselves to high academic standards and group work can cause significant anxiety if they are concerned that their grade may be negatively affected by the contributions of others. Individual assessment helps to alleviate this anxiety, ensuring students are recognised for their personal efforts. Additionally, having students self-report their own and their peers' contributions provides valuable insight into task distribution and highlights any inequities in workload. This approach not only fosters accountability and fairness but also promotes a more inclusive learning environment where all students feel their efforts are valued and their unique needs are respected.

Recommendations supporting collaboration through structure, capacity building and clear targeted outcomes

22. Scaffold collaborative group tasks by providing clear strategies to help students understand task delegation in small-group activities.

23. When conducting small-group activities, provide a clearly defined task outcome that students are required to achieve as a group.

24. Where possible, assess group work contributions individually rather than collectively grading as a group.

Prioritising student voice and agency

Generalising stereotypes of neurodivergent interests (for example, assuming all neurodivergent children would prefer to use digital resources) can create participation barriers. Students should be treated as collaborators when selecting and trialling digital and non-digital resources intended to support their participation in inclusive classrooms. Asking neurodivergent students for their feedback and preferences affords them the agency to decide how their minds and bodies are best supported.

Teachers can celebrate differences in learning and how children express their thoughts and personalities by providing students with choices around how to demonstrate what they have learnt. Multimodal curriculum design can provide neurodivergent students with flexible opportunities to use their voice in their preferred modality and foster a greater sense of belonging at school. Students with non-speaking communication preferences can be supported to contribute to class discussions and build social connections with peers by normalising diverse communication methods and providing access to alternative communication devices, mini whiteboards, and virtual communication spaces.

The enactment of student-centred approaches such as these relies on the capacity of teachers to engage in novel teaching practices that they may not have been trained in providing. Indeed, many teachers identify as lacking confidence in their ability to support neurodivergent students, particularly in secondary settings despite generally supporting the notion of inclusive education from a social justice perspective (Cook & Ogden, 2021). So, providing teachers with explicit advice and teaching strategies focused on prioritising student voice and agency can play a key role in helping teachers to enact inclusive teaching and learning.

For example, in partnership with expert teachers, White (2019) developed a range of targeted evidence-based teaching strategies with supporting advice that provides teachers with a range of multimodal, student-centred approaches that prioritise learner preferences, interests, and agency, and can be applied or adapted to support the learning of neurodivergent students. These evidence-based teaching strategies and advice focus on teaching digital literacy, a key curriculum area that enables neurodivergent students to learn to use technology and use technology to learn (White et al., 2020).

Recommendations for prioritising student voice and agency

25. Once students develop proficiency of a concept or skill, provide them with choices about how they would like to apply the knowledge or skill to demonstrate their mastery.

26. Encourage students to share their thoughts and provide feedback through class-level tools such as polls.

27. Ask students for their feedback and preferences on technology.

Technology as a virtual teaching assistant for supporting all students

For all students, digital literacy is a key capability needed to engage effectively in the 21st Century world. For neurodiverse students, developing digital literacy capability is of increased importance given the particular benefits that technology use can offer this cohort of learners as well as the risks it can pose. Digital literacy is “being able to interpret and use the symbols, text/graphics, and tools of digital technology and networks, and also the ability to do so in a culturally appropriate manner” (White et al., 2020, p. 138). Developing digital literacy ability means that learners can leverage technology in safe and socio-culturally appropriate ways to help them engage in opportunities for learning while remaining in control of their use of technology. It is important that teachers do not assume the digital literacy abilities of their students, but instead use validated assessment tools to determine what their students know and are ready to learn next. For example, resources such as the ABLES/SWANs digital literacy assessment and teaching tools provide teachers with evidence-based supports to understand and explicitly teach digital literacy to neurodivergent students who may be working below the level of their age-group peers (White et al., 2020).

Encouraging short learning and working ‘sprints’ by using timers can support the whole class in promoting task maintenance and space for rests and reflection. Visual timers displayed to the whole class have the benefit of providing support to all learners without singling out students with executive functioning differences or broadcasting surprising alarms. Completing a smaller task in an achievable amount of time (a ‘micro-goal’) can help students maintain motivation by affording them regular instances where they can feel proud to have achieved a small goal. As students’ understanding of time and planning becomes more sophisticated, they can take over responsibility to set their own timers and micro-goals. Providing access to noise monitors that use different coloured lights to show how noisy an environment is can benefit students and teachers by helping them to notice when the room is too loud which can contribute to vocal and mental fatigue. Steps can then be taken to return the room to a comfortable volume, or children can be provided access to sensory support like noise-cancelling headphones or earmuffs.

The accessibility features built into common hardware and software offer neurodivergent students a range of opportunities to access and engage with information in ways that can meet their unique access needs and preferences (White & Harrison, 2024). Explicitly teaching all students how to locate and use accessibility features such as text-to-speech, colour contrast, captioning, and focus settings can help increase student agency over how they engage with their technology to optimise its use for their learning and engagement. Encouraging all students to experiment with accessibility features to support learning can help students to better understand their individual needs as learners and how technology can be one way to meet them.

Recommendations for using technology as a virtual teaching assistant for supporting all students

28. Explicitly teach every student digital literacy to support them to safely and effectively use technologies in the learning environment and beyond.

29. Teach students to conduct their own 'learning sprints' through setting 'micro-goals' and the use of timers within classes; and to use digital noise monitors to self-monitor the volume of noise within the learning environment.

30. Teach all students to access and use the accessibility features built into the hardware and software within their digital ecosystem to meet their needs and preferences in order to optimise their learning experiences.

Transparent assessment through effective rubric design

Effective teaching and learning for all learners requires that teachers understand what a learner already knows and can do in order to identify what they are ready to learn next, or their Zone of Proximal Development (ZPD) (Vygotsky, 1978), where the learning is neither too hard nor too easy. Good assessment practices enable teachers to accurately identify a learner's ZPD for the purpose of targeting teaching to that point and tracking learning over time to ensure progress (Griffin, 2017). High-quality developmental rubrics are an important part of good assessment practices because they explicitly describe how a learner can demonstrate what they know and can do in a domain (for example, Mathematics or Literacy) or learning task from a low to high level for each of the main aspects, often known as *capabilities*, within the domain or task. Developmental rubrics are comprised of increasing degrees of detail for each capability depending on the complexity of the learning area. The capabilities are then individually described in greater detail through *indicators*, which are broad statements about the things that a learner can do, make, say, or write that a teacher could observe and interpret as an expression of the capability in question. *Quality criteria* then detail how well, or to what extent each indicator can be demonstrated from an emergent to an advanced level.

Well-designed developmental rubrics can help teachers to ensure their teaching aligns with the capabilities being assessed by highlighting what is important within a learning domain or task. They also support transparency in assessment by helping teachers to reliably assess and mark tasks across students by providing a consistent, clear description of what success looks like at increasing levels of complexity. Teachers can then interpret these scores or marks as an approximation of a learner's ZPD as they indicate what they know and are able to do now, as well as what they are ready to learn next (the level above their current marks). This means that teachers can target instruction to the students' point of readiness to learn.

The use of precise language to describe what success looks like at increasing levels of ability for each of the rubric's indicators can help communicate to learners the key features of a task. Doing so helps students understand the expectations for their learning and focus their efforts on meeting those expectations to the best of their ability, rather than spend time and effort trying to understand the task. Developmental rubrics can be developed to assess current ability across a complex domain like reading, a capability within reading (for example, sound-letter recognition), or to assess the performance of an assessment task, such as reading a short passage.

Regardless of the complexity of what is being assessed, providing well-designed rubrics specific to the capability or assessment task can also help learners to demonstrate their underlying knowledge and skills within that capability or task through different means of expression that suit their needs and preferences. If an assessment task regards knowledge about photosynthesis, for example, the developmental rubric would describe increasing levels of the different indicators of the knowledge about photosynthesis being assessed. How a student chooses to express that knowledge could be through writing, building a model, or giving a presentation, provided that the underlying knowledge is demonstrated as per the descriptions in the rubric. Such flexibility in assessment reflects the UDL Guidelines 3.0 (CAST, 2024b) as an example of inclusive practice for neurodivergent students.

To help learners gain the most benefit from a developmental rubric, teachers should explicitly explain each indicator and the quality criteria to students, using a linked example of how students could demonstrate each quality criterion. Modelling how to meet each increasing level of complexity or ability provides clarity to students, reducing cognitive load and confusion about the expectations for a task so they can concentrate on showing their teacher and themselves what their know and can do. Examples showing a range of high-quality rubrics used to support the teaching and learning of neurodivergent students and/or students with intellectual disability are embedded in the ABLES/SWANs assessment and teaching tools, which have helped thousands of teachers to inform their understanding of the abilities of these students and target their teaching to improve learning (Griffin & Woods, 2020).

Recommendations for facilitating transparent assessment through effective rubric design

31. Use developmental rubrics that use precise language to communicate the key features within each capability being taught and assessed.

32. Design a different rubric for each capability to focus the learner on a specific component of their learning.

33. Explicitly explain each quality criteria to students, using a linked example of the expected outcomes for each level.

Sustainable solutions to common barriers and challenges in using technologies in schools

Providing ongoing training to teachers on the full functionality of the software and hardware available to them as teaching and learning tools is essential for overcoming common barriers and challenges in using technologies in schools. Effective training builds teachers' capacity, confidence, and independence, enabling them to leverage digital tools to enhance learning outcomes and streamline classroom management. Through the analysis of the literature and the case studies, the researchers identified two interrelated priority areas requiring professional training for all teachers: the effective use of digital tools and knowledge around neurodiversity-affirming practice. By offering resources such as troubleshooting guides and clear procedures, schools can empower teachers to through the development of their technological-pedagogical knowledge. Encouraging teachers to experiment with digital tools fosters a proactive approach to classroom management and supports tailored learning experiences. Likewise, providing teachers with support and professional coaching to build capacity in identifying dysregulation in children and helping them co-regulate reduces instances of misinterpreting dysregulation for disruptive behaviour choices. Technology should be part of a broader ecosystem of co-regulation and self-regulation strategies that teachers can use to support learners to participate in academic and social classroom activities. Equipping teachers with ongoing opportunities to develop these skills maximises the potential of available technologies and promotes a culture of innovation and adaptability within the school community.

Limiting the number of different brands and configurations of devices within a school's digital ecosystem helps create a consistent and predictable experience for both learners and teachers. Different devices often operate on varying systems, which may interact with centralised classroom technology, such as Lumio, in inconsistent ways, potentially causing disruptions. A greater variation in devices increases the likelihood of technical issues, such as app updates or operating system upgrades that are incompatible with classroom tools, or differences in program versions leading to varying functionality. Standardising hardware ensures compatibility across peripheral items like chargers, adapters, and cases, simplifying logistics and reducing the risk of students being unable to participate fully due to device-specific issues. By streamlining the technology used, schools can minimise disruptions, enhance reliability, and foster a more efficient and equitable learning environment.

Establishing clear whole-school guidelines and routines for preparing and using digital technologies in the classroom, alongside effective mitigation processes, ensures a smooth integration of technology into learning. Standardised expectations, such as requiring students to charge their devices overnight, promote accountability and readiness for class activities. However, some technical issues, like reduced battery capacity over time, are inevitable. To address these, schools should implement practical backup solutions, such as maintaining spare chargers in classrooms. Providing and operating student devices centrally, such as through a class laptop bank with individual student logins, further enhances consistency and reliability. This approach eliminates variability in device functionality, ensures devices are properly maintained and charged by school staff, and reduces the burden on students and families. These strategies create a predictable and efficient digital learning environment, minimising disruptions and maximising instructional time.

Recommended solutions to common barriers and challenges in using technologies in schools

34. Provide training to teachers on how to use the full functionality of the software and hardware available to them as teaching and learning tools, including the management affordances.

35. Limit the number of different brands and configurations of devices within the digital ecosystem to create a more consistent and predictable experience for learners and teachers.

36. Develop clear whole-school guidelines and routines on preparing and using digital technologies for learning within the class, alongside mitigation processes for when these guidelines are ineffective.

Summary and mapping of recommendations

For ease of reading and discussion, a collated list of all 36 recommendations emerging from this research project is presented in Table 5. Each recommendation has also been mapped to UDL Guidelines 3.0 (CAST, 2024b), with some mapping to a single design consideration and others responding to multiple design considerations.

Table 5. Mapping of recommendations with the UDL principles.

		Engagement			Representation			Action and expression		
	Recommendation	*Welcoming Interests & Identities*	*Sustaining Effort & Persistence*	*Emotional Capacity*	*Perception*	*Language & Symbols*	*Building Knowledge*	*Interaction*	*Expression & Communication*	*Strategy Development*
Interactive explicit teaching aligning with the principles of UDL	1. Develop a shared understanding across the school of pedagogical practices that focus on modelling worked examples for students and then providing opportunities for students to apply their learning to other contexts of interest.		✓				✓		✓	
	2. Plan regular opportunities during instruction for students to interact with peers, actively discuss knowledge and demonstrate their skills.		✓							
	3. Provide time and space for teachers to share planning to allow the development of high-quality resources that are responsive to local culture and context.	✓			✓					
Supporting executive functioning through digital tools	4. Provide digital scaffolds and graphic organisers to help students to organise information and their thinking in a structured and systematic way.		✓				✓		✓	✓

	5. Explicitly teach new vocabulary and provide students with access to an ongoing digital vocabulary database.					✓				
	6. Optimise the amount of information displayed on a screen at once by providing chunks of key information and integrating text with supporting visuals.				✓	✓	✓			
Integrating the targeted activation of prior knowledge and daily reviews	7. Introduce new topics with clear connections to previous learning to build from prior understandings.						✓			
	8. Allow students to be able to access prior learning materials and resources as required to revise foundational concepts or knowledge.						✓			
	9. Conduct a daily review at the beginning or conclusion of a lesson that revises both recent and historical knowledge and skills.						✓			
Developing self-regulation in the use of technology through the gradual release of responsibility	10. Gradually release responsibility from the teacher to the learner by using guided access digital tools.								✓	
	11. Explicitly teach self-regulation strategies to remain on task while using technology.	✓		✓						
	12. Provide time for students to explore their interests through technology.	✓								

Establishing routines and systems	13. Use either a digital or non-digital visual activity schedule to create a predictable and safe structure for the class.	✓		✓						
	14. Use visual timers and ongoing cycles of activity and whole class check-ins during independent work.	✓							✓	
	15. Provide a single, consistent method for students to submit their digital work.									✓
Integrating physical and digital resources	16. Normalise the use of non-digital resources alongside digital resources by explaining to learners the affordances of each and the rationale for why the teacher is requesting the use of each tool at a particular point in the lesson.		✓							
	17. Allow students to access their own personal whiteboard, either physical or digital, for every lesson and explicitly teach them to use these as a concrete support for reducing cognitive load.	✓	✓				✓		✓	✓
	18. Provide both physical and digital copies of textbooks and other learning materials to accommodate student learning preferences and information processing needs.	✓	✓		✓			✓		
Creating a safe culture for active participation	19. Allow anonymous contributions during class brainstorming activities with clear expectations in place around responding to shared ideas.	✓	✓	✓						

	20. Provide consistent options for multimodal contributions to class discussions where students can contribute via their preferred mode of communication.	✓				✓			✓	
	21. Use talking partners to rehearse responses to prompts before calling on students in front of the class.		✓						✓	
Supporting collaboration through structure, capacity building and clear targeted outcomes	22. Scaffold collaborative group tasks by providing clear strategies to help students understand task delegation in small-group activities.		✓	✓					✓	
	23. When conducting small-group activities, provide a clearly defined task outcome that students are required to achieve as a group.		✓							✓
	24. Where possible, assess group work contributions individually rather than collectively grading as a group.	✓	✓	✓						
Prioritising student voice and agency	25. Once students develop proficiency of a concept or skill, provide them with choices about how they would like to apply the knowledge or skill to demonstrate their mastery.	✓					✓		✓	
	26. Encourage students to share their thoughts and provide feedback through class-level tools such as polls.		✓							
	27. Ask students for their feedback and preferences on technology.	✓		✓						

Technology as a virtual teaching assistant for supporting all students	28. Explicitly teach every student digital literacy to support them to safely and effectively use technologies in the learning environment and beyond.	✓								
	29. Teach students to conduct their own ‘learning sprints’ through setting ‘micro-goals’ and the use of timers within classes; and to use digital noise monitors to self-monitor the volume of noise within the learning environment.	✓	✓						✓	
	30. Teach all students to access and use the accessibility features built into the hardware and software within their digital ecosystem to meet their needs and preferences in order to optimise their learning experiences.				✓			✓		
Transparent assessment through effective rubric design	31. Use developmental rubrics that use precise language to communicate the key features within each indicator of quality.		✓							✓
	32. Design a different rubric for each capability to focus the learner on a specific component of their learning.		✓							✓
	33. Explicitly explain each quality criteria to students, using a linked example of the expected outcomes for each level.		✓							✓
Creating solutions to common	34. Provide training to teachers on how to use the full functionality of the software and hardware available to them as teaching and	✓								✓

	learning tools, including the management affordances.									
	35. Limit the number of different brands of devices within the digital ecosystem to create a more consistent and predictable experience for learners and teachers.	✓								✓
	36. Develop whole-school guidelines and routines on preparing and using digital technologies for learning within the class, alongside mitigation processes for when these guidelines are ineffective.	✓		✓						✓

Limitations of this research project

This research project aimed to explore the impact of digital tools and strategies on the educational experiences of neurodivergent children in a range of school settings. While the study provides valuable insights, several limitations must be acknowledged that may affect the generalisability and comprehensiveness of the findings.

Limitations within the literature selection

A key limitation of the literature analysis is the focus on peer-reviewed academic literature. Although peer-reviewed publications are crucial for ensuring rigor and credibility, they represent only a fraction of the available knowledge and experiences surrounding neurodivergent students. Many neurodivergent children, parents, and educators share valuable insights in grey (non-academic) literature such as personal blogs, websites, and social media platforms. These sources often provide firsthand accounts of lived experiences and practical insights into the challenges and successes of neurodivergent students, which may not be adequately captured in the peer-reviewed literature. Therefore, while the study relied on established academic sources, it is important to recognise that these grey literature sources could contain additional relevant experiences and perspectives that were not fully incorporated into the analysis.

Limitations in the selection of case study schools

Another limitation relates to the selection of case study schools. SMART Technologies, the research sponsor, provided a list of twenty schools for the case studies, from which six were selected to participate in the research by the Chief Investigator Matthew Harrison. This meant that all six schools used the products and services offered by SMART Technologies. While these schools were not influenced by the sponsor in terms of data collection or analysis, the association with the sponsor may introduce a potential bias in terms of the types of schools included. As the participating schools were all users of SMART Technologies' products, there may be a concentration of certain characteristics, such as access to technology or a specific approach to digital learning, which could influence the findings. However, the research was designed to ensure that data collection and analysis were independent of the sponsor's influence, maintaining objectivity throughout.

Limitations manifesting from the sample size and implications for generalisability

The study's reliance on a small number of case study schools also presents a limitation in terms of the generalisability of the findings. With only six schools included in the research, the conclusions drawn from these individual cases may not fully reflect the broader diversity of educational environments or experiences of neurodivergent children. The relatively small sample size means that the findings cannot be confidently extended to all schools or populations of neurodivergent children, particularly given the wide variation in educational practices, resources, and support systems across different regions and contexts.

To address this limitation, the research sought to include a range of schools from different cultural, geographical, and socio-economic backgrounds. This diversity aimed to ensure that a variety of experiences were represented within the case study sample. While this strategy enhanced the richness of the data, the small number of schools still limits the ability to make broader, population-wide generalisations about the impact of digital tools on neurodivergent students in all educational settings.

Considerations of contextual factors and variability

It is also important to note that the case study approach, while providing in-depth insights into individual school settings, also means that each case is shaped by its unique context. Factors such as school culture, leadership, teacher training, and community involvement all influence how educational tools and strategies are implemented and received. As such, the findings from this research reflect the experiences of the specific schools involved but may not be directly applicable to schools with different contextual factors or resources. While the diversity of schools included in the study helps to mitigate this limitation to some extent, the variability in educational settings means that conclusions should be interpreted with caution, particularly when considering their application in other contexts.

Despite these limitations, this research contributes valuable knowledge to the field of neurodivergent education, particularly in the context of digital tools and their impact on learning. Future research that expands the scope of case studies, includes a broader range of literature sources, and explores additional contextual factors will help to build on the findings of this study and provide a more comprehensive understanding of the needs and experiences of neurodivergent students in educational settings.

Conclusions and next steps

At this critical juncture in the global shift towards inclusive education, there is a compelling need to reimagine how digital technologies can be positioned as transformative learning tools. As schools strive to dismantle barriers that have historically marginalised neurodivergent students, digital technologies offer unprecedented opportunities to create environments where all learners feel safe, valued, and excited to participate. This research highlights the importance of amplifying the voices of all stakeholders, especially students, whose lived experiences are too often overshadowed by those of teachers, researchers, and parents. By centring the perspectives of both students and educators, the study provided a nuanced understanding of how digital tools can scaffold learning, promote inclusion, and enrich the overall school experience for neurodivergent students.

The findings of this research emphasised the critical role digital technologies can play in creating inclusive conditions for engagement, representation, and action and expression. Through adaptive features, collaborative opportunities, and multimodal tools, digital platforms were shown to enable personalised learning pathways that cater to diverse strengths and needs. Importantly, the study revealed that the effective use of these technologies requires thoughtful integration into pedagogical practices, guided by the principles of Universal Design for Learning (UDL). Utilising this framework ensures that technologies are not just add-ons but central elements of an inclusive learning ecosystem, addressing cognitive, sensory, and social-emotional needs holistically.

Moreover, the research underscored that successful implementation of inclusive digital technologies hinges on the professional knowledge of educators. Six case studies helped the researchers to better understand the conditions in which school ecosystems can be places of innovation. Teachers need access to ongoing training and resources to build confidence and competence in using these tools effectively. The study also highlighted the importance of a collaborative school culture, where educators, support staff, students, and families work together to co-design learning experiences that reflect the principles of inclusion. By fostering such partnerships, schools can better leverage digital technologies to create dynamic, responsive learning environments that empower neurodivergent students to thrive.

This research contributes to the growing body of knowledge on inclusive education by demonstrating how digital technologies can be harnessed to support neurodivergent learners. By prioritising the voices of students and teachers, it offers actionable insights into the design and implementation of tools and practices that enhance engagement, representation, and expression. As education systems continues to strive for more effective ways to remove barriers for all students, it is imperative to view digital technologies not merely as tools for instruction but as powerful enablers of inclusion, belonging, and agency. The findings and recommendations emerging from this research project provide a roadmap for educators, policymakers, and technologists to collaboratively build inclusive school communities where all learners can realise their full potential. It is important for teachers and school leaders to recognise that implementing these recommendations will take time and energy, and to accept that inclusive education is a journey and not a destination. This understanding was captured beautifully in a comment from the teacher at School E below, who noted the challenge of the process and the rewards for their efforts. It is clear that while developing professional knowledge and skills in inclusive digital pedagogies takes time, the researchers believe every teacher can develop these competencies when the environmental conditions allow them the space and opportunities to learn and grow.

"I think with just time and lots of support for teachers, they will start to... The first few lessons that I did with the SMART Board were atrocious. We had things not working. We had kids that couldn't log in properly. I didn't know the ins and outs of how to do it. It might've been five or so lessons that were not great, and then they start getting easier and easier and easier. And now I use it every day."

Teacher in School E

References

Abdelnour, E., Jansen, M. O., & Gold, J. A. (2022). ADHD diagnostic trends: Increased recognition or overdiagnosis. *Missouri Medicine, 119*(5), 467–473.

Almutlaq, H., & Martella, R. C. (2018). Teaching elementary-aged students with autism spectrum disorder to give compliments using a social story delivered through an iPad application. *International Journal of Special Education, 33*(2), 482–492. https://eric.ed.gov/?id=EJ1185588

Antoninis, M., April, D., Barakat, B., Bella, N., D'Addio, A. C., Eck, M., ... & Zekrya, L. (2020). All means all: An introduction to the 2020 Global Education Monitoring Report on inclusion. *Prospects, 49*, 103-109.

American Psychiatric Association. (2013). Diagnostic and Statistical Manual of Mental Disorders, 5(5). https://doi.org/10.1176/appi.books.9780890425596

Asperger, H. (1991). "Autistic psychopathy" in childhood. *Autism and Asperger Syndrome*, 37–92. https://doi.org/10.1017/cbo9780511526770.002

Baggetta, P., & Alexander, P. A. (2016). Conceptualization and operationalization of executive function. *Mind, Brain, and Education, 10*(1), 10–33. https://doi.org/10.1111/mbe.12100

Balt, M., Fritz, A., & Ehlert, A. (2020). Insights into first grade students' development of conceptual numerical understanding as drawn from progression-based assessments. *Frontiers in Education, 5*(80). https://doi.org/10.3389/feduc.2020.00080

Berninger, V. W., & O'Malley May, M. (2011). Evidence-based diagnosis and treatment for specific learning disabilities involving impairments in written and/or oral language. *Journal of Learning Disabilities*, *44*(2), 167–183. https://doi.org/10.1177/0022219410391189

Berton, R., Kolasinska, A., Gaggi, O., Palazzi, C., & Quadrio, G. (2020). A Chrome extension to help people with dyslexia. *Proceedings of the International Conference on Advanced Visual Interfaces.* http://dx.doi.org/10.1145/3399715.3399843

Bettelheim, B. (1967). *The empty fortress: Infantile autism and the birth of the self.* Free Press.

Cardon, T., Wangsgard, N., & Dobson, N. (2019). Video modeling using classroom peers as models to increase social communication skills in children with ASD in an integrated preschool. *Education and Treatment of Children, 42*(4), 515–536. https://doi.org/10.1353/etc.2019.0024

CAST. (2024a, November 29). *About Universal Design for Learning*. https://www.cast.org/impact/universal-design-for-learning-udl

CAST. (2024b, November 29). *The UDL Guidelines*. https://udlguidelines.cast.org/

CAST. (2024c, November 29). *The UDL Guidelines: Representation.* https://udlguidelines.cast.org/representation/

CAST. (2024d, November 30). *The goal of UDL: Learner agency.* https://udlguidelines.cast.org/more/udl-goal/

Chapman, R., & Bovell, V. (2022). Neurodiversity, advocacy, anti-therapy. In *Handbook of autism and pervasive developmental disorder: Assessment, diagnosis, and treatment* (pp. 1519-1536). Cham: Springer International Publishing.

Chapman, L., Rose, K., Hull, L., & Mandy, W. (2022). "I want to fit in… but I don't want to change myself fundamentally": A qualitative exploration of the relationship between masking and mental health for autistic teenagers. *Research in Autism Spectrum Disorders, 99*(99), 102069. https://doi.org/10.1016/j.rasd.2022.102069

Cheang, R., Skjevling, M., Blakemore, A., Kumari, V., & Puzzo, I. (2024). Do you feel me? Autism, empathic accuracy and the double empathy problem. *Autism*. https://doi.org/10.1177/13623613241252320

Chow, C., & Cooper, K. (2024). What are the lived experiences of strengths in autistic individuals? A systematic review and thematic synthesis. *Autism in Adulthood*. https://doi.org/10.1089/aut.2023.0172

Courtney Leigh Miller, Jelinkova, K., Charabin, E. C., & Climie, E. A. (2024). Parent and child-reported strengths of children with ADHD. *Canadian Journal of School Psychology, 39*(1). https://doi.org/10.1177/08295735231225261

Chung, P. J., Patel, D. R., & Nizami, I. (2020). Disorder of written expression and dysgraphia: definition, diagnosis, and management. *Translational Pediatrics, 9*(S1), S46–S54. https://doi.org/10.21037/tp.2019.11.01

Cibrian, F., Lakes, K. Tavakoulnia, A., Guzman, K., Schuck S., & Hayes, G. (2020). Supporting self-regulation of children with ADHD using wearables. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems.* http://dx.doi.org/10.1145/3313831.3376837

Cook, A., & Ogden, J. (2021). Challenges, strategies and self-efficacy of teachers supporting autistic pupils in contrasting school settings: a qualitative study. *European Journal of Special Needs Education, 37*(3), 371–385. https://doi.org/10.1080/08856257.2021.1878659

Crompton, C. J., Hallett, S., Ropar, D., Flynn, E., & Fletcher-Watson, S. (2020). “I never realised everybody felt as happy as I do when I am around autistic people”: A thematic analysis of autistic adults’ relationships with autistic and neurotypical friends and family. *Autism, 24*(6), 136236132090897. https://doi.org/10.1177/1362361320908976

Dickinson, K., & Place, M. (2016). The impact of a computer-based activity program on the social functioning of children with Autistic Spectrum Disorder. *Games for Health Journal, 5(*3), 209–215. https://doi.org/10.1089/g4h.2015.0063

Doan, M., Cibrian, F., Jang, A., Khare, N., Chang, S., Li, A., Schuck, S., Lakes, K., and Hayes, G. (2020). CoolCraig: A smart watch/phone application supporting co-regulation of children with ADHD. *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems.* http://dx.doi.org/10.1145/3334480.3382991

Doikou-Avlidou, M. (2015). The educational, social and emotional experiences of students with dyslexia: The perspective of postsecondary education students. *International Journal of Special Education, 30*(1), 132–145. https://eric.ed.gov/?id=EJ1094794

Doyle, N. (2020). Neurodiversity at work: a biopsychosocial model and the impact on working adults. *British Medical Bulletin*, *135*(1), 108–125. https://doi.org/10.1093/bmb/ldaa021

Dueñas, A. D., Plavnick, J. B., & Bak, M. Y. S. (2018). Effects of joint video modeling on unscripted play behavior of children with autism spectrum disorder. *Journal of Autism and Developmental* Disorders, 49(1), 236–247. https://doi.org/10.1007/s10803-018-3719-2

Dvorsky, M. R., Langberg, J. M., Evans, S. W., & Becker, S. P. (2016). The protective effects of social factors on the academic functioning of adolescents with ADHD. *Journal of Clinical Child & Adolescent Psychology, 47*(5), 713–726. https://doi.org/10.1080/15374416.2016.1138406

Erfurt, G., Hornecker, E., Ehlers, J. & Plasckies, S. (2019). Hands-On Math. *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems.* http://dx.doi.org/10.1145/3290607.3313012.

Espina, E., Marbán, J. M., & Sáez, A. M. (2022). A retrospective look at the research on dyscalculia from a bibliometric approach. *Revista de Educación*, *396*, 201-229. https://doi.org/10.4438/1988-592X-RE-2022-396-535

Fachantidis, N., Syriopoulou-Delli, C. K., Vezyrtzis, I., & Zygopoulou, M. (2019). Beneficial effects of robot-mediated class activities on a child with ASD and his typical classmates. *International Journal of Developmental Disabilities, 66*(3), 245–253. https://doi.org/10.1080/20473869.2019.1565725

Farghaly, W. M., El Tallawy, S. H., Ramadan, A. S., Abdelrasol, R. B., Omar, M. S., Eltallawy, H. N., & Mohamed, K. O. (2022). Training second-grade dyslexic students using a computerized program in Asyut, Egypt. *The Egyptian Journal of Neurology, Psychiatry and Neurosurgery*, *58*(1). https://doi.org/10.1186/s41983-022-00480-y

Feder, K., Majnemer, A., & Synnes, A. (2000). Handwriting: Current trends in occupational therapy practice. *Canadian Journal of Occupational Therapy, 67*(3), 197–204. https://doi.org/10.1177/000841740006700313

Graber, A., & Graber, J. (2023). Applied behavior analysis and the abolitionist neurodiversity critique: An ethical analysis. *Behavior Analysis in Practice*, 16(4), 921-937.

Griffin, P. (2017). *Assessment for teaching* (2nd ed.). Cambridge University.

Griffin, P. & Woods, K. (Eds.) (2020). *Understanding Students with Additional Needs as Learners*. Springer. https://doi.org/10.1007/978-3-030-56596-1

González-Castro, P., Cueli, M., Areces, D., Rodríguez, C., & Sideridis, G. (2016). Improvement of word problem solving and basic mathematics competencies in students with attention deficit/hyperactivity disorder and mathematical learning difficulties. *Learning Disabilities Research & Practice, 31*(3), 142–155. https://doi.org/10.1111/ldrp.12106

Harris, E. (2023). Autism prevalence has been on the rise in the US for decades—and that's progress. *JAMA Medical News*, *329*(20), 1724–1724. https://doi.org/10.1001/jama.2023.6078

Haberstroh, S., & Schulte-Körne, G. (2019). The diagnosis and treatment of dyscalculia. *Deutsches Aerzteblatt Online*, *116*(7), 107–114. https://doi.org/10.3238/arztebl.2019.0107

Habib, M. (2000). The neurological basis of developmental dyslexia: An overview and working hypothesis. *Brain, 123*(12), 2373–2399. https://doi.org/10.1093/brain/123.12.2373

Hamilton, L. G. (2024). Emotionally based school avoidance in the aftermath of the COVID-19 pandemic: Neurodiversity, agency and belonging in school. *Education Sciences, 14*(2), 156. https://doi.org/10.3390/educsci14020156

Hanghøj, T., Lieberoth, A., & Misfeldt, M. (2018). Can cooperative video games encourage social and motivational inclusion of at-risk students? *British Journal of Educational Technology, 49(*4), 775–799. https://doi.org/10.1111/bjet.12642

Heidegger, M. (1977). *The question concerning technology, and other essays.* Harper & Row.

Hu, X., & Han, Z. R. (2019). Effects of gesture-based match-to-sample instruction via virtual reality technology for Chinese students with autism spectrum disorders. *International Journal of Developmental Disabilities, 65*(5), 327–336. https://doi.org/10.1080/20473869.2019.1602350

Hughes-Roberts, T., Brown, D. J., Burton, A., Shopland, N., Tinney, J., & Boulton, H. (2023). Digital game making and game templates promotes learner engagement in non-computing based classroom teaching. *Technology, Knowledge, and Learning*. https://doi.org/10.1007/s10758-023-09654-w

Huntington, R. N., Badgett, N. M., Rosenberg, N. E., Greeny, K., Bravo, A., Bristol, R. M., Byun, Y. H., & Park, M. S. (2022). Social validity in behavioral research: A selective review. *Perspectives on Behavior Science, 46*(1). https://doi.org/10.1007/s40614-022-00364-9

Isaac, V., Vladimir López, & María Josefina Escobar. (2024). Arousal dysregulation and executive dysfunction in attention deficit hyperactivity disorder (ADHD). *Frontiers in Psychiatry,* 14. https://doi.org/10.3389/fpsyt.2023.1336040

Kim, G. Y., Zimmerman, K. N., Cheatham, G. A., & Smith, K. (2023). Visual cues using mobile technology to support in-class transition for all children. *Young Exceptional Children, 27*(1), 42-54. https://doi.org/10.1177/10962506231195900

Kirby, P. (2020). Dyslexia debated, then and now: a historical perspective on the dyslexia debate. *Oxford Review of Education, 46*(4), 472–486. https://doi.org/10.1080/03054985.2020.1747418

Kirkham, P. (2017). 'The line between intervention and abuse'–autism and applied behaviour analysis. *History of the human sciences, 30*(2), 107-126.

Knight, V. F., Kuntz, E. M., & Brown, M. (2018). Paraprofessional-delivered video prompting to teach academics to students with severe disabilities in inclusive settings. *Journal of Autism and Developmental Disorders, 48*(6), 2203–2216. https://doi.org/10.1007/s10803-018-3476-2

Kosc, L. (1974). Developmental Dyscalculia. *Journal of Learning Disabilities*, *7*(3), 164- 177. https://doi.org/10.1177/002221947400700309

Kucian, K., & von Aster, M. (2014). Developmental dyscalculia. *European Journal of Pediatrics*, *174*(1), 1–13. https://doi.org/10.1007/s00431-014-2455-7

Kussmaul, A. (1877). Chapter XXVII. In von Ziemssen H. (Ed.), Cyclopaedia of the practice of medicine: Vol. XIV: Diseases of the nervous system and disturbances of speech (pp. 770–778). William Wood.

Ledbetter-Cho, K., O'Reilly, M., Watkins, L., Lang, R., Lim, N., Davenport, K., & Murphy, C. (2020). The effects of a teacher-implemented video-enhanced activity schedule intervention on the mathematical skills and collateral behaviors of students with autism. *Journal of Autism and Developmental Disorders, 53,* 553-568. https://doi.org/10.1007/s10803-020-04495-3

Lei, J., Leigh, E., Charman, T., Russell, A., & Hollocks, M. J. (2023). Understanding the relationship between social camouflaging in autism and safety behaviours in social anxiety in autistic and non-autistic adolescents. *Journal of Child Psychology and Psychiatry, 65*(3). https://doi.org/10.1111/jcpp.13884

Lewis, K. E., & Fisher, M. B. (2016). Taking Stock of 40 Years of Research on Mathematical Learning Disability: Methodological Issues and Future Directions. *Journal for Research in Mathematics Education*, *47*(4), 338–371. https://doi.org/10.5951/jresematheduc.47.4.0338

Lewis, R., Graves, A., Ashton, T., & Kieley, C. (1998). Word processing tools for students with learning disabilities. *Learning Disabilities Research & Practice, 13*, 95–108.

Liddle, R. (2014, March 15). Dyslexia is meaningless. But don't worry – So is ADHD. *Spectator.* https://www.spectator.co.uk/article/dyslexia-is-meaningless-but-don-t-worry-so-is-adhd/

Lubniewski, K. L., & McArthur, C. L. (2018). Evaluating instructional apps using the App Checklist for Educators (ACE). *International Electronic Journal of Elementary Education*, *10*(3), 323–329. https://doi.org/10.26822/iejee.2018336190

London, A. S., & Landes, S. D. (2019). Cohort Change in the Prevalence of ADHD Among U.S. Adults: Evidence of a Gender-Specific Historical Period Effect. *Journal of Attention Disorders*, *25*(6), 771–782. https://doi.org/10.1177/1087054719855689

Mandak, K., Light, J., & McNaughton, D. (2018). Digital books with dynamic text and speech output: Effects on sight word reading for preschoolers with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *49*(3), 1193–1204. https://doi.org/10.1007/s10803-018-3817-1

Meilleur, A.-A. S., Jelenic, P., & Mottron, L. (2014). Prevalence of clinically and empirically defined talents and strengths in autism. *Journal of Autism and Developmental Disorders, 45*(5), 1354–1367. https://doi.org/10.1007/s10803-014-2296-2

Milton, D. E. M., Heasman, B., & Sheppard, E. (2020). Double Empathy. *Encyclopedia of Autism Spectrum Disorders*, 1–9. https://doi.org/10.1007/978-1-4614-6435-8_102273-2

Mirfin-Veitch, B., Jalota, N., & Schmidt, L. (2020). Responding to neurodiversity in the education context: An integrative literature review [Report]. Donald Beasley Institute, 56.

Munzer, T., Hussain, K., & Soares, N. (2020). Dyslexia: neurobiology, clinical features, evaluation and management. *Translational Pediatrics, 9(*S1), S36–S45. https://doi.org/10.21037/tp.2019.09.07

Nally, A., Holloway, J., Lydon, H., & Healy, O. (2020). The Edmark® Reading Program: A comparison of computerized and table top presentation in reading outcomes in students with autism spectrum disorder. *Journal of Developmental and Physical Disabilities, 33*(2), 259–278. https://doi.org/10.1007/s10882-020-09747-9

Ntalindwa, T., Nduwingoma, M., Uworwabayeho, A., Nyirahabimana, P., Karangwa, E. K., Rashid Soron, T., Westin, T., Kharunanthe, T., & Kharunanthe, T. (2021). Adopting the use of digital content to improve the learning of numeracy among children with autism spectrum disorders in Rwanda: A thematic content analysis study (Preprint). *JMIR Serious Games.* https://doi.org/10.2196/28276

Orton, S. T. (1955). Introduction excerpts from reading, writing and speech problems in children. *Bulletin of the Orton Society*, 5(1), 10–11. https://doi.org/10.1007/bf02657575

Ozdowska, A., Wyeth, P., Carrington, S., & Ashburner, J. (2021). Using assistive technology with SRSD to support students on the autism spectrum with persuasive writing. *British Journal of Educational Technology, 52*(2), 934–959. https://doi.org/10.1111/bjet.13063

Pérez-López, D., Cascales-Martínez, A., Martínez-Segura, M.-J., & Contero, M. (2016). Using an augmented reality enhanced tabletop system to promote learning of mathematics: A case study with students with special educational needs. *EURASIA Journal of Mathematics, Science and Technology Education*, *13*(2), 355-380. https://doi.org/10.12973/eurasia.2017.00621a

Reading Well. (2014, May 5). *In defence of dyslexia.* https://www.dyslexia-reading-well.com/the-dyslexia-debate.html

Reeve, R. A. (2019). Mathematical learning and its difficulties in Australia. In A. Fritz, V. G. Haase, & P. Räsänen (Eds.), *International Handbook of Mathematical Learning Difficulties*. (pp. 253-264). Springer. https://doi.org/10.1007/978-3-319-97148-3_16

Reeve, R. A., & Waldecker, C. (2017). Evidence-based assessment and intervention for dyscalculia and maths disabilities in school psychology. In M. Thielking & M. D. Terjesen (Eds.), *Handbook of Australian School Psychology* (pp. 197–213). Springer International. https://doi.org/10.1007/978-3-319-45166-4_10

Rosen, N. E., Lord, C., & Volkmar, F. R. (2021). The diagnosis of autism: From Kanner to DSM-III to DSM-5 and beyond. *Journal of Autism and Developmental Disorders, 51*(12), 4253–4270. https://doi.org/10.1007/s10803-021-04904-1

Sartini, E. C., Knight, V., Spriggs, A. D., & Allday, R. A. (2020). Effects of systematic instruction and self-directed video prompting on text comprehension of elementary students with autism spectrum disorder. *Research in Autism Spectrum Disorders, 72*, 101529. https://doi.org/10.1016/j.rasd.2020.101529

Schippers, L. M., Greven, C. U., & Hoogman, M. (2024). Associations between ADHD traits and self-reported strengths in the general population. *Comprehensive Psychiatry, 130*(1), 152461. https://doi.org/10.1016/j.comppsych.2024.152461

Sedgwick, J. A., Merwood, A., & Asherson, P. (2018). The positive aspects of attention deficit hyperactivity disorder: A qualitative investigation of successful adults with ADHD. *ADHD Attention Deficit and Hyperactivity Disorders*, *11*, 241–253. https://doi.org/10.1007/s12402-018-0277-6

Sewell, A. (2022). Understanding and supporting learners with specific learning difficulties from a neurodiversity perspective: A narrative synthesis. *British Journal of Special Education, 49*(4). https://doi.org/10.1111/1467-8578.12422

Sikirica, V., Flood, E., Dietrich, C. N., Quintero, J., Harpin, V., Hodgkins, P., Skrodzki, K., Beusterien, K., & Erder, M. H. (2014). Unmet needs associated with attention-deficit/hyperactivity disorder in eight European countries as reported by caregivers and adolescents: Results from qualitative research. *The Patient - Patient-Centered Outcomes Research*, *8*(3), 269–281. https://doi.org/10.1007/s40271-014-0083-y

Slee, R., & Tait, G. (2022). What Is Inclusive Education and Why All the Fuss?. In *Ethics and Inclusive Education: Disability, Schooling and Justice* (pp. 1-20). Cham: Springer International Publishing.

Sprenger-Charolles, L., Siegel, L. S., Jiménez, J. E., & Ziegler, J. C. (2011). Prevalence and reliability of phonological, surface, and mixed profiles in dyslexia: A review of studies conducted in languages varying in orthographic depth. *Scientific Studies of Reading, 15*(6), 498–521. https://doi.org/10.1080/10888438.2010.524463

Sproston, K., Sedgewick, F., & Crane, L. (2017). Autistic girls and school exclusion: Perspectives of students and their parents. *Autism & Developmental Language Impairments, 2*(2), 239694151770617. https://doi.org/10.1177/2396941517706172

Strickland, J., Woods, K., & Pavlovic, M. (2020). Assessing and understanding early numeracy for students with additional needs. In P. Griffin & K. Woods (Eds.) *Understanding Students with Additional Needs as Learners*. Springer. https://doi.org/10.1007/978-3-030-56596-1_9

Suero Montero, C., Kämäräinen, A., Kilpiä, A., Dindar, K., Pihlainen, K., & Kärnä, E. (2023). Research design in inclusive learning environments for and with children on the autism spectrum – Towards multimodal data collection. *Turkish Online Journal of Educational Technology*, *22*, 42-59.

Sun, X., Allison, C., Matthews, F. E., Sharp, S. J., Auyeung, B., Baron-Cohen, S., & Brayne, C. (2013). Prevalence of autism in mainland China, Hong Kong and Taiwan: a systematic review and meta-analysis. *Molecular Autism, 4*(1), 7. https://doi.org/10.1186/2040-2392-4-7

Taylor, H., & Vestergaard, M. D. (2022). Developmental dyslexia: Disorder or specialization in exploration? *Frontiers in Psychology,* 13. https://doi.org/10.3389/fpsyg.2022.889245

Taylor, W. (2016, November 4). Hidden talents masked by a learning disability. *Learning Essentials.* https://learningessentialsedu.com/hidden-talents-masked-by-a-learning-disability/

Tan, P., & Alant, E. (2016). Using peer-mediated instruction to support communication involving a student with autism during mathematics activities: A case study. *Assistive Technology*, *30(*1), 9–15. https://doi.org/10.1080/10400435.2016.1223209

Therrien, M. C. S., & Light, J. C. (2018). Promoting peer interaction for preschool children with complex communication needs and autism spectrum disorder. *American Journal of Speech-Language Pathology, 27(*1), 207–221. https://doi.org/10.1044/2017_ajslp-17-0104

Thiemann-Bourque, K., Feldmiller, S., Hoffman, L., & Johner, S. (2018). Incorporating a peer-mediated approach into speech-generating device intervention: Effects on communication of preschoolers with autism spectrum disorder. *Journal of Speech, Language, and Hearing Research*, 61(8), 2045–2061. https://doi.org/10.1044/2018_jslhr-l-17-0424

United Nations Convention on the Rights of Persons with Disabilities, December 13, 2006. https://www.ohchr.org/en/instruments-mechanisms/instruments/convention-rights-persons-disabilities

University of Oxford. (n.d.). *Dyscalculia*. Equality and Diversity Unit. https://edu.admin.ox.ac.uk/dyscalculia

Vogelgesang, K. L., Bruhn, A. L., Coghill-Behrends, W. L., Kern, A. M., & Troughton, L. C. W. (2016). A single-subject study of a technology-based self-monitoring intervention. *Journal of Behavioral Education, 25*(4), 478–497. https://doi.org/10.1007/s10864-016-9253-4

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Harvard University.

Wilson, W. J., Harper-Hill, K., Armstrong, R., Downing, C., Perrykkad, K., Rafter, M., & Ashburner, J. (2021). A preliminary investigation of sound-field amplification as an inclusive classroom adjustment for children with and without autism spectrum disorder. *Journal of Communication Disorders, 93*, 106142. https://doi.org/10.1016/j.jcomdis.2021.106142

White, E. H. (2019). Strategies for teaching digital literacy to students with multiple disabilities including vision impairment (MDVI): Combining evidence with expertise. *Journal of the South Pacific Educators in Vision Impairment, 12*(1). 14-48. https://www.spevi.net/wp-content/uploads/2015/07/JSPEVI-Vol-12-2019.pdf

White, E. H. & Harrison, M. (2024). Technology for inclusion. In A. Ashman & S. Poed (Eds.) *Education for Inclusion and Diversity* (7th ed., pp. 157-190). Pearson.

White, E. H., Pavlovic, M., & Poed, S. (2020). Understanding and mapping digital literacy for students with disability. In P. Griffin & K. Woods (Eds.) *Understanding Students with Additional Needs as Learners*. Springer. https://doi.org/10.1007/978-3-030-56596-1_10

White, E. H. (August 16-20, 2021). Applying empirical learning progressions for a holistic approach to evidence-based education: SWANS/ABLES. *Research Conference 2021: Excellent progress for every student: Proceedings and program.* Australian Council for Educational Research. https://doi.org/10.37517/978-1-74286-638-3_6

Young, A., Clendon, S., & Doell, E. (2021). Exploring augmentative and alternative communication use through collaborative planning and peer modelling: a descriptive case-study. *International Journal of Inclusive Education,* 1–16. https://doi.org/10.1080/13603116.2020.1867383

Wissell, S., Karimi, L., Serry, T., Furlong, L., & Hudson, J. (2022). “You don’t look dyslexic”: Using the job demands—resource model of burnout to explore employment experiences of Australian adults with dyslexia. *International Journal of Environmental Research and Public Health, 19*(17), 10719. https://doi.org/10.3390/ijerph191710719

Wood, R., Crane, L., Happé, F., Morrison, A., & Moyse, R. (Eds.). (2022). *Learning from autistic teachers: How to be a neurodiversity-inclusive school*. Jessica Kingsley Publishers.

Zhou, Q. (2022). How does dyslexia influence academic achievement? *Proceedings of the 2022 2nd International Conference on Modern Educational Technology and Social Sciences (ICMETSS 2022),* 861–868. https://doi.org/10.2991/978-2-494069-45-9_104

POSTERA CRESCAM LAUDE

THE UNIVERSITY OF
MELBOURNE