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Contents

- 154 Editorial Comment
Angela J. Fawcett
- 158 Developmental Dyslexia—a useful concept?
John Stein
- 172 Investigating the Impact of the Preschool Intervention Programme on Struggling Learners
Shakthi Sathiasilan, Yiyao Weng and Angela J. Fawcett
- 194 Dyslexic Strengths in Times of Adversity
Thomas G. West
- 204 The effectiveness of reading, spelling and writing support for a large sample of school-aged children with Dyslexia: factors influencing efficacy.
Sharyfah Nur Fitrya
- 224 Parenting during COVID-19: Stress of Fathers with and without Children with Special Needs in Singapore
Eugene Lim Wen Jie and Heidi Chong
- 248 Effectiveness of Mobile Assistive Technology on Improving the Self-Perceptions of Students with Dyslexia in Singapore
Yee Ning Tan, Tharshini Lokanathan and W. Quin Yow
- 280 Dyslexia with language weaknesses: Recommendations to guide organisation-based efforts for school-going learners based on educational therapists' perspectives
Hani Zohra Muhamad and Hannah bte Shafiq Abdullah
- 310 UNITE SPLD 2022 Presentation Abstracts



Editorial Comment

Angela J. Fawcett, Editor-in-Chief

It is a very great pleasure to publish this issue of the Asia Pacific Journal of Developmental Differences, published by the Dyslexia Association of Singapore Limited, which is now in its 9th year of publication. In recognition of the broader manifestations of dyslexia now identified, and modifications in the criteria for diagnosis, DAS have extended their reach to include a wider range of developmental differences, including a range of co-morbidities and this is now clearly reflected in DAS revised mission. We continue to be grateful for the support of our scientific board of reviewers and the international editorial board drawn from both academics and professionals, to reflect the aims of the journal. This enables us to resolve any outstanding issues satisfactorily and ensures we continue to maintain the highest international standards of ethics and professionalism.

I am delighted to present a rich assembly of papers in this issue, published to coincide with DAS UNITE SpLD International conference 2022. Here we are able to draw on key international researchers in the area, whose keynote presentations were so well received by participants in UNITE SpLD 2021. An internationally recognised expert on visual aspects of dyslexia, Professor John Stein from Oxford University, presents an update on theoretical aspects of dyslexia, and how these relate to practice, in the first article on Developmental dyslexia – a useful concept? This addresses established and recent evidence of visual differences in processing in relation to understanding causative aspects of dyslexia, that are often overlooked in language-based research. This article sets the scene for a series of studies of dyslexia across the age range, evaluating the impact of COVID-19 on progress.

The second article, with authors Shakthi Sathiasilan and Yiyao Weng from DAS as well as myself, considers the impact of the DAS Preschool Intervention Programme (PELP) on struggling learners. In this study, the progress of a group of 'at risk' learners who undertook intervention, was compared with a control group who received a pre and post-test only, and normal preschool support, over a 20-week period. The PELP had previously been positively evaluated with a group of this type, but earlier studies had not included a control group. This design allowed the authors to successfully disentangle the impact of maturation from the process of remediation. The control group improved on spelling and sentence copying, but the intervention group showed significant gains in

phonogram knowledge, phonemic awareness, high frequency words, reading and spelling. This is an important study indicating that it is never too early to start providing systematic support towards improvement for children in this group.

COVID-19 has completely changed the lives of families across the world, and so it has become increasingly important to recognise the need for change under these circumstances. Access to learning has needed to move from face to face to online, creating the need for new methods of assistance in learning. An internationally acclaimed author, the leader of a Positive dyslexia movement in the USA, Thomas West, who proudly asserts the strengths of dyslexia, heads up this section which looks at differences in the way that dyslexics learn, and their outstanding potential in areas where others may struggle. In the next article in this section, an analysis of progress in the DAS Main Literacy Programme in the early days of COVID during 2020 is presented by Sharyfah Nur Fitriya from DAS. This large sample of 1280 children continued to make significant progress in reading, spelling and writing, so that despite the many changes from face to face to online teaching, the programme has remained effective.

Interestingly, a further analysis of a group of 1000 children drawn from Fitriya, 2021, (prior to COVID), identified key factors in success or failure for these children. These key factors included home resources, and the length of time and consistency of attendance, with strong implications drawn for learning in the changing education system post-COVID. Finally, in this section, an analysis of parenting during COVID from Eugene Lim Wen Jie and Heidi Chong, considered the heightened stress associated with supporting a child with special needs for fathers during this period. Based on a series of questionnaire studies, the authors identified significant issues for fathers of all children, with work-life balance the most significant for fathers of children with special needs, rather than the measure of financial stability and resilience which had an additional impact on fathers of neurotypical children. Interestingly, the highest stress was found for fathers of younger children with special needs during the COVID-19 pandemic.

In the next article, authors Yee Ning Tan, Tharshini Lokanathan and Quin Yow from Singapore University of Technology and Design, consider the impact of mobile assistive technology on the self-esteem of students with dyslexia. A sample of children from grades 2-6 were provided with Lexicaid, designed with support from dyslexia experts, to aid single word reading through the capacity to create flashcards, use text to speech scanning, access definitions, and highlight key words. Use was monitored at home over a period of 6 weeks, with questionnaires on motivation and self-esteem delivered at pre and post-test. Measures of reading and spelling themselves showed no significant impact of the support, although consistent improvements in literacy skill were found for the intervention group, but not the controls, whose performance remained fairly static over this period. However, significant changes in self perceptions of reading and spelling competence, as well as in motivation to read was found at post-test in the intervention group. There is considerable potential for further development of support of this type, which can allow struggling readers to gain a measure of independence, with a

longer period of support likely to produce a more significant impact on aspects of literacy itself. Nevertheless, simply improving the motivation to read and enhancing self-esteem can in itself lead to major gains over time.

Finally, an article from Hani Zohra Muhamad from DAS in conjunction with Hannah bte Shafiq Abdullah from Temasek Polytechnic. In this insightful qualitative study, the author uses a series of questionnaires and interviews to address the importance of language in the development of literacy in children with co-morbid language and literacy disorders. With the aim of creating a manual on teaching children with combined disorders, the study showed that some DAS educational therapists were not aware of this pattern of difficulties, and that whatever their background, educational therapists found it more difficult to support children with mixed disorders. Strategies used to support these children ranged from those successful in the classroom, to those designed for use outside. Overall recommendations included the need for additional training in these aspects of support, which will be addressed by the forthcoming manual.

To cap this interesting series of articles, this issue also includes the abstracts drawn from UNITE SpLD 2022 Conference.

Overall, I am sure you will agree that this issue of the APJDD presents a rich panoply of information for those involved in special needs, whether in terms of theory, practice, or both. It has been a great pleasure to review this interesting collection of articles, with their great depth and breadth of coverage of the area. I look forward to reading further articles from these authors, from both internationally established and future experts, with the continued development of their expertise over time. Don't forget to join us all for UNITE SpLD 2022, which will again be available for attendance on line, with an opportunity to engage with the speakers, and continued opportunities after the event to catch up on those sessions you have missed.

Angela J Fawcett
June 2022

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Developmental Dyslexia—a useful concept?

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Abstract

Until recently Developmental Dyslexia (DD) was diagnosed if a person's reading and spelling was far behind what would be expected on the basis of their oral and non-verbal skills and they had a family history of similar reading problems; it was thought to be due to a hereditary failure of the reading circuits to develop properly in the brain. However, now it is widely believed that DD is due to failure to grasp the fact that the letters in a word represent the sounds in that word- the so-called phonological theory. Since the basis of all reading is the phonological principle, DD cannot now be distinguished from the many other causes of reading failure, and its very existence is doubted by some. Nevertheless, there is growing evidence in favour of the idea that DD can be specifically identified as due to disordered development of magnocellular neurons in the brain. These cells are specialised for temporal processing. Therefore, magnocellular weakness causes poor timing of visual events, hence inaccurate sequencing of the letters and sounds in words, which impedes learning to read. This means that people with developmental dyslexia do not have a diseased brain, but simply a different brain. Indeed, in many ways this may actually be a superior brain. Impaired growth of magnocellular neurones during development probably leaves room for parvocellular neurones to grow more connections. These may impart a holistic, rather than a linear, sequential, cognitive style to people with DD, and this can confer on them a more fertile imagination, innovation, originality and creativity. These talents may explain why the gene variants promoting dyslexia have been retained in the human genome. Therefore, our educational systems need to nurture, not condemn, dyslexics. Society urgently needs their strengths to help us cope with our increasingly complex world.

Keywords: Developmental Dyslexia, reading problems, magnocellular weakness and parvocellular strengths

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INTRODUCTION

This article describes a view of dyslexia that derives from the author's experience as a neurophysiologist and neurologist interested in the visual guidance of attention and movement. It was a great honour to be asked to give a talk to the Dyslexia Association of Singapore. Singapore's educational system is widely regarded as one of the best in the World. Decades of generous State funding (<20% of the National Budget) for teachers, schools and the educational infrastructure has meant that for the last twenty years or so, the average 15 year old from Singapore has scored the highest marks of all the countries in the world in the triennial Programme for International Student Assessments (PISA, 2019).

The Singapore system has achieved this high standard by imposing a fairly rigid diet of rote learning facts derived from likely exam questions & regurgitating them accurately. For reading, this involves teaching systematic phonics from infancy onwards to every child. But paradoxically, just as many educationalists in the US & UK were beginning to wonder how they could emulate Singapore's success by teaching yet more systematic phonics to children (Guardian, 2022(2), at the same time in Singapore itself, some people were beginning to wonder whether bludgeoning every child with phonics in their 'one size fits all' programme was really the best way, because it seemed that this might be suppressing children's natural creativity. Many were beginning to argue that a more flexible system, capable of adapting to each child's individual learning style might be better, in particular to suit the needs of developmental dyslexics (DD).

DYSLEXIA DEFINITION

However, at the moment there is a great deal of confusion about what DD is or even whether it can truly be said to exist at all. Here therefore, we will outline how there is probably quite a simple neurological explanation of why some children have difficulty with learning to read despite normal or high oral and non-verbal abilities. We will also discuss why this condition is so common – why the gene variants that cause the condition may have survived in our genome by carrying compensating advantages. Forward thinking people in Singapore want to nurture these advantages by developing a more flexible Educational System, because Singapore, above almost all other nations, depends upon the ingenuity and creativity of her Human Capital for successful survival.

The word 'dyslexia' (in Greek literally, 'disordered words') was coined by Rudolf Berlin in 1884 to apply to the rare patients he studied in whom brain damage had caused selective loss of their ability to read, yet had left them with their previous speech and oral comprehension skills intact (Berlin, 1884). We would now call this 'acquired dyslexia'. 9 years later J. Pringle Morgan borrowed Berlin's idea to help explain why his 14 yr old patient, Percy, after 8 yrs of schooling, still could not even read his own name. His teacher claimed that he would be judged the brightest boy in the class, if the assessment

could be entirely oral. So Morgan suggested that he might have a hereditary version of Berlin's dyslexia, which he called 'congenital word blindness' (Morgan, 1896). We now call this 'developmental dyslexia' (DD) because it is now clear that it does not always have a visual basis. Morgan thought that the normal reading circuits in the left hemisphere had failed to develop properly in Percy - probably under genetic control.

For the next 75 years it was generally agreed that the key characteristic of developmental dyslexia was unexpectedly slow reading progress, despite normal speech and oral comprehension; ie it was thought to be caused by a specific neurological deficit that could be diagnosed by demonstrating a discrepancy between a dyslexic child's normal or high oral abilities, and her exceptionally poor reading.

THE PHONOLOGICAL THEORY

Around 1970 however the 'phonological theory' of dyslexia was introduced. This suggested that developmental dyslexia was mainly due to failure to learn and absorb the 'phonological principle' (Liberman et al., 1974). This is the principle that underlies all reading, namely that spoken words can be split into a series of elementary sounds, phonemes, which are represented by the letters in the printed word. It is clear that any child who fails to learn to read, has found it difficult to grasp the rules of how letters translate into sounds because this phonological principle is the basis of all reading.

However, this 'theory' of dyslexia is not really a theory at all in the sense of providing explanations; it is more of a tautology, merely repeating, using different words, that the children fail to learn the basic principle of reading. A proper theory should explain *why* things happen- why some children fail to learn this basic phonological principle.

Worse however, the theory has given rise to the mistaken belief that failure to absorb the phonological principle is the key feature of dyslexia. But since every child who fails to learn to read has failed to understand how letters translate into word sounds, such failure cannot specifically identify developmental dyslexia, since all the other children who find reading difficult for other reasons are also finding it hard to grasp the phonological principle. Hence this approach makes it impossible to distinguish developmental dyslexia from the numerous other possible causes of poor reading, such as low intelligence, poor teaching, truancy, social deprivation, or lack of family support.

DYSLEXIA CONFUSION

So today, the concept of dyslexia has become very confused and actually impossible to define clearly. Since it cannot now be clearly distinguished from any of the other causes of poor reading, some people believe that it cannot be said to exist at all, and that the whole concept should be abandoned (Elliott & Grigorenko, 2014). On the contrary however, others earn the scorn of the first group by arguing that dyslexia can be

identified as a positive brain difference, often leading to an unusually advantaged cognitive style that permeates the whole of life, involving the gamut of mental and physical health, education, intellect, culture, sport, social interactions and career success (West, 2009, Eide & Eide, 2011).

This article will basically support the second group, by briefly covering the consistent, strong and persuasive evidence that developmental dyslexia does indeed exist; that it can be easily identified; and that the brain differences it involves do indeed permeate the whole of life, and can carry with them significant positive advantages. Otherwise DD would not be so common.

Visual timing

The starting point for this account is the role of visual timing signals in the visual guidance of attention and movement. It is obvious that reading commences with the visual system - moving your eyes to see the letters and words in the right order. It does not start with their sounds or phonology. Learning that words consist of visual sequences of letters is the very first step in learning to read.

When children are first confronted with a printed word, they see it as a whole object, like a bug, or a mouse. You don't see a mouse as a whisker, then nose, then ears, then body, then tail, but as a whole mouse. Hence the first thing children have to do when beginning to learn to read is to grasp that written words actually consist of a sequence of letters which they have to learn to identify in the right order. This visual sequencing involves timing when the eyes or visual attention alight on the first letter of the word, identifying it, then timing when the eyes move on to the next letter, identifying that and so on.

Visual primes Auditory sequencing

It has been clearly demonstrated that it is only when children have learnt to properly sequence the letters in a word visually, do they begin to grasp that the spoken version of the word can also be split down into a corresponding sequence of separate sounds, phonemes (Morais et al., 1979). Thus learning to see a word as a sequence of letters primes children to learn to disassemble its spoken form into its sequence of phonemes. Only then can they grasp the phonological principle. Seeing the letters properly in the right sequence comes first. Thus visual sequencing is the initial step in learning to read, and it primes phonological analysis, and together these processes build up a background understanding of how each spoken word is formed of a sequence of separate sounds (the phonological principle).

Visual Magnocellular Neurons

This timing and sequencing is known to be carried out by a specialised set of timing neurons in the visual processing system, known as the visual magnocellular system (Merigan & Mounsell, 1993). This starts with large ganglion cells in the retina at the back of the eye, the magnocellular cells (*magnus* = large in Latin). These rapidly translate light detected by the rod and cone light receptors into nervous impulses that are sent up large fibres in the optic nerve, back to the brain. These large neurons form only 10% of all the ganglion cells in the eye. But they are specialized for timing when things happen. They are up to 50 times larger in area than the parvo (P- small) cells. So they cannot detect small details, like the difference between a small 'a' and an 'o'. But they do time events very rapidly and precisely. For instance, in the word dog, they time when the eyes look at the O, after the D. So they enable you to remember that the O came after the D. Thus, they play a crucial role in enabling you to sequence the letters in a word in the right order.

On the other hand, the majority of ganglion cells in the retina (90%) are small parvocells (L. *parvus*=small) which detect the detail you need to distinguish and identify the letters. The M- cells guide your eye movements to the right location, and they instruct the P- cells to identify what the letter is at that location.

Impaired development of M- cells

But because M cells are large, they need more upkeep, and so they are very vulnerable to drugs and damage. It has been shown convincingly that their development is impaired in many neurodevelopmental conditions such as dyslexia, dyspraxia, ADHD, and autism. In dyslexia, the evidence is now overwhelming, that the M- cells are abnormal (Meillleur et al., 2020, Benito-Kwiecinski et al., 2021). Here there is only space to give a few examples. But the amount of evidence in favour of the M- hypothesis grows literally every day. So it is baffling that most of it is completely ignored whilst the phonological theory of dyslexia still dominates completely.

Some of the most convincing evidence for impaired development of visual magnocells in dyslexia was first uncovered by Livingstone & Galaburda over 30 yrs ago (Livingstone et al., 1991). They studied the brains of dyslexic people who had been patients of the celebrated dyslexia neurologist, Samuel Orton, in the 1930s. He had persuaded them to bequeath their brains to the Orton brain bank, now at Harvard University. Galaburda's detailed histological study of the magnocellular layers of the thalamic visual lateral geniculate nucleus (LGN) in these brains showed that their M-cells were, on average, 30% smaller than in an ordinary control brain. Also, these cells spilled over into the Parvo layers so that there was no longer a clear space between the M- and P- layers, unlike in ordinary brains.

Nowadays, we do not have to wait for people to die before we can look at their brains with sufficient resolution. Using powerful magnetic resonance imaging (MRI) with a 7 Tesla magnet, Giraldo-Chica and colleagues were able to measure the thickness of the visual M cell layers in the LGN in living people with dyslexia (Giraldo-Chica, Hegarty & Schneider, 2015). And this has confirmed, so far in nearly 20 dyslexics, that they have significantly thinner LGN m- cell layers, particularly on the left side.

Visual reading problems

Earlier it was mentioned how reading starts with seeing letters properly in the right order. Many dyslexic children complain of visual problems when they try to read. These odd perceptions of letters moving around, changing places, blurring, splitting into two etc. seem to be the result of their impaired M- cell function. This is because the M cells control the movements of the eyes and attention when reading. If they are not working properly, the eyes wander out of control, like if you were drunk and things look blurry and in motion; this is called oscillopsia. (Maybe that's never a problem in Singapore!)

Interventions to improve M- function

The best way of demonstrating cause and effect is by Intervention. If you can show that a treatment that improves M- cell function in dyslexics helps them to improve their reading, this is strong evidence that M- activity plays a causal role in reading development. That these interventions are so successful attest to the crucial role of M- cell timing for learning to read and they provide strong evidence in favour of the visual magnocellular contribution to dyslexia. Here there is room for only a few examples, but there are many more that could be mentioned.

First, the most 'physiological' intervention would be to directly train M cells to respond better to moving stimuli and see whether this helps children with their reading. Terry Lawton has carried out numerous studies confirming this. She trains dyslexic children to detect low contrast moving stripes on a stationary striped background, and uses a computer programme that iteratively reduces the contrast as they improve, thus training the M- cells to get even better at it. As well as greatly improving M- cell sensitivity, this significantly accelerates their reading progress (Lawton & Stein, 2022).

Action video games

Another popular way of improving visual timing is to encourage children to play action video games – ie. games in which the child has to actively track targets. In general these have been clearly shown to improve the speed and accuracy of the direction of visual attention (Bevalier & Davidson, 2013). In a recent metanalysis of their effects in dyslexic children it was found that a commonly available action video game, not involving any reading at all, increased their reading rate and fluency and that these gains lasted for at

least 2 months and also accumulated if the games were continued (Peters et al., 2019). Visuo-attentional interventions are therefore highly effective in helping dyslexic children's reading, even though they do not involve any reading or phonics at all. They can help the children to improve their reading usually as much or more than other strategies most of which need much more teacher time and expense, and they are probably effective for all orthographies, since they don't involve reading a script.

Yellow filters

Although M- cells do not contribute to seeing colour, nevertheless, because they mainly receive from both red and green retinal cone receptors, they are most strongly stimulated by a combination of red and green light, which is yellow. Therefore, another completely different approach to improving M- cell timing function is to ask dyslexics to view text through 'Unique Yellow' filters. (They are called unique because almost everybody (even those with anomalous colour vision – slightly colour blind) agrees that the yellow is pure, neither greenish or reddish. Also they match the mix of wavelengths supplied by maximal sunlight at midday in the summer). Thus our yellow filters pass precisely the right mix of red and green light to stimulate M- cells maximally.

After just three months wearing these unique yellow filters, the dyslexics' magnocellular function improved very significantly: their visual motion sensitivity, contrast sensitivity and vergence control improved, hence their reading progress almost doubled, whereas control dyslexics, receiving just dark glasses limiting wavelengths across the whole spectrum, progressed by only one month in the three months, ie they went backwards, which is often the case with dyslexics who receive no special help (Ray, Fowler & Stein, 2005).

Blue filters

Another group of dyslexics benefit from viewing text through the opposite colour, 'unique blue' filters. These pass most light at 475 nanometres, - Oxford blue! These children advanced their reading by 13 months in the three months, whereas those receiving the placebo dark glasses went backwards again (Clisby et al., 2000).

Unique blue filters probably work via the brain's internal clock in the suprachiasmatic nucleus in the hypothalamus. This clock needs to be synchronized with changing day length between winter and summer. At sunrise the first rays of sun light in the morning are blue, and they are detected by special retinal ganglion cells which contain the blue sensitive pigment, melanopsin (Spitschan, 2019). These project to the hypothalamus and activate the M- timing cells via the 'blue nucleus', the locus coeruleus. So blue increases arousal and the children's ability to concentrate, and this is probably how it helps them to improve their reading so greatly.

Thus these treatment interventions that target the magnocellular timing systems are all successful in helping dyslexics to learn to read. Hence these examples add to the mounting evidence that impaired M- cell development is an important contributor to dyslexic people's reading problems.

Omega 3 DHA

Moving to an example of a slightly more speculative intervention, this concerns the brain's nutrition. As mentioned earlier, M- cells are highly vulnerable to drugs, disease and poor nutrition. The nutrient to which they are most sensitive to lacking in the diet, is the omega 3 long chain polyunsaturated fatty acid, (DHA), docosahexaenoic acid. This is because DHA is an essential component of the membranes of all nerve cells, as it provides just the correct physico-chemical environment for nerve cells' electrical activity (Crawford et al., 2013). Because M- cells are large, they contain more DHA than do smaller cells. So lack of DHA in the diet is a particular danger for them. Our main source of DHA is oily fish, and worldwide consumption of oily fish is decreasing, though less so in Singapore, maybe, than in the UK.

Many children with dyslexia in the UK come from highly disadvantaged backgrounds and we found that they had very low levels of DHA in their red cells, suggesting that they had not consumed enough throughout their lives. We therefore decided to see whether improving the nutrient content of their diets by giving them supplements of fish oil omega 3s might help them to improve their M- cell function, hence their reading. Indeed it did! In a randomised control trial (RCT), compared with similar children who received placebo supplement capsules, those who received the omega 3s improved their M- cell sensitivity, improved their concentration and greatly accelerated their reading progress (Richardson & Montgomery, 2005).

DEVELOPMENTAL DYSLEXIA DOES EXIST

What has been demonstrated so far in this article is that developmental dyslexia does indeed exist, contrary to the nay-sayers. There is now a great deal of evidence that backward reading in otherwise intelligent children is at least partly caused by impaired development of the brain's magnocellular timing systems, which are essential for sequencing letters and sounds properly. Part of this evidence is the often dramatic effectiveness of such apparently crazy treatments as video games, yellow, or blue filters, or omega threes in helping people with dyslexia to improve their reading skills.

The advantages of dyslexia

However, you might well ask, do we really want to fix dyslexics' timing weaknesses when those weaknesses can often be accompanied by such great talents. Everybody has their favourite list of famously successful dyslexics, such as Leonardo da Vinci, Rodin, Picasso,

Churchill, Einstein, and Edison. Might improving their reading have eliminated their exceptional talents?

There is no doubt that some dyslexics are prodigiously talented in areas other than reading. Dyslexia is 4x commoner in London art students than in the general population (Everatt, Steffert & Smythe, 1999). Likewise Lundberg & Wolf found that it is 10x commoner in Swedish art students than in other University students (Wolff & Lundberg, 2002). But these talents are not just confined to the arts. Dyslexia is also much commoner amongst entrepreneurs; being 35x commoner among entrepreneurial millionaires than among their managers! (Logan, 2008). And they are twice as likely to own two or more businesses.

It is often argued that dyslexics develop such talents only because they had to work so hard to find ways of avoiding reading. So it is claimed that they tend to choose art or architecture, practical engineering, computing or politics because none of these require much reading. But this argument is not very convincing. Actually nowadays all those professions do demand a great deal of reading. Furthermore, simply avoiding reading doesn't explain why so many dyslexics are so exceptionally successful at these professions.

Balanced Polymorphism

When a gene variant, ostensibly disadvantaging, is nevertheless common in the human genome, it is likely that it has confers some hidden compensating advantage, in a so called 'balanced polymorphism'. The classic example of this is Sickle Cell Anaemia (Weaver & Hedrick, 1992). If you inherit 2 copies of the sickling gene ('a'), all your red blood cells become thin and sickle shaped and so they clump together, sludge, damage and block your small blood vessels and cause severe anaemia and death quite quickly. However, if you inherit just one copy, only half your red cells sickle and these are much more resistant than normal, to the malaria parasite. The parasite cannot get into the sickled cells, hence you are more likely to survive into adulthood and pass on that gene to your children. Hence the 'a' recessive gene sickling variant survives in our genome as a defence against malaria.

Analogously, the same genes that contribute to dyslexia, may make people inherently more likely to become good artists etc. because the genes endow upon them unusual talents that enable them to flourish in these professions. Furthermore, learning to read was only invented c. 5000 years ago, and it has only become crucial in the last hundred years or so for most people; this is much too short a time for these genes to have been removed by natural selection for reading.

Dyslexia Talents

Because most of the emphasis in dyslexia research has been upon on the deficits that lead to reading failure, there have been comparatively few studies looking for possible compensating advantages that might have been conferred by a genetic balanced polymorphism. Usually the advantages have been discovered only as an unexpected by product of studies searching for deficits. One of the very first was in 1982, that of Lovegrove and colleagues (Lovegrove et al., 1982) who showed that, although dyslexics had lower contrast sensitivity to coarse gratings (spatial frequency (SF) = 2 Hz), to which mainly the M-cells are sensitive, they were actually a great deal more sensitive (400x so) to fine gratings (SF = 16 Hz). Only parvo cells respond at these high spatial frequencies, so this suggests that parvo cells are more richly connected in people with dyslexia.

Parvocellular advantage

This parvo advantage may be a result of their M- cell deficit. 90% of all the neurons that are born in the last three months of pregnancy are eliminated in the first few months of infancy, because they fail to make useful connections – ‘use it or lose it’ runs the adage. Magnocellular neurones in dyslexics start with the disadvantage of being smaller than normal, so that in this ruthless competition, their main competitors, parvo cells, can proliferate even more than is usual in ordinary brains. Anyway, in all brains parvo cells make much more branching and extensive connections with each other than do magno cells (Kravitz et al., 2012). So, in dyslexics the parvo cell networks probably end up, after the first few months of infancy, being considerably more interconnected than in ordinary brains.

This parvo superiority in people with dyslexia has been found to manifest itself by their having much higher sensitivity than in ordinary people both to the fine details that distinguish one letter from another (Geiger & Lettvin, 1987) and also for discriminating colours (Dautrich, 1993). But this difference is found, not at the centre of gaze (the fovea), but in peripheral vision where ordinary brains have very poor sensitivity to fine detail and virtually no colour vision at all, because normally there are very few parvocells this far out from the fovea. We confirmed these findings by demonstrating that the EEG potentials evoked in dyslexics by fine gratings (SF = 16 Hz) filling the whole visual field, are larger in dyslexics than in ordinary readers (Stein, 2021). Taken together all these results support the conclusion that the impaired development of the visual magnocellular system in people with dyslexia is accompanied by superior connectivity of their parvocellular visual networks.

This means that they can detect small details (high spatial frequencies) and small colour differences, particularly away from the centre of gaze, better than ordinary readers can. This difference probably explains why they like to think in pictures visually rather than with words (West, 1991). Due to their superior peripheral detail vision they can pick up

features that ordinary readers take longer to find and may miss altogether. But this does not imply that they have overall visuospatial superiority; it is only found when peripheral detail is required quickly.

This wider field of vision for detail manifests itself in their performance at detecting 'impossible figures' - whether drawings represent real objects, or ones that could not exist in reality, such as Penrose's triangle, Schuster's trident or M.C. Escher's impossible waterfalls. Most people have to shift fixation from one end of the picture to the other in order to detect their impossibility, but many dyslexic people can see the drawing all at once, hence to spot their inconsistencies more rapidly. So they are much faster at deciding whether they are impossible (von Karolyi & Winner, 2004).

Holistic thinking

This visual superiority endowed by their increased parvocellular connectivity, means that the way people with dyslexia tend to think is 'holistic' - seeing the big picture all at once. So they can see problems as if from a helicopter, flying above the forest of problems, and spotting solutions, rather than working sequentially from the roots. Likewise, this enables them to create a complete mental picture from separate pieces, by quickly seeing how they all fit together. Thus they can often see more easily than ordinary brains how the flat 2 dimensional plans of a building would look in 3 dimensions when built; this is why the architect, Richard Rodgers, himself a dyslexic, preferred to employ only dyslexics in his drawing office.

These exceptional characteristics are not confined to vision, but extend to mentation and abstraction. Thus, people with dyslexia often seem to have more vivid imaginations with a stronger tendency to daydream, all suggesting a superior ability to harness the brain's ability to alter and create new perceptions. They are said to be more curious about how things work, more insightful and intuitive, more highly aware of their environment with a heightened awareness of everything. They seem to have this uncanny ability to see patterns, both literally and also in data or ideas, to fill in their missing parts and to see what doesn't fit in. All these characteristics clearly contribute to their heightened artistic talents, innovation and general creativity.

None of these talents and traits can be easily studied scientifically however, because they depend so much on very subjective judgements which are not readily evaluated objectively. Here it is argued that the superior parvocellular connectivity of people with dyslexia is what explains how they develop this different way of thinking from ordinary brains. This holistic style contrasts with the more common linear, step by step, sequential thought processes of ordinary brains. So if a dyslexic survives school s/he is often very successful in life. But most schooling enforces a 'one size fits all' linear analytic programme, which is totally inappropriate for the dyslexic learning style and may harm

them for life. This appears to be what Singapore seems to be realising now and is taking steps to correct.

Exploration v. exploitation

The gene variants underlying the development of this holistic cognitive style have probably survived in our genome because in the search for optimum approaches to problems, they promote 'exploration' of new possibilities rather than sticking with 'tried and trusted' behaviour that works in predictable situations but may not be appropriate when circumstances change. As Helen Taylor points out, successful cooperation in groups depends on most people being 'exploitative', exploiting strategies that have worked well in the past, but a minority of about 10% should be more explorative - suggesting new approaches to new problems (Taylor, Fernandes & Wraight, 2022). Without these creative thinkers the chances of finding innovative solutions to new problems would be greatly diminished. Note that this has nothing to do with reading, and probably the selective pressure towards these proportions predates reading by several million years.

Note also that since humans are unique in being able to think using abstract symbols (Deacon, 2007), the dyslexic cognitive style advantages us not only in the search for solutions to practical problems, such as finding food, but also for thinking - searching in 'abstract space' for solutions to abstract cognitive problems that are often represented using symbols such as in language or mathematics. This generalisation of holistic thinking into such abstract meta-analysis is what underlies the general creativity and innovation for which the dyslexic mind is so famous.

It allows people with dyslexia to fully utilise all aspects of their individuality (perception, intellect, emotions, imagination, experience, actions and skills,) to achieve a more comprehensive and effective understanding of most situations and problems, than can ordinary brains. They are often able to understand complex systems faster and more completely than most people. Their holistic cognitive style enables them to grasp the many different types of relationships between the many elements in a system, and to discern any pattern within it, together with any missing pieces; and thus to spot crucial errors quickly. In particular, this explains their often remarkable 'people skills' - rapidly integrating all they know, all they've experienced and heard about a person to form an unusually accurate judgement - 'reading' a person's character. Even if these descriptions are only true of a minority of dyslexics, we should ensure that our educational systems do not stifle the development of such talents, as Society needs them urgently.

CONCLUSIONS

Due to the current dominance of the phonological theory as to its cause, there is currently no agreement about what Developmental Dyslexia is, or even whether it really

exists. Nevertheless, there is growing evidence in favour of the idea that it is due to disordered development of temporal processing by the brain, because the magnocellular neuronal systems which are responsible for timing, fail to develop properly. This magnocellular weakness leads to poor linear sequencing of the letters and sounds in words which impedes learning to read. This means that people with developmental dyslexia do not have diseased, but simply different, brains. Indeed, in many ways they may actually be superior brains. This is because impaired growth of magnocellular neurones during development may allow parvocellular neurones to flourish more, and grow more connections, which imparts a holistic, rather than a linear, sequential, cognitive style to DD. This confers greater imagination, innovation, originality and creativity and explains why the gene variants promoting dyslexia have been retained in the human genome. Therefore, we need to nurture, not disparage, dyslexics. Society needs them urgently to help us cope with our increasingly complex world.

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Investigating the Impact of the Preschool Intervention Programme on Struggling Learners

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Abstract

Previous research has shown that a Preschool Intervention Programme (PELP) designed and delivered in Singapore based on Orton Gillingham small group support led to significant improvements in early literacy with large effect sizes (Sim et al., 2015). However, it was unclear how much of this improvement was the result of maturation over time, because this earlier study did not include controls. Moreover, it was not clear whether or not satisfactory gains could be achieved with a shorter targeted programme. In order to address this, a controlled short-term study with a repeated measures design investigated the impact of this Programme on children who had been identified as struggling in the early years environment.. Participants (14 control group and 13 intervention group) completed a pre assessment battery followed by post assessment 10 weeks later. The intervention group underwent 20 hours of early literacy intervention over 10 weeks focusing on key aspects of early literacy, while the control group did not attend any form of intervention apart from normal kindergarten attendance. The results indicated that the experimental group outperformed the control group in phonogram knowledge, phonemic awareness, high frequency words, reading and spelling. The control group made significant improvements in spelling and sentence copying only, with all other measures largely unchanged over time. The implications of this study are that we cannot rely on the process of maturation to improve the skills of preschool children who are not keeping pace with their peers, and without explicit intervention they will continue to fall further behind and struggle with ongoing learning. Directions for policy and practice will be considered.

Keywords: intervention, phonics, literacy, controlled

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INTRODUCTION

Research from many countries worldwide has shown that the early years can be critical for children's progress in literacy and learning, with those struggling at this stage continuing to show impaired performance over many years. The development of emergent literacy skills will influence the development of conventional literacy skills. There has been some debate about what comprises emergent literacy, and a recognition that for some children explicit teaching will be needed in order to progress. These issues can be particularly important where children are learning to read bilingually, as they are in Singapore.

LITERATURE REVIEW

Emergent literacy skills are critical for a child's academic success in his formal school years (Lonigan et al., 2013). These include a clear developmental progression from spoken to written language, including alphabet knowledge, linking the phoneme to the grapheme, and phonological awareness including such elements as rhyming and segmentation. This, then provides the foundation and prepares the ground for early reading and spelling. Failure to grasp these early elements of literacy, has a long-term impact on progress, because as the struggling learner strives to catch up with their peers, the rest of the class are developing skills without them. This means that a struggling preschool learner with poor emergent literacy will require intervention to catch up with typically achieving peers.

Research has demonstrated that poor readers, for example will continue to show impaired performance up to 10th grade and beyond (Protopapas et al., 2011; Sparks et al., 2014), based on the Matthew effect originally identified by Stanovich in 1986, and confirmed in recent longitudinal models (Sullivan et al, 2017). Moreover, the older the child is, the longer and more intense intervention he will need, due to the cumulative effect of the skills the child has missed (Torgesen 2001). Learners with poor early literacy skills attained poorer academic achievements compared to their peers with competent early literacy skills (Dennis and Horn 2011). Receiving intervention earlier reduces the literacy gap, thus decreasing the likelihood for the learner to develop severe reading difficulties (See & Koay 2014).

A recognition that early intervention can be effective has inspired a wide range of approaches internationally over the last 40 years. Inevitably there have been clashes between advocates of the whole word approach to learning and advocates of phonology culminating in the reading wars in the USA (Adams, 90). Reading Recover in New Zealand (Clay, 1985) has been amongst the most widely used, focusing on the lowest 20% of achievement. However, there has been criticism from Tunmer and colleagues (2013) of the cost effectiveness of Reading Recovery, based on the moderate impact of the approach and failure to complete the intensive 1 to 1 tuition for 30-40% of

participants. Moreover, initially the programme failed to include important findings coming through on the role of phonological awareness, for example rhyming (Bradley and Bryant, 1983). A consensus has now emerged that phonics training is one of the most important early reading skills, although more recently it has been recognised that a combination of phonics and letter recognition is key (Schneider, Roth and Ennemoser, 2000). A comprehensive recent analysis, (Suggate, 2016) found that most systematic controlled interventions had a positive effect, particularly if they were in addition to mainstream teaching.

A recent major study in Ohio, USA, the Dyslexia Pilot Project (Morrison et al., 2020) examined the impact of a multi-tiered literacy intervention based on universal screening and evidence based literacy support matched to individual levels of need. The impact of this type of support has led to the US Response to Intervention initiative (see for example, Vellutino et al., 2008), which evaluated a range of small group interventions. These included Orton Gillingham approaches delivered for 120-160 minutes spread over 4 days each week, delivered by over 200 teachers across a range of schools, with progress monitored by use of DIBELS (Good and Kaminski, 2002), at pre and post-test. The positive results, with a decrease in students achieving below the norm for their age indicated no need to move towards further intensive individual support, following this small group support. Moreover, the 58-74% of children performing at or above grade level by grade 2 persisted at follow-up indicating lasting improvement.

Early literacy intervention for struggling learners has been found to be effective at an earlier age than previously considered, from the age of 4 years old onwards. Struggling learners between 5 and 7 years old required intensive intervention over a 10 week period to catch up with their peers (Nicolson et al., 1999; Nicolson et al., 2000). Interestingly, these two studies from Nicolson and colleagues produced some of the largest effect sizes found in the literature (Brooks, 2007). A recent study (Fawcett and Jones, 2019) was undertaken with over 600 reception class children in Wales in the UK. These children were screened using the Dyslexia Early screening test (Nicolson and Fawcett, 2004), at the age of 4.5-5 years old. The study found that children at risk of failure made significant improvement following 12 weeks intervention for 1 hour weekly. Moreover, 86.6% showed no risk following a 12 week intervention targeting phonological processing and visual and auditory memory, delivered over 12 hours. By contrast, at 8 years old, struggling learners who have never received any form of intervention would require up to 67.5 hours of intensive individual literacy support to bridge the literacy gap between them and their peers (Torgesen, 2001).

Many of these children will be at risk for diagnosis of dyslexia, and without support at home and school may struggle to succeed. More importantly, early literacy difficulties that were not identified and addressed would continue to persist into adulthood, impacting on both academic success and self-esteem.

THE STUDY CONTEXT - THE SINGAPOREAN BACKGROUND.

Moving to the current study, in Singapore, English is the main medium of instruction in school. In addition Primary 1, children are expected to be equipped with basic English literacy skills. According to the Nurturing Early Learners Framework, this includes reading high frequency words, spelling and writing short sentences (Ministry of Education 2018) hence, learners with poor early literacy skills will not have met the prerequisites needed for success in formal school, placing them at an immediate disadvantage. Although English is the language of instruction in Singapore, the country officially recognises 4 official languages (English, Chinese, Malay and Tamil) with children being exposed to a second language from birth, in kindergarten or part of compulsory education at the age of 7 (Dixon, 2011; Sun, 2019). Second language acquisition literature generally indicates native language skills to be an important predictor of second language proficiency (Borodkin & Faust, 2014). As struggling learners show difficulties in phonological processing (Elbro et al., 2012), this affects their ability to acquire both of the languages they are expected to be able to read and write in. Learners who lack exposure to the English language at home and have poor attendance in school are further handicapped in their learning, given their weak command of English. Children starting school in Singapore will be drawn from a range of backgrounds, including Chinese, Indian and Malay origins, and their experience of English prior to starting their education will be mixed. Recent longitudinal research, (Hjetland et al., 2019) has demonstrated two independent routes through from pre-school to literacy, one based on code-related skills, (letter knowledge and phonological awareness) and the other based on pre-school spoken vocabulary and listening skills. This suggests that there may be particularly intractable problems for children who show difficulties with both routes to success. A number of recent papers have identified the potential problems for children who are learning in school in English, when their home language differs from the language of instruction. A recent study, for example, from Chen and colleagues, (Chen et al., 2020), on the prevalence of disability in pre-school children in Taiwan, showed that speech and language delay or disorder was the predominant issue for over 42% of disabled children identified from the a larger sample of over 3000 pre-schoolers. Moreover, models have shown that when there are delays in either or both the home language and the language of instruction, there are likely to be delays in the acquisition of literacy, (Lonigan et al., 2018). This suggests that it is even more critically important that problems are identified early and support provided in a bilingual society, in order to prevent children falling behind in their literacy, despite catching up with their peers in oral language. While most Singaporean children are bilingual, English is the language of instruction in mainstream schools. All subjects are taught in English. Students learn a second language weekly in a limited classroom capacity (Sun et al, 2018). As this study focuses on English literacy skills, all students recruited in this study were native English language speakers,

DAS Early Literacy Intervention Programme

Earlier research has demonstrated that it is possible to successfully identify and support struggling preschool learners in Singapore (See & Koay, 2014, Sim et al, 2015). The Dyslexia Association of Singapore has been offering the Preschool Early Literacy Programme (PELP) since 2006. The programme has since reached out to more than 1100 struggling learners (Wong & Sathiasilan 2018). The programme caters to 5 and 6 years old Kindergarteners 1, 2 and K2 (Repeat) learners with literacy difficulties or developmental delay in early literacy. The programme provides a 2 hours weekly intervention class outside of regular school hours to struggling learners. It runs with a small class ratio of 1 Educational Therapist with up to 5 struggling learners. The learners are grouped according to their ability. The curriculum is guided by Orton-Gillingham principles and early childhood pedagogy. Components covered within a typical PELP classroom include: alphabet knowledge, letter formation, phonogram knowledge, phonological awareness, high-frequency words, shared reading, early writing and comprehension skills.

The Intervention Approach – Literature review

The Orton-Gillingham (OG) is an effective instructional approach used to teach individuals with literacy difficulties. The OG approach is language based and is taught systematically, sequentially and cumulatively. It moves from simple to complex language skills to help struggling learners acquire mastery and automaticity through cumulative learning to reinforce learned information. It is also prescriptive and diagnostic as teachers assess learners' abilities and customise lessons to meet their needs (Rose & Zirkel 2007). In Singapore, OG-based intervention programmes have been found to improve word recognition, word expression, reading and spelling of learners between the age of 6 to 14 years (Lim & Oei 2015). In addition, Lim and Oei (2015) found early intervention was associated with better intervention outcomes in both reading and spelling among Singaporean struggling preschool learners. Meta-analyses on early literacy intervention have demonstrated intervention effect sizes are greatest in preschool (Wanzek et. al. 2018).

OG-based early literacy intervention often incorporates phonics in its curriculum. A meta-analysis by the National Reading Panel (2000) found struggling learners require explicit and systematic instructions in phonics. Literacy interventions have to be implemented with a broad literacy curriculum that focuses on teaching phonics and phonological awareness, letter-sound correspondence, fluency, vocabulary, comprehension and writing. Moreover, it is important to incorporate listening, speaking, and vocabulary building to know what the word means during reading (Foorman et al., 2015). Programmes that incorporate these components will maximise their effectiveness in remediating struggling learners. In line with research-based findings, the components covered in PELP's curriculum include alphabet knowledge, letter formation, letter-sound

correspondence, phonological awareness, learnt words, shared reading, early writing and spelling.

Study purpose

The PELP programme has previously been found to improve children's early literacy skills. Sim, et al., (2015) found significant differences in a sample of 56 students who averaged 48.7 hours of intervention with large effect sizes. Interestingly, Sim et al (2015) noted that effect sizes of this magnitude were found in only 32% of the programmes evaluated by the National Reading Panel. Similarly Wong and Sathiasilan (2018) also found that in a sample of 294 students with a wide range of intervention hours (average 62 hours) significant improvements were found in all tested areas of early literacy with large effect sizes. However, both studies were unable to establish if students would show marked improvements over a shorter period of time. It was also unclear how much of these improvements were facilitated over time by their attendance of kindergarten and the natural processes of maturation. In order to remove extraneous variable such as literacy knowledge gained in kindergarten and maturation effect, a controlled study with a repeated measures design was undertaken to assess the impact of PELP intervention on struggling learners.

Research design

This investigative study uses a quantitative approach to measure participants' pre-post test scores on measures of their early literacy, with an intervention group and a control group. The study design is represented in figure 1.

It is important to note that all the participants continued to participate throughout the study, with no changes in the participant groups from pre to post-test, ensuring continuity in the study.

Research question and hypothesis

This research aims to investigate the impact of the DAS Preschool Early Literacy Programme (PELP), an early literacy intervention programme for 5 to 7 year olds struggling learners in Singapore. The research questions were:

1. Was the PELP intervention approach effective in significantly helping kindergarteners improve on their early literacy learning outcomes?
2. When compared with similar peers who only attend kindergarten, will children attending PELP significantly outperform them in early literacy outcomes, indicating an additive effect over and above the process of maturation?

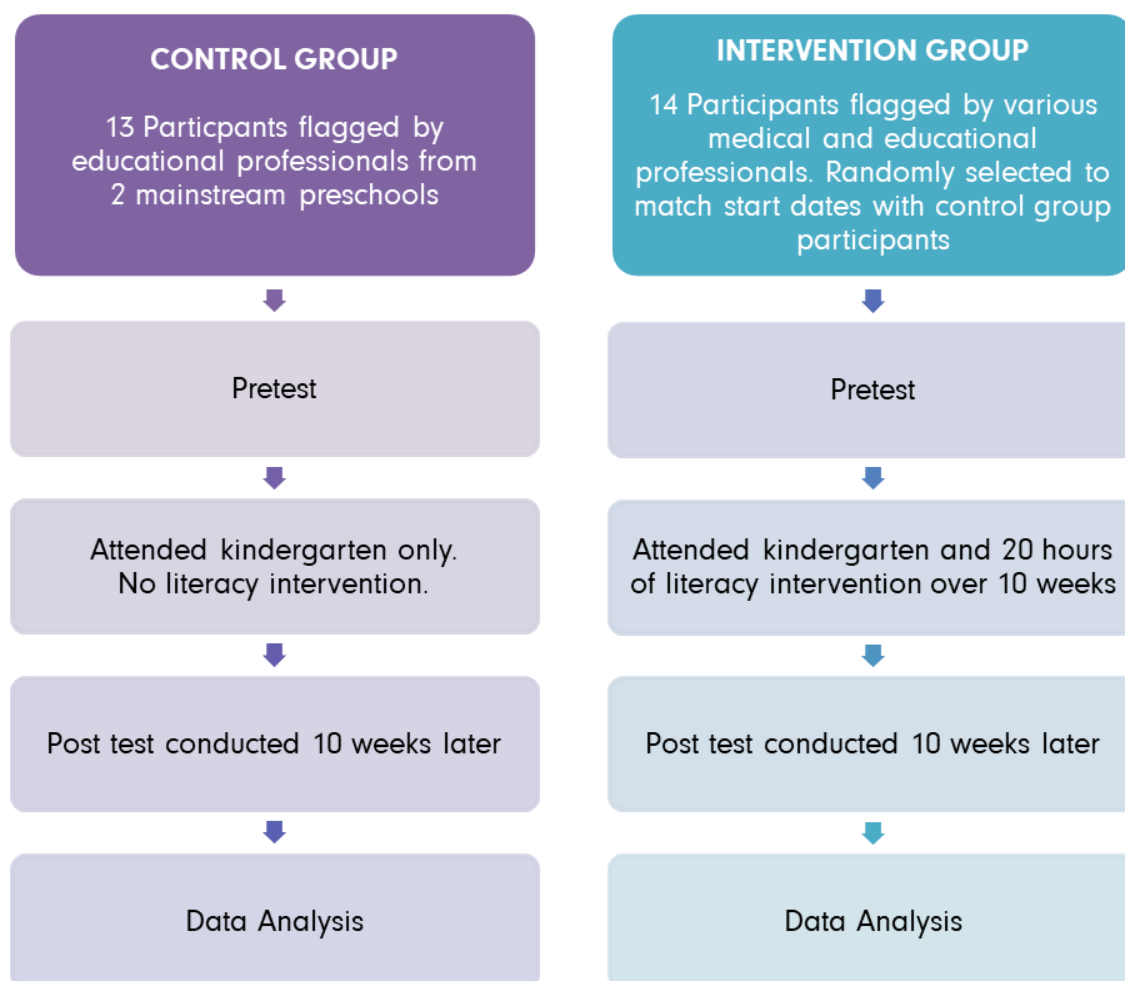


Figure 1. The research design

METHOD

Participants

Data was collected from 27 learners (18 male, 9 female) from Kindergarten 1 and 2 students.

The control group consisted of 14 students (8 male, 6 female). 11 were from Kindergarten 1 and 3 from Kindergarten 2 (Mean age = 5.36, $SD=0.48$). The students were attending school in two regular mainstream kindergartens and were not attending any other phonics based interventions or enrichment classes. They were selected by their teachers on the basis of their ongoing difficulties in the early stages of literacy. These teachers

had attended talks by the Dyslexia Association of Singapore on what to look out for in preschool struggling learners and were well acquainted in identifying struggling learners and referred students yearly for literacy intervention. The control group consisted of children who had been flagged by their teachers as being struggling learners who were not attending other forms of intervention. These children had previously been identified as children who would benefit for the PELP Programme whose parents had declined to join. The control group participants came from two mainstream kindergartens that the PELP programme offers in-house intervention support for after school hours.

The intervention group consisted of 13 students (10 male, 3 female). 11 were from Kindergarten 2 and 2 students were Kindergarten 2 (Repeat) (Mean age =5.67,SD=0.43). These students had been referred for literacy intervention by professionals such as hospitals (pediatricians, psychologists ,educational therapists) or mainstream preschool teachers who noticed that these students displayed significant struggles in learning. Struggling learners in the intervention group attended 20 hours of intervention (2 hours weekly over 10 weeks). Depending on their literacy gap, early literacy interventions were planned and carried out using OG principals guided by early childhood pedagogy. Students from the intervention group were randomly selected from four different centres based on their start date to ensure their data would be collected at approximately the same time as the control group participants.

Ethics permission

Ethics permission for the study was obtained from the research committee of the Dyslexia Association of Singapore.

Procedure

Control group. Information sheets and consent forms were disseminated to the kindergarten parents of the schools that agreed to participate in the study. In order to participate, students must not be attending other intervention programmes or enrichment classes. Parents were informed that they could withdraw their children from the study at any time and all participant details would be anonymised. Anticipating that there might be difficulties in getting mainstream kindergarten parents to agree to allow their children to participate in the control group study, some incentives were introduced. For their participation they were given a 20 dollar voucher upon completion of the study, as well as an individualised update from the authors at the conclusion of the study to inform them of their child's literacy strengths and weaknesses. A pre assessment was completed, followed by a post- assessment ten weeks later by the authors of this paper who are also Educational Therapists and trained yearly to conduct these pre and post assessments.

Intervention group. The intervention group was a sample of children attending DAS PELP for support. The first 13 students who enrolled in the programme at the beginning of the year whose parents had agreed to participate in research were selected. Their pre-assessment was completed followed by 20 hours of intervention over 10 weeks after which a post-informal assessment was administered. Pre and post assessments were conducted by the Educational Therapists who were conducting the intervention. All preschool educational therapists were trained to conduct the pre and post assessment and attended a 45 minute refresher course yearly as part of their compulsory continual professional development.

Materials

DAS Preschool Pre and Post Assessment was used as the pre-test and post-test measure. 5 areas were assessed. They were alphabet knowledge, phonogram knowledge, phonemic awareness, learnt words, reading and spelling in combinations ranging from vc, cvc, ccvc, ccvcc to cccvc (v = vowel, c = consonant) and sentence writing. Further information is detailed below.

Data collection

The DAS Preschool Pre Assessment (an updated version of the test reported in Wong, 2015) was administered to preschool participants from both control and intervention groups. 10 weeks later the DAS Preschool Post Assessment was administered to both control and intervention groups again. The intervention group received 20 hours of literacy intervention in the duration between pre and post-informal. The control group received no intervention during this period, but attended their normal preschool provision.

Pre and Post-test Assessment

The assessment was divided into 7 areas:

Alphabet knowledge - the ability to name letters, sequence letters and ability to form all lower and upper case letters.

Phonogram knowledge - the ability to identify the letter-sound correspondence of the 26 letters as well as advanced phonograms (e.g.: consonant digraph, trigraphs, magic e).

Phonemic awareness the ability to segment words into their individual phonemes.

Learnt words - the ability to read 50 common high frequency words.

Reading - the ability to read words of increasing difficulty starting with vc, cvc, ccvc, ccvcc, cccvcc and magic e words. There were 3 words in each category of difficulty.

Spelling the ability to spell words of increasing difficulty starting with vc, cvc, ccvc, ccvcc,

cccvcc and magic e words. There were 3 words in each category of difficulty.

Therefore, a student with a score of 3 on reading or spelling would have only been able to manage to read/spell words in the vc category while a student with a score of 11 would have been able to read/spell words in the cvcc category.

Sentence writing - the ability to copy a sentence, with accuracy in punctuation, letter formation and spacing in between words.

The intervention

Children in the intervention group attended DAS pre-school support sessions for 2 hours weekly in small groups to receive support in the PELP curriculum including alphabet knowledge, letter formation, letter-sound correspondence, phonological awareness, learnt words, shared reading, early writing and spelling. The present intervention is governed by the Orton Gillingham Principles (OG; Orton, 1966). The OG instructional approach is phonics based and relies heavily on the integration of systematic, sequential and multisensory methods to teaching literacy skills. These components are explained in detail in table 1.

Planning for Individual Intervention and Quality

After the Pre-Informal Assessment, the educational therapist makes note of the literacy strengths and weaknesses exhibited by the child and uses it to make an individualised intervention plan. A child who might be competent in alphabet knowledge and phonogram knowledge but who is unable to read will spend a larger portion of the session completing blending and other phonological activities. Using the OG principles, the educational therapist also adjusts the content weekly for each session to focus and revise the areas the child was uncertain of in the previous lesson. (Wong, 2015). Each session consists of a small group of 2 to 4 students who are placed together as they share a similar literacy profile. The weekly intervention covers alphabet knowledge, phonogram knowledge, phonemic awareness, reading and spelling tailored to the literacy needs of the group.

Multisensory, tactile and educational technology tools are used to enhance early learning. These are illustrated in Figure 1 below, where letter recognition is reinforced by the use of texture and tracing. All educational therapists are specifically trained to work with pre-schoolers at risk of dyslexia or other learning needs. The educational therapists additionally undergo a minimum 50 hours of continued professional development yearly to refresh and learn new skills relevant to literacy intervention. Each educational therapist is also observed teaching and graded annually to ensure that the intervention standards are met.

Table 1:. The Orton Gillingham Approach

LANGUAGE BASED – Uses phonograms and spelling rules that most of the language abides by to make it easier for the learner to decode and integrates this in reading, spelling and pronunciation

COGNITIVE – The various techniques to learning are derived from a neurological understanding of how learning occurs with regard to reading and writing

STRUCTURED, SEQUENTIAL AND CUMULATIVE – This is also known as the language triangle in which direct instruction is delivered systematically and in a sequential manner. Consistent reviews of this allows for mastery of concepts and good retention. New literacy skills related to these prior concepts that have just been mastered are then taught cumulatively This is especially vital to achieving automaticity.

SIMULTANEOUSLY MULTISENSORY - Integrating visual, auditory, kinaesthetic and tactile exercises in instruction to build strong connections to literacy components.

DIAGNOSTIC-PRESCRIPTIVE - The therapist constantly observes the learner and makes note of both verbal and non-verbal cues to assess the progress made and difficulties the learner might be facing. The therapist then uses this information to reflect and make changes in strategies or lesson delivery to allow the learner to experience a higher degree of success.

EMOTIONALLY-SOUND - This teaching approach aims at looking at existing areas of strengths and capitalises on teaching new concepts using these. In doing so it aims to increase the experience of success and help create a confident student who is motivated to learn further (Joshi,et al., 2002; Orton, 1966 ; Ritchey & Goeke, 2006).



Figure 2 Some examples of multisensory strategies used to teach phonograms and sight words (Wong, 2015)

RESULTS

In order to evaluate the impact of the PELP intervention, and establish whether or not the changes from pre to post were related to the intervention or more directly to the process of maturation, data from pre and post tests were tabulated for the 2 groups of participants, and compared within and between groups. See table 2 for means and standard deviations for the intervention and control groups at pre and post-test. It may be seen from the data below that for all but phonogram knowledge both groups made improvements over the time period. A range of scores were obtained, reflecting the level of complexity of the tasks involved.

Table 2: Within group differences on battery of tasks

Variable	Intervention	N= 13	Control	N= 14
	Pre test mean (SD)	Post test mean (SD)	Pre test mean (SD)	Post test mean (SD)
Alphabet Knowledge	87.31 (26.62)	104.08 (22.71)	85.36 (25.48)	87.71 (29.82)
Phonogram Knowledge	15.46 (7.11)	24.92 (3.12)	18.71 (10.06)	17.43 (9.88)
Phonemic Awareness	1.85 (3.41)	9.15 (7.72)	4.86 (7.48)	6.00 (7.46)
Learnt Words	13.69 (14.69)	23.08 (16.61)	20.07 (20.78)	22.29 (21.39)
Reading	1.08 (1.66)	5.85 (4.71)	3.71 (6.59)	3.50 (4.29)
Spelling	0.46 (1.13)	4.00 (4.45)	1.00 (2.22)	1.93 (2.59)
Sentence Copying	20.85 (13.32)	32.23 (10.48)	26.29 (13.32)	33.14 (10.48)

Quantitative Data From Pre and Post

Data analysis

SPSS Version 20.0 was used for data analysis. To identify the improvements each group made, a 2 factor repeated measures Anova was performed, comparing the pre and post assessment scores.

Between group differences

A 2 factor repeated measures Anova of the scores at pre and post-test between the control and intervention group revealed that the intervention group significantly outperformed the control group in the phonogram knowledge, phonemic awareness, learnt words, reading and spelling tasks as reported below in Table 2 and 3 and figures 3 and 4.

Table 3: Results of Anova table for significant effects intervention

Variable	Sig.	
	Main effect (time)	Interaction effect
Alphabet knowledge	0.023	0.08
Phonogram knowledge	0.002**	0.00***
Phonemic Awareness	0.001***	0.01**
Learnt Words	0.00***	0.002**
Reading	0.007**	0.004**
Spelling	0.00***	0.024*
Sentence copying	0.00***	0.313

* $p < .05$

** $p < .01$

*** $p < .001$

In order to check the impact of the intervention a Cohen's effect size (1988) was calculated, based on the mean and standard deviation of each group. A small impact effect size is 0.2, a moderate effect size 0.5 and a large effect size, 0.8 or more.

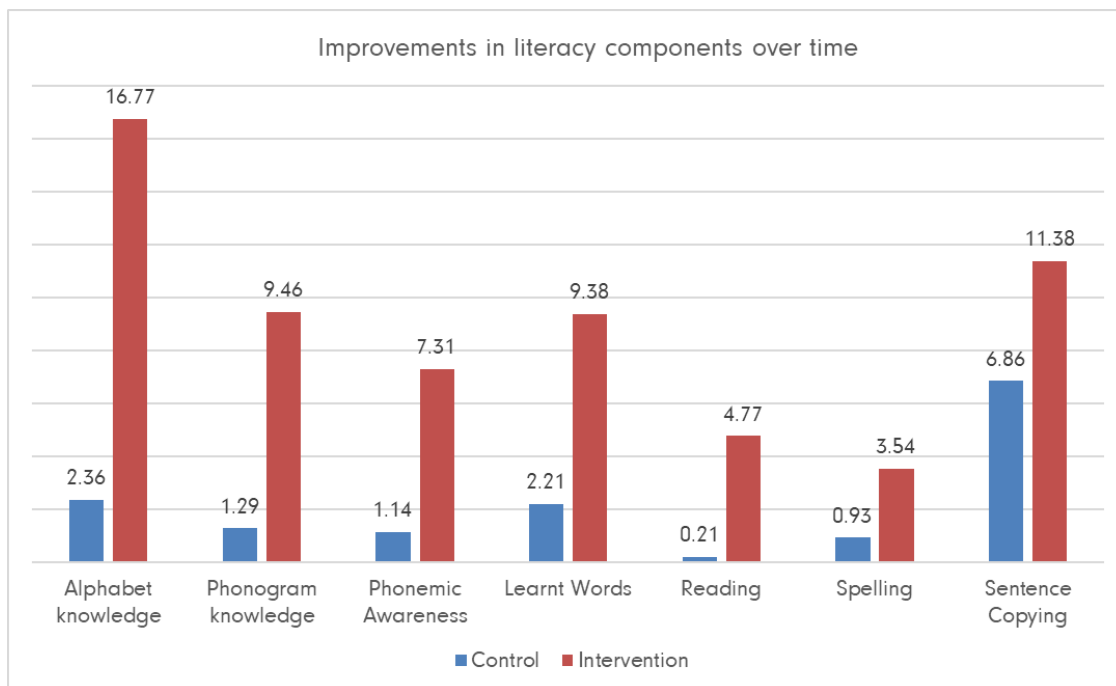


Figure 3. Differences between scores at pre/post for intervention and control

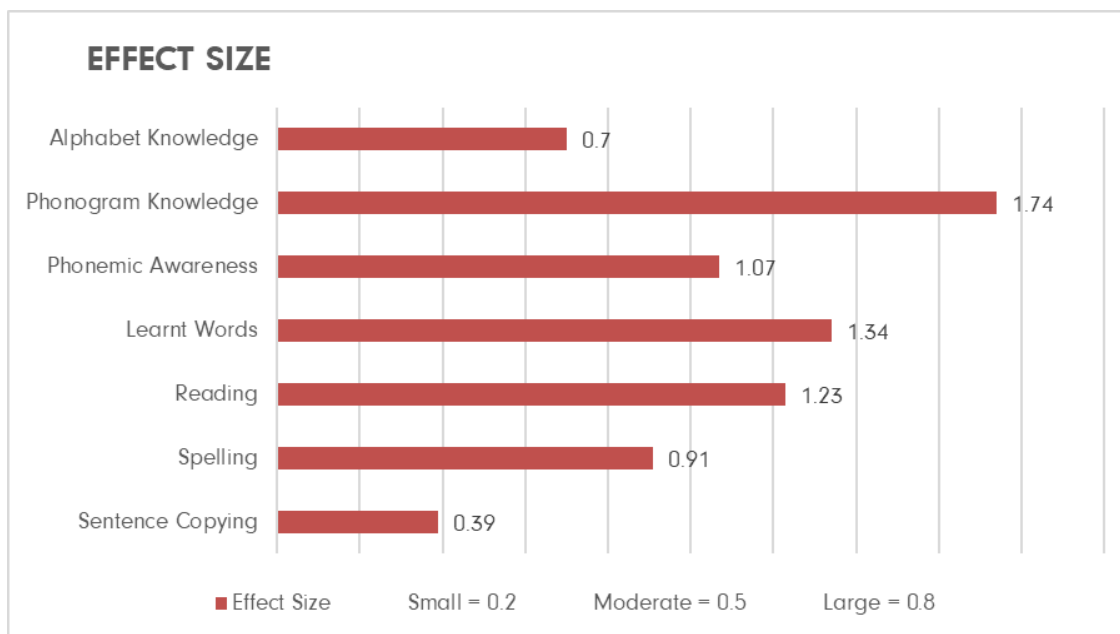


Figure 4. Effect sizes for intervention compared with controls

From figure 4 above it can be seen that most of the effect sizes are large with the exception of sentence copying (small effect) and alphabet knowledge (moderate).

To further investigate, an independent sample t-test of the differences from pre to post between the control and intervention group was conducted to check the hypothesis that the intervention group would show larger margins of improvements.

Alphabet Knowledge - Mean improvement for intervention participants of 16.77 points, which was statistically significant ($t(12) = -2.54$, $p = 0.026$) with a moderate effect size ($d = 0.68$).

Phonogram knowledge Mean improvement for intervention participants of 9.46 points, which was statistically significant ($t(12) = -5.66$, $p < 0.001$) with a large effect size ($d = 1.72$).

Phonemic awareness Mean improvement for intervention participants of 7.31 points, which was statistically significant ($t(12) = -3.95$, $p = 0.002$) with a large effect size ($d = 1.22$).

Learnt words Mean improvement for intervention participants of 9.38 points, which was statistically significant ($t(12) = -6.78$, $p < 0.001$) with a moderate effect size ($d = 0.6$).

Reading ability Mean improvement for intervention participants of 4.77 points, which was statistically significant ($t(12) = -4.36$, $p = 0.001$) with a large effect size ($d = 1.35$).

Spelling ability Mean improvement for intervention participants of 3.54 points, which was statistically significant ($t(12) = -3.40$, $p = 0.005$) with a large effect size ($d = 1.09$).

Sentence copying Mean improvement for intervention participants of 11.38 points, which was statistically significant ($t(12) = -2.90$, $p = 0.013$) with a large effect size ($d = 0.95$).

To further investigate, a paired sample t-test of the differences from pre to post for the control group independently, was conducted to check the alternative hypothesis that maturation would improve performance without the need for explicit intervention.

Pre and post-test within Control group

Spelling ability Mean improvement for control participants of 0.93 points, which was statistically significant ($t(13) = -2.24$, $p = 0.042$) with a small effect size ($d = 0.39$).

Sentence copying Mean improvement for control participants of 6.86 points, which was statistically significant ($t(13) = -3.17$, $p = 0.007$) with a moderate effect size ($d = 0.57$).

All other scores for Alphabet knowledge, Phonogram knowledge, Phonemic awareness, Learnt words and reading ability were not significant.

DISCUSSION

The study aimed to identify if enrolment in PELP intervention over ten weeks would lead to improvement in early literacy areas: alphabet knowledge, phonogram knowledge, phonemic awareness, learnt words, reading, spelling and sentence writing. Data analysis showed that the intervention group made statistically significant gains in all tested early literacy components after 20 hours of intervention. In contrast, struggling learners who did not attend intervention only made significant improvements in spelling and sentence copying over the ten week period. This suggests that without explicit support, children will continue to struggle in most of the important early learning skills which form the foundation for literacy acquisition.

It was notable that the intervention group showed greater difficulty with all subtasks of the assessment battery prior to intervention apart from alphabet knowledge, which was slightly higher than controls. However, there was considerable variability within the group reflected in the high standard deviation scores for most of the subtests. This meant that they had greater potential for improvement over the course of the intervention, and also reflected their greater need for participation in the intervention study than the controls, who were referred for extra support by teachers, rather than by psychologists and speech therapists. The controls, by comparison showed only small impact from attendance at pre-school, with performance deteriorating on two of the subtests, phonemic knowledge and reading. Comparisons between the groups showed significantly greater impact of participation in the intervention than the effects of kindergarten and maturation. Moreover, calculating the effect sizes for improvements in comparison with controls showed that the majority were large, which is interesting in the context of the National Reading Panel findings. Effect sizes of this level were also identified in previous research, with the PELP intervention in Singapore, with intervention covering a longer time-period (Sim et al, 2015, Wong & Sathiasilan, 2018). Short term interventions have previously been found to be highly effective in the UK (Nicolson et al, 1999, 2000, Fawcett and Jones, 2019). This suggests (in line with the findings of Suggate (2016), that it is the intensity and breadth of intervention, rather than the time period, which has the major impact.

In terms of the individual subtests evaluated, it is interesting here to compare the results with those in the literature from equivalent research. In PELP, alphabetic knowledge and its corresponding phonograms are explicitly taught in the classroom. Alphabet knowledge enhanced the learning of phonogram knowledge. Puranik and Apel (2010) also proposed alphabet and phonogram knowledge predicted spelling skills in 4 and 5 year old learners. By building the alphabet and phonogram knowledge, struggling learners build their foundation to pick up more advanced phonological awareness skills.

The significant improvement in phonemic awareness was notable, as children at risk of developing literacy difficulties were found to exhibit poor articulatory skills, resulting in

ongoing problems with phonological awareness (Nicolson and Fawcett 2008). Phonemic awareness (PA), a subset of phonological awareness, is also an early predictor of child's reading success (Kaminski and Powell-Smith 2017). Therefore, phonemic awareness instruction was explicitly taught within PELP. Kilpatrick (2015) found basic and advanced phonemic awareness instruction contributed to effective literacy remediation. When struggling learners build their competency in alphabet knowledge, phonogram knowledge and phonemic awareness, they can make the connections between sound, spoken and written language and transfer their knowledge and skills into print form, such as reading, spelling and writing tasks (Terrell and Watson 2018).

This is thought to occur because improvements in phonemic awareness help children to recognise the letters, give corresponding letter sounds and apply these skills to help them blend or read words. Moreover, the intervention group were also able to identify the individuals phonemes in a word and translate the sound into print. Daly, et al., (2005) proposed in the hierarchy of phonemic awareness that a child is first able to isolate the beginning sound, followed by blending phonemes and segmenting the phonemes in a word. This was further supported by Nation and Hulme (1997) who found phoneme segmentation skills were the best predictors in first graders reading and spelling. The current study appears to corroborate these findings from other research groups, as struggling learners in the intervention group showed significant improvements in alphabet knowledge phonogram knowledge, phonemic awareness which converged into improvements in reading and spelling.

A comparison of the differences between the control and intervention group indicated that when their gains were compared, the intervention group significantly outperformed the control group in measures of phonogram knowledge, phonemic awareness, sight word knowledge, reading and spelling. Other interventions have found that with structured phonological based reading interventions, an average growth rate of as much as 130% when compared with a control group over eight months can be achieved (Gray et al., 2017). Shorter interventions have shown mixed results suggesting that typically reading success requires a longer intervention duration (Bedard et al., 2017; Duff et al., 2014). The results of this study indicated that the OG instructional approach and a broad literacy curriculum with emphasis on phonics, phonological awareness and letter-sound correspondence maximises its effectiveness in struggling learners (NRP 2000).

LIMITATIONS, FUTURE DIRECTIONS AND IMPLICATIONS

The small sample size in this study limited the ability to generalise to a wider population and in future research this study could be replicated with a larger sample size. Moreover, this study may suffer from fade out, in common with many intervention studies in the literature, (Bailey et al., 2017). Therefore, it would be useful to follow-up the progress of this sample over time in order to assess the stability of the improvements in the longer-term.

It would also be beneficial if this study is replicated to gather qualitative feedback from educational therapists on individual student progress and the intervention. In addition, in future research it would be good practice to have independent assessors who had not taken part in the intervention itself, evaluating the children in both groups. It would also be interesting to evaluate the confidence and well-being of the children involved in a child-friendly questionnaire.

CONCLUSIONS

The findings in this study are in line with others in demonstrating that the PELP, an OG and phonologically based instructional literacy intervention has positive impacts on struggling learners. More importantly, the emphasis on alphabet knowledge, phonogram knowledge and phonemic awareness contributed significantly to reading and spelling skills. These results have demonstrated, as in Nicolson and colleagues studies in the UK, (1999, 2000) that a short term intervention of just 10 weeks, with 20 hours support can be effective at age 5. Ongoing research is needed to establish how long-lasting the impact of these effects can be.

The findings have demonstrated the importance of providing early intervention for struggling learners. This lays the foundation necessary for the development of conventional literacy skills required for formal schooling. Learners with adequate early literacy have demonstrated better academic achievements, compared to their peers with less competent early literacy skills (Dennis and Horn 2011). Therefore, it is critical to push for early intervention to help struggling learners reduce the gap.

In terms of policy and practice internationally, identifying and supporting early learners who are struggling to progress can ensure that many of these children accelerate and can begin to keep pace with their peers. This will leave a subgroup of more impaired children who will need continued support in order to achieve their potential. It is not enough to conclude that normal classroom experience will be sufficient to bridge the gap between those struggling and their more successful peers. Failure to progress in the early years can impact progress for a lifetime, impacting on self-esteem, fulfilment and life chances. No country can afford to neglect the opportunity to provide this essential support to ensure the future prosperity of their nation.

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Dyslexic Strengths in Times of Adversity

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Editor's Note: In this invited article following his talk for the UNITE SPLD 2021 conference, Thomas West applies his knowledge of dyslexic strengths in times of adversity, following the COVID pandemic. West's understanding of dyslexia has always, in my view, been influenced by the framework of Seligman (1990) on learned optimism, which later became incorporated into my colleague Rod Nicolson's Positive dyslexia movement (Nicolson, 2015).

Abstract

Months before the world began to realize the full impact of the strange new illness first reported in Wuhan, China, in December 2019, the author had agreed to give a talk for graduating high school students in June of 2020. As conditions worsened, he was in a quandary, trying to think of what to tell these college bound students with dyslexia, who had completed their studies at The Siena School near Washington, DC. Eventually, he decided to focus on the creativity and resilience that so many dyslexics have exhibited so often, especially in times of change, uncertainty and sometimes great adversity. In this article, based on the talk, the author recalls how certain neurologists and researchers had pointed out that dyslexics have often been responsible for highly original innovations and advances as scientists, inventors and entrepreneurs. Accordingly, he hoped that the dyslexic students would be able see themselves as well suited to deal with their own unfolding trial and test -- displaying the special talents of dyslexics for creative solutions in times of uncertainty and adversity. The following article tells the story of his efforts to make this case -- providing arguments and stories that could be helpful to these students and possibly helpful to a larger audience -- as the world continues to deal with the long-term ups and downs of COVID-19 in its several variants -- while at the same time the world also begins to deal with major changes in the nature of jobs and work in the age of ubiquitous computing, computerized "deep learning" and artificial intelligence (AI).

Keywords: Dyslexia, Dyslexia Strengths, COVID-19.

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PRESENTATION FOR THE GRADUATING CLASS

Initially, I puzzled about what I could say to the graduating students. I had promised. But the world had changed. It was to be the first “virtual” commencement – via a then unfamiliar computer link system. It had only been a few months – and the whole world was frantically trying to figure out how to deal with the rapid spread of the virus. It was a time of many difficulties and dangers. I realized that I had to fully acknowledge that what the students were seeing – what was indeed, in so many ways, really The Worst of Times. However, I hoped to somehow be able to show that this, in some ways, could also be seen as The Best of Times – for each student, for their class, for their school and for their larger community.

It was The Worst of Times – it was, indeed, a time for resilience and fortitude, for innovation and survival. They were having to deal with a true global pandemic. They had been locked in, away from school and their friends, having to continue classes virtually, facing an uncertain future. In those early months, all over America a great many had lost their jobs. In recent days there had been protests and demonstrations in Washington and all around the country – and, indeed, all around the world. After many cases and many deaths, a few places were slowly “reopening” – but all too soon – so that this also had many hazards and dangers.

In spite of all of this, I was bold to say that these could be seen also, in some ways, as The Best of Times. I noted that in the long history of human kind, we had been told, dyslexics seem to have had a special role. According to some researchers, dyslexics sometimes seem unusually well suited to deal with major changes – to being able to see opportunities inside of adversity. They are known to be particularly good at rethinking situations in an original way. They are known to be able to see what others cannot see. They are good at not being stuck with conventional views and conventional solutions. They have trouble reading and memorizing old knowledge – but they are often really good at creating new knowledge and insights. (Eide & Eide, 2011; Gechwind & Galaburda, 1987; West 2009).

I told the students that my own story was that I came into the field (as is so often the case) with the testing of our two young sons – who started having dyslexia-related problems in school in the earliest years of education. I told them how, as a worried parent, I got myself tested. I explained that I could hardly read at all until about the fourth year of primary school – and that I have always read very, very slowly – although, as I discovered later, sometimes I could read more deeply than my classmates. I explained how in those early days I had been totally unaware of the larger pattern of dyslexic traits, especially the hidden strengths that often went along with the obvious weaknesses (West, 2017).

I further explained to the students how I soon realized that my family included at least three generations of dyslexics – our sons, myself and my father. My father was a brilliant and highly skilled artist and teacher – who had won many major prizes – but who also had many dyslexic traits. My mother was not dyslexic but was also a highly skilled professionally trained artist who also won top prizes (in spite of extensive hearing loss from childhood scarlet fever).

I had begun to see that it was possibly significant that my mother was from a old Quaker family with many generations of visual thinking occupations – silver smiths, early mechanics and engineers who had designed, built and operated water powered mills in both England and in America (and much later a few early airplane pilots) – occupations that are often linked to the visual and hands-on strengths of those with dyslexia. My parents had met in the early 1930s at the Pennsylvania Academy of the Fine Arts in Philadelphia. Both had high visual talent with high level training in classical artistic skills - loving to paint portraits of watermen, cooks and dancers, sailboats, a floating theater, old barns and green fields, rural landscapes in the manner of the French Impressionists of the late 19th century.

I explained to the students that when I began my own serious study of dyslexia – I immediately looked to the dyslexics who were successful in various fields. I was less interested in “fixing” the problems. Rather, I was much more interested in understanding the areas of distinctive strength and talent. I wanted to look at the fields where dyslexics were successful. I wanted to see what we could learn from them – how dyslexics could succeed in worlds of changing jobs, skills and technologies. In time, my interest in strengths and talents led me to meet some extraordinarily amazing people and directed me to look into some new and exciting areas of work.

Early on, I realized that many things had been changing in fundamental ways – many changes that tended to favor dyslexics once again, as they had in the past. I soon realized that all the low-level reading and clerical tasks that dyslexics have difficulty with were becoming less and less important in the world of work. In contrast, the high-level visual thinking talents and skills where dyslexics often excel were becoming more and more important in the world of work once again. Indeed, West noted that some researchers have asserted that the dyslexic brain often seemed to be optimized for innovation and original discovery – aspects especially useful in times of radical change and uncertain threat. (Eide & Eide, 2011; EY Report, 2018; West, 2009,).

Looking for talented and successful dyslexics, one of the first places I looked was computer graphics and the organization ACM SIGGRAPH – a field that includes film animation, video games, data visualization, simulators for airplane pilots and 3-D models and structures for architects, biologists, mathematicians and surgeons. This field often features a remarkable melding of ancient forms of art and story-telling with the newest high-speed computer graphic technologies. I began to attend the annual conferences –

and there were major technical advances every year. From the outset, the highly visual people I met at these computer graphics conferences explained to me that half the people in the industry were probably dyslexic.

I met one woman who was responsible for the computer graphics in major films like *Titanic* and *The Fifth Element*. She told me that she had assembled a small group of the most talented computer graphic artists and technologists. They dealt with the most difficult problems in the films. She had hired them for their extreme talents based on samples of their work. She had ignored their paper credentials. In time, she discovered that entire team was dyslexic – one hundred percent. (West, 2017).

This taught me a lesson: dyslexics can be super stars when they discover their special areas of talent – and when they find the right industry and position to put their talents to use.

This also taught me that one of the most important things is to be able to retain one's spirit – one's resilience – and not be beaten down by many early failures – and not be convinced by others that you can't move on to high levels of accomplishment – sometimes very high levels. (Eide & Eide, 2011; West, 2005 onwards)

Indeed, when I talked to highly creative and successful dyslexic people in the sciences and business and elsewhere, they say the higher up you go in an area of strength, the easier it gets. For example, I found that many high-level scientists are familiar with the mixed talents common among dyslexics. They instantly know what you are talking about. Conventionally trained teachers usually do not understand these things; they are often compelled to focus on memorization and testing rather than insight and discovery (Dreyer, Dreyer & King, 2001-2004; West, 2022).

A wonderful example of great success after repeated failures is Jack Horner – the famous paleontologist who has been advisor to Stephen Spielberg for his four Jurassic Park films. I got to know Jack over the years at several conferences and I visited him twice at his digs in northern Montana.

Jack explained to me that he was mostly a failure in lower school and high school. His high school English teacher gave him a grade of "D minus, minus, minus." The teacher said you passed, barely, but "I never want to see you again." Jack said he sent this teacher a copy of his first book (written with help from a co-writer, of course). Indeed, Jack says he has written more books than he has read. (Horner, 2007)

Although Jack had failed a lot, he said he never felt a failure. Why? Because when young, he won all the science fair prizes. He built a Tesla coil – and he also built a rocket. When he first told me this, I just assumed he meant a small model rocket. But he said, "Oh no, it wasn't a small model rocket. It was 5 feet tall and it blasted to 27,000

feet." I said, "Jack, that was dangerous, you could have shot down an airliner!" Jack could not do the low-level work – but when given the opportunity, he could accomplish things way beyond his classmates.

In Montana, if you have graduated from high school you could start college. Jack failed in college seven times (as he once reminded me) but he never gave up. He took a low-level job cleaning and preparing fossils. He kept searching the dry wild lands of Montana. He could not get funding from professional grants for his research. But he asked a local beer company and got the funding he needed – to eventually make important discoveries. In time, his work was respected and he became famous. He designed the dinosaur museum exhibits in Bozeman, received honorary degrees and started teaching paleontology.

He would have his 19 graduate students write their papers and put them in the computer so Jack could have his computer read the papers to him. He said that his mission was to get these graduate students to "think like a dyslexic." "I don't want them to clutter their minds with 'other people's thoughts,'" he said. He wanted them to observe nature directly and see what was there in front of them in the fossil evidence. He tried to teach them how to think "out of the box" like a dyslexic. He said that normally dyslexics think "out of the box" – because "they have never been in the box." (Horner, 2007).

I think Jack's example is a great one because it shows that he is definitely not suited to conventional academic studies. But he was – and still is – extremely well suited to understanding nature and science – seeing clearly what the fossil evidence revealed – seeing things that other scientists have missed.

Another great example is one of Jack's graduate students, Mary Schweitzer. Mary is also dyslexic. One year, Jack and his team had found a very large set of fossil bones from a Tyrannosaurus Rex at the face of a high cliff in northern Montana. It was in a remote area so it was hard to get people and equipment in and out. They found that the fossil femur (that is, the upper leg bone) of the T Rex (when covered with protective plaster of Paris) was so big and heavy that the loaned helicopter couldn't lift it. So, they had to cut this femur in half.

They sent one half to Mary. They didn't treat it with any chemicals as they normally do. Mary looked inside and what she saw immediately was a deposit of calcium inside the bone – like the deposits of calcium found inside bird bones when they are ready to make egg shells. So, Mary knew right away that the T Rex had been a pregnant female.

But there was more. Inside the bone Mary also found tiny flexible blood vessels and the remnants of red blood cells. Mary and her assistant said they could not sleep for weeks because they thought they would never be believed. She published her findings in Science magazine (Schweitzer, 2006) and indeed she was attacked. The critics said it is not possible for such things to survive for more than 60 million years. Subsequent papers

(Schweitzer, Wittmeyer & Horner, 2007) drew "howls of scepticism." Some said: "These parts would "not survive tens of millions of years." Was this "contamination?"

However, later, other scientists repeated her discoveries and admitted that her work was legitimate. "'Milestone' paper opens door to molecular approach" (Service, 2017). So, Mary Schweitzer, PhD, Jack's dyslexic grad student, started a whole new subfield of scientific study – molecular paleontology – a scientific subfield that all would have believed to be completely impossible. (Horner, 2007; NHK interview, 2017.)

Another amazing story is about William J. Dreyer, a dyslexic molecular biologist at the California Institute of Technology, in Pasadena, known as "Caltech." Years ago, Bill contacted me and said he had read my first book and thought that I understood how he thinks. "No one else does," he said. He suggested, "Next time you're in the Los Angeles area come and visit. I want to tell you my story." It turned out that Bill's story was very interesting indeed. (Dreyer, Dreyer & King, 2001-2004)

Bill started off as a poor student and he was uncertain about what he could and could not do. But he took some tests and realized he had some areas of special ability, especially in visual thinking. He started studying biology and he soon realized that he could understand what was going on in the laboratory better than others. Because he could use his powerful dyslexic imagination to see how the molecules fit together in various ways, he developed a new theory related to the human immune system. (Dreyer, Grey & Hood, 1967; West, 2009, West 2014).

He told his professors which experiments they should do and what the results would be. They helped him write his papers, based on his new theories. For 12 years, he gave talks about his new theories. Many professionals in the field were angered by these talks; it was all so new that they could not understand what he was talking about; they thought it was heresy.

Later, a different scientist, working in Switzerland, doing experiments that were illegal in United States at the time, proved that Bill's new theories were correct. And this other scientist received a Nobel Prize (Susumu Tonegawa, was awarded the Nobel Prize, Physiology or Medicine, 1987). (Tauber & Podolsky, 1997).

Bill told me, I think honestly, that he was not upset about not receiving the Nobel Prize. He told me that once you receive the prize your life is not your own – everybody wants a piece of you. (At Caltech, Dreyer was surrounded by a number of Nobel Prize winners.) Bill said that he was happy to be vindicated and to know that his theory was correct and was eventually accepted by everyone in the field. Bill also became the "idea man" to start six "bio tech" companies.

But there's still more to Bill's story. Bill had a dyslexic grandson named Brandon King. Brandon was in high school, flunking courses, fighting with his parents, feeling very low. So, his grandfather asked him to come and visit and help with his research using Brandon's computer skills. Each day Bill talked to Brandon and said: "This is what I want you to do today. Since you are good with computers, I want you to write this little search program – but before that you need to know this biology. . . ."

Soon, Brandon started to help in the laboratory at Caltech as a volunteer. Then he was a part-time employee. Eventually he was a full-time employee helping with the computer side of the biology laboratory at the Caltech. In a short time, according to Bill, Brandon was doing "post doc" level work at the laboratory – and he still hadn't graduated from high school. (Dreyer, Dreyer & King, 2001-2004; West 2014)

Eventually Brandon went on to college at the famous University of California at Berkeley (because they had the best learning disability support program) and was able to graduate with honors and start his own business. (West, 2009, 2014)

Because of my books and talks, many stories of successful dyslexics have come my way. The field is full of paradoxes and surprises. Great writers who cannot spell. High level mathematicians who don't know their math facts. A Nobel Prize winning biologist who had been in "special education" and thought she was stupid (Carol Greider, Nobel Prize, Physiology or Medicine, 2009).

It is important for educators and test designers to understand that there are whole areas of talent that they do not know how to measure or comprehend. Many clever students are great with memorization and test taking, but they are not good at developing new ideas or making new discoveries. Rather, often dyslexics seem to be well suited to these tasks.

Over many years, stories of dyslexic entrepreneurs like Richard Branson have been written about in the business press (Branson, 1999). This is not new. However, what is new is that in the last few years there have been formal reports written by major business management consultant firms. A report by one of the big four management consultant companies (EY – formerly Ernst and Young) states the case that what businesses want in the future are the skills and talents and strengths that are common among dyslexics. (EY Report, 2018).

With the new powerful computers of today many of the clerical tasks – the tasks that our traditional educational system trains human beings to do – are now being done faster and more cheaply by machines – especially with massive data available in the cloud along with "deep learning" and artificial intelligence (AI).

Businesses realize that what they now need from their human employees is something quite different from the past. They want the innovation, creativity, big picture thinking and other abilities that appear to be common among dyslexics (but seem to be comparatively rare among certain non-dyslexics).

From the EY report: The Value of Dyslexia: "Our research shows that dyslexic strengths provide a significant opportunity for organizations to harness a different, and widely untapped, pool of talent . . . Dyslexic individuals have differing abilities, with strengths in creative, problem solving and communication skills and challenges with spelling, reading and memorizing facts. Generally, a dyslexic cognitive profile will be uneven. Dyslexic individuals really do think differently. In work . . . these varied cognitive profiles give dyslexic individuals natural abilities to form alternative views and solve problems creatively. Heightened cognitive abilities in certain areas, such as visualization and logical reasoning skills and natural entrepreneurial traits can bring a fresh, often intuitive perspective." (EY Report, 2018).

These are the kinds of things that some of us been saying for many years. But it is wonderful indeed to hear these words from established management consulting companies. I told the students that it is important for you, the class of 2020, to acknowledge the many great problems and stresses of our time. But along with all your own difficulties with dyslexia, remember that you have many advantages in ways of thinking that others do not have.

So, I told them that I wanted them to see that it may be possible to view current problems and difficulties as opportunities – to show the world – and to show yourselves – what you really can do.

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Recommended Readings

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Biographical Sketch

Thomas G. West is the author of three books. His first book – *In the Mind's Eye: Creative Visual Thinkers, Gifted Dyslexics and The Rise of Visual Technologies* – was first published in 1991 and was released in a third edition in 2020. The book has been translated into Japanese, Chinese and Korean. Awarded a gold seal by the Research Libraries of the American Library Association, the book was recognized as one of the “best of the best” for the year (in their broad psychology, psychiatry and neuroscience category). Mr. West has been invited to provide presentations for scientific, medical, art, design, computer and business groups in the U.S. and 19 other countries, including groups in Australia, Canada, New Zealand, Dubai-UAE, Hong Kong, Taiwan, Singapore and twelve European countries.

West has long been interested in the talents of dyslexic individuals along with the history of visual thinking in making discoveries as well as the way the worlds of education and work are slowly being transformed by powerful computer technologies, many visual and graphical. West's second book is *Thinking Like Einstein: Returning to Our Visual Roots with the Emerging Revolution in Computer Information Visualization* (2004). His third book is *Seeing What Others Cannot See: The Hidden Advantages of Visual Thinkers and Differently Wired Brains* (2017).

West has given presentations and workshops for organizations such as NASA Ames, MIT and Harvard University in the US, the Netherlands Design Institute in Amsterdam, the Glasgow School of Art, Oxford University and GCHQ in the UK, the Dyslexia Association of Singapore and a meeting of 50 Max Planck Institutes in Göttingen, Germany. West's papers and personal blog have been deposited in a permanent archive in the U.S. National Library of Medicine, National Institutes of Health.

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The effectiveness of reading, spelling and writing support for a large sample of school-aged children with Dyslexia: factors influencing efficacy.

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Abstract

In a follow up to an earlier study (Fitriya, 2021) on the longitudinal progress of children with dyslexia, this study further examines the specific learning difficulties associated with Dyslexia, and factors influencing success. Dyslexia hampers accuracy and word fluency in reading and spelling, which is addressed by the Dyslexia Association of Singapore (DAS) in their literacy English Main Literacy Programme (MLP). This programme provides support to students diagnosed with Dyslexia in reading, spelling, and writing using the Orton Gillingham instructional approach. This research aims to examine the effectiveness of the English Main Literacy Programme (MLP) in Singapore in remediating the literacy challenges faced by students with Dyslexia. The present study firstly evaluated the progress of a total of 1280 students between seven and 17 years of age who were enrolled in the programme for one year. The Curriculum-Based Assessment (CBA) was utilized to evaluate the progress of the students in the study using the following test items: (1) words to spell (2) words to read (3) writing tests. Analysis involved the use of both hypothesis testing and the Central Limit Theorem (CLT) across a one-year timespan (from Term 4 in 2019 to Term 4 in 2020), a particularly challenging time for education. Based on a Z-score to ascertain the statistical significance of the results, study findings revealed a significant increase in the mean scores between Term 4 2019 ($M = 92.71$) and Term 4 2020 ($M = 93.98$). This is indicative of a statistically significant improvement in the academic performance of Dyslexic students who participated in the literacy intervention. The validity of this literacy intervention supports the efficacy of the English Main Literacy Programme (MLP) as an evidence-based literacy practice, even during the period of challenge relating to Covid and the switch to online learning. In order to evaluate the impact of individual differences on success or failure, a 2nd phase of the study examined progress within this pattern of improvement, drawing on data from over 1000 children who had participated in the previous study (Fitriya, 2021), during a period of greater normality. These results revealed that home resources, participation in support within the DAS specialist programmes, the length of time and consistency of attendance at DAS for support were implicated in those children who progressed, remained static or regressed. Implications for practice are considered, which are likely to be of particular importance during the period of change experienced in education post-Covid.

Keywords: Central Limit Theorem, curriculum assessment, hypothesis testing, statistical significance, word accuracy, word fluency

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INTRODUCTION

Dyslexia is an increasingly prevalent problem found in school-aged children. Dyslexia, a deficit in phonological language, which is characterized by issues in phonological awareness, processing and speed of processing as well as verbal memory (Fitriya, 2021). Dyslexic students often encounter difficulty with comprehension, spelling, word recognition, and writing (Fitriya, 2021; Lyon et al., 2003; Rutter et al., 2006). As a result, students with Dyslexia also have difficulty concentrating as well as behavioural, emotional, and language issues (Fitriya, 2021; Lyon et al., 2003; Rose, 2009; Rutter et al., 2006). The challenges Dyslexic students encounter on a daily basis diminish their self-esteem and zest for learning (Fitriya, 2021; Gooch et al., 2016).

In Singapore, students with Dyslexia are supported by the Dyslexia Association of Singapore (DAS). This organization has adopted and implemented the principles associated with a highly structured, phonic-based, multi-sensory approach to teaching and learning as developed by Orton Gillingham to support reading, writing, and spelling (Fitriya, 2021; Ritchey & Goeke, 2006; Rose & Zirkel, 2007). DAS uses an integrated curriculum designed to meet the various needs and demands of dyslexic students with varying abilities (Fitriya, 2021). This present study seeks to measure the academic performance and progress made by dyslexic students ($n = 1280$) 7-17 years of age who were enrolled in the English Main Literacy Programme (MLP) for a year (from Term 4 2019 and Term 4 2020). Assessments were made using the Curriculum-Based Assessment (CBA) to test words to spell, words to read as well as writing assessments.

LITERATURE REVIEW

Reading and writing impairments are associated with children diagnosed with Dyslexia. Assessment of transcription issues and follow-up discussion can assist in understanding the effectiveness of the DAS English Main Literacy Programme (MLP) in improving the literacy challenges these children face.

Dyslexia and its Impact on Reading and Spelling

Dyslexic students often find it hard to read, write and spell words during their education journey (Catts et al., 2012). Dyslexia is a learning disability that affects children and poses challenges in reading and writing that may be aggravated when exposed to a noisy classroom setting (Calculus et al., 2016, 2018). Researchers further indicate that students with Dyslexia do poorly on reading and writing exercises, implying that Dyslexics have a deficit in phonological skills (Sümer Dodur & Altındağ Kumaş, 2021). Amongst other challenges, Dyslexia hinders the reader's ability to link intense sounds and symbols together. In this case, the student with Dyslexia will struggle with phonemic stages. Reading instruction in schools primarily focuses on robust phonemic-based reading methods, whereby the student must decode words (Galuschka et al., 2020).

Readers, therefore, take the initiative to translate instructions systematically, going letter by letter. Decoding is the aspect that consumes much of the dyslexic student's comprehension ability because their difficulty in processing each word impacts their understanding. These are cognitive comprehension abilities. Spelling and reading involve reciprocal parts of one task, which are essential since they connect letters and reading sounds (Hagan-Burke et al., 2011).

Dyslexic students will exhibit common types of spelling difficulties which are persistent until adolescence. The dyslexic problem is evident when students are engaging in phonological processing. (Hagan-Burke et al., 2011). Therefore, when spelling unknown words and encoding, students require practice and need to apply different strategies that the teacher has taught them. Students also have difficulties remembering long sentences, as students with Dyslexia tend to have weak working memory (Alloway et al., 2017). It is for those reasons that the student's spelling abilities often end up predicting their reading abilities.

With difficulty in spelling and reading, it is no surprise that students with Dyslexia manifest difficulties in writing. They also have poor spelling, lack of vocabulary, and poor organization skills (Hebert et al., 2018). In DAS, we have the English Main Literacy Programme (MLP) that addresses all these challenges in students. This study aims to evaluate the progress made by these students.

DAS Main Literacy Programme (MLP) Integrated Curriculum

The DAS MLP intervention is substantiated by evidence-based research and instruction from the National Reading Panel (US), Professional Practice Guidelines (SG), and the Rose Report (UK). Individualised group lessons based on the Orton-Gillingham principles (National Reading Panel, 2000; Ritchey & Goeke, 2006; Rose & Zirkel, 2007) are taught as part of the programme.

With reference to Figure 1, the MLP integrated curriculum begins with developing students' vocabulary languages and progressing upwards. In addition, educational technology tools are utilized to aid students' learning and ensure that students are engaged throughout the lesson given their digital readiness.

National Reading Panel

According to the National Reading Panel (2000)'s analysis, the optimum method in reading instruction comprises vocabulary language, explicit phonemic awareness instruction, systematic phonics instruction, and ways to enhance fluency and comprehension. It is found that teaching children to read requires a combination of techniques:

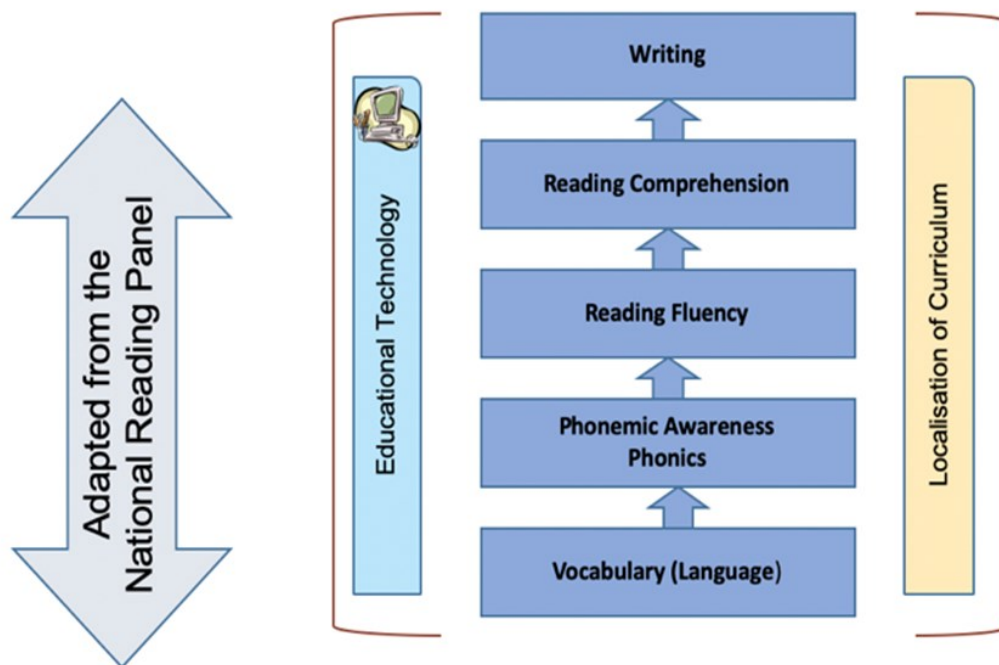


Figure 1. DAS Main Literacy Programme Integrated Curriculum

- ◆ **Phonemic awareness** – the understanding that spoken words can be broken down into smaller segments of sound known as phonemes. Children who are read to at home, particularly those materials that rhyme, typically develop the basis of phonemic awareness. When children are not read to, they will need to be taught how to break words down into smaller sounds. It is important to note that Dyslexic children may show this pattern of difficulties, even when parents have read to them extensively.
- ◆ **Phonics** – the knowledge that letters of the alphabet represent phonemes, and these sounds are combined to form written words. Readers who are proficient in phonics can sound out unfamiliar words without having to memorise them beforehand.
- ◆ **Fluency** – the ease of recognizing words, being able to comprehend, and reading with greater speed, accuracy, and expression. Children gain fluency by practicing reading until it becomes automatic. One method for assisting children in becoming fluent readers is guided oral repeated reading.

- ◆ **Guided oral reading** – reading aloud while receiving guidance and feedback from skilled readers. The combination of practice and feedback improves reading fluency.
- ◆ **Teaching vocabulary words** – teaching new words when they appear in the text or introducing new words separately. This form of instruction also aids reading ability.
- ◆ **Reading comprehension strategies** – methods for helping students to comprehend what they have read. It involves having students summarize what they have read to obtain a better understanding of the material.

In addition, in the DAS enhanced curriculum, the new concept is incorporated into writing. The new concept is the new teaching topic for the day and integrating the new concept into various lesson plan components is a means to provide more holistic literacy instruction. The in-house curriculum has implemented strategies to address students' reading, writing, and spelling challenges through the English Main Literacy Programme (MLP).

Orton Gillingham (OG) principles

At DAS, the Orton Gillingham (OG) principles of structured, sequential, multi-sensorial, and phonics-based approaches are adopted to educate students on the basic concepts of reading, spelling, and writing (Ritchey & Goeke, 2006; Rose & Zirkel, 2007).

- ◆ **Diagnostic and prescriptive** – in which lessons are built on learners' learning needs and profiles.
- ◆ **Emotionally sound** – where lessons are aimed at helping learners achieve success while bridging any gaps in their knowledge.
- ◆ **Cognitive** – each lesson covers fundamental and advanced literacy skills and strategies vital for reading, spelling, reading comprehension, and writing.
- ◆ **Structured, cumulative, and sequential** – the knowledge and skills taught build on previous lessons to ensure that learners are proficient and confident in applying what they have learned and acquired (Ritchey & Goeke, 2006; Rose & Zirkel, 2007).

In addition to incorporating the OG principles, PPP (Presentation, Practice, Production) stages approach is adopted to teach and communicate concepts to students. The Presentation stage facilitates pre-activity conversations through modelling. The Practice stage supports and guides students in a structured, cumulative, and sequential manner to

enhance learning. The Production stage presents opportunities for students to be independent in applying the concepts or skills they have learned (Criado, 2013).

Factors Influencing Intervention Efficacy

Past reviews on the effectiveness of intervention approaches for students with Dyslexia revealed that interventions aimed at remediating spelling and reading skills should emphasize targeting their literacy skills rather than underlying auditory or visual factors (Galuschka et al., 2020). Research has been shown that direct, explicit spelling instructions are more effective in improving spelling than implicit self-study approaches. Furthermore, intervention components beneficial for spelling abilities include instant corrective feedback and several spelling exercise opportunities (Wanzek et al., 2006; Williams et al., 2017).

Research has shown an association between children's socioeconomic background and their reading abilities. Specifically, economically disadvantaged children tend to demonstrate slower reading development (Aikens & Barbarin, 2008; Diuk et al., 2019; Schiff & Lotem, 2011). High socioeconomic status (SES) families might have more means to afford a wide range of resources that provides their children a developmental advantage and seek out alternative educational strategies as compared to low SES children who may lack access to such resources, limiting learning opportunities afforded to children from low-income backgrounds (Bradley & Corwyn, 2002; Noble et al., 2006). Children may thus be able to overcome phonological challenges and attain adequate reading achievement in such a highly supportive environment (Noble et al., 2006). Noble and colleagues (2006) revealed that a higher SES environment might buffer children with lower phonological skills reading abilities. Besides, prior studies have demonstrated that educators' perception of their students' academic skills influences the teaching techniques employed and students' outcomes (Begeny et al., 2008; Mojavezi & Tamiz, 2012). This underscores the possibility of multiple factors in influencing students with Dyslexia's progression in their literacy skills. Accordingly, in an exploratory vein, the present study also seeks to explore various factors influencing the literacy intervention in enhancing students' literacy skills with Dyslexia.

METHOD

Research Aim

The research aims to evaluate the progress made by students with Dyslexia enrolled in the DAS English Main Literacy Programme (MLP) in their reading, spelling, and writing skills through the enhanced curriculum teaching methods. A significant improvement would validate the educational intervention in knowledge transfer to students.

Research Hypothesis

We hypothesized that, on average speaking, there would be a significant improvement in the mean difference in students' performance in the Curriculum-Based Assessment (CBA) between Term 4 2019 and Term 4 2020.

Research Design and Procedures

One thousand two hundred eighty Singaporean school-aged children with Dyslexia, aged 7 to 17 years old, were recruited to participate in the present study. These students were enrolled in the English Main Literacy Programme (MLP) at the Dyslexia Association of Singapore (DAS) for literacy intervention. All students held an official diagnosis of Dyslexia, assessed and diagnosed either at the DAS or elsewhere in Singapore, based on Full-Scale IQ (FSIQ) and difficulties in literacy that resulted in lowered achievement compared to neurotypical peers.

A longitudinal study was adopted to review the effectiveness of the English Main Literacy Programme (MLP) in improving students' literacy skills. Progression in their reading, spelling, and writing abilities was assessed using the Curriculum-Based Assessment.

Curriculum Based Assessment (CBA)

All students were assessed using the CBA to track their knowledge transfer and progression in the English Main Literacy Programme (MLP). The CBA focused on three main tests assessing the words to read, words to spell, and writing tests. The following are a few examples of Curriculum-Based Assessment (CBA), such as words to read and words to spell (Figures 2 and 3). In the CBA words to read, students were given five minutes to read as many words as possible, progressing from easy to difficult.



Figure 2. A Sample of Word Reading Accuracy (Fitriya, 2021) © DAS

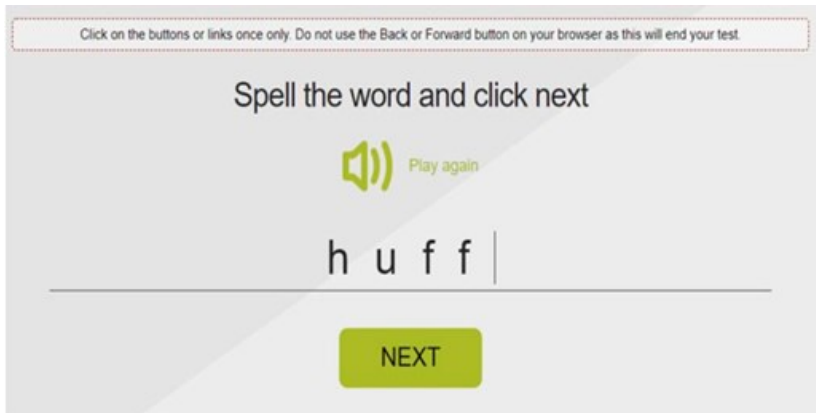


Figure 3. A Sample of Word Spelling (Fitriya, 2021) © DAS

In the CBA words to spell, students heard the spelling words by pressing the play again button, and following, typed the words in the designated space.

RESULTS

Percentage scores

To examine the effectiveness of the English Main Literacy Programme (MLP), students' progression across a one year period, specifically between Term 4 2019 and Term 4 2020, were evaluated and compared. Students' individual total CBA scores were computed by summing their reading, spelling, and writing scores. Subsequently, an overall score for each student was calculated as a percentage of the total possible score.

CBA = reading + spelling + writing scores

$$\text{Percentage scores} = \frac{\text{Reading + Spelling + Writing Scores (CBA)}}{\text{Total Score Possible}} \times 100\%$$

Following, mean percentage scores for each of the time points, specifically, Term 4 2019 and Term 4 2020, were computed by averaging the sum of 1280 students' percentages scores in each term, which would then be used for our analysis.

$$\text{Mean percentage scores} = \frac{\text{Summation of 1280 students' percentage scores}}{1280}$$

Data Analysis

The Central Limit Theorem (CLT) and hypothesis testing are used to analyse the research data. The rationale for the analytical method employed is that it allows the evaluation of two mutually exclusive statements about a population to ascertain which statement is best accounted for by the sample data. The hypothesis testing approach is used to determine the statistical significance of the research undertaken to demonstrate that the results obtained were not by chance alone. By statistically significant, we indicate that if we are to select multiple independent random samples of 100 students, who took the CBA test in Term 4 2020, then what is the probability that most of the random samples will have an average mean higher than Term 4 2019 ($\mu_{20} > \mu_{19}$).

The null hypothesis states no statistically significant mean difference in students' CBA percentage scores between Term 4 2019 and Term 4 2020.

$$\text{Null hypothesis: } H_0: \frac{\mu_{20} - \mu_{19}}{s/\sqrt{n}} = 0$$

$$\text{Research hypothesis: } H_1: \frac{\mu_{20} - \mu_{19}}{s/\sqrt{n}} > 0$$

Figure 4a presents the trajectory of students' mean percentage scores across one year in the three test items: words to read, words to spell, and writing tests.

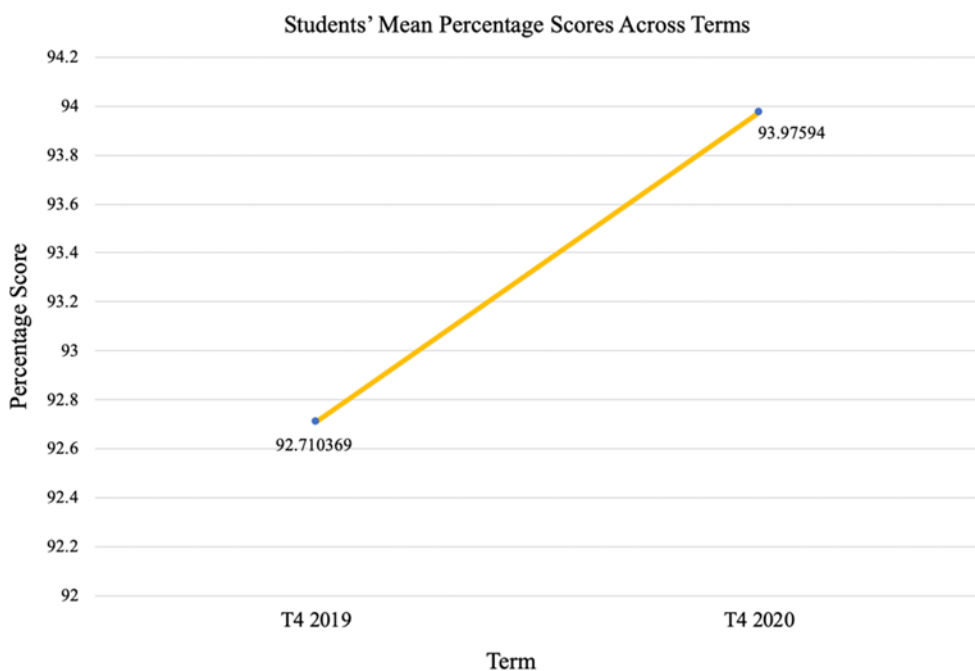


Figure 4a. Progression of Mean % Scores Across 1 Year, Precisely, Term 4 2019 & Term 4 2020

A Z-test was conducted, comparing the average mean percentage scores in Term 4 2019 and Term 4 2020. According to the finding, mean CBA percentage scores increased between Term 4 2019 ($M = 92.71$, $SD = 4.17$) and Term 4 2020 ($M = 93.98$, $SD = 3.36$). With reference to Figure 4b presented below, the Z score indicates a significant improvement, and the null hypothesis is rejected.

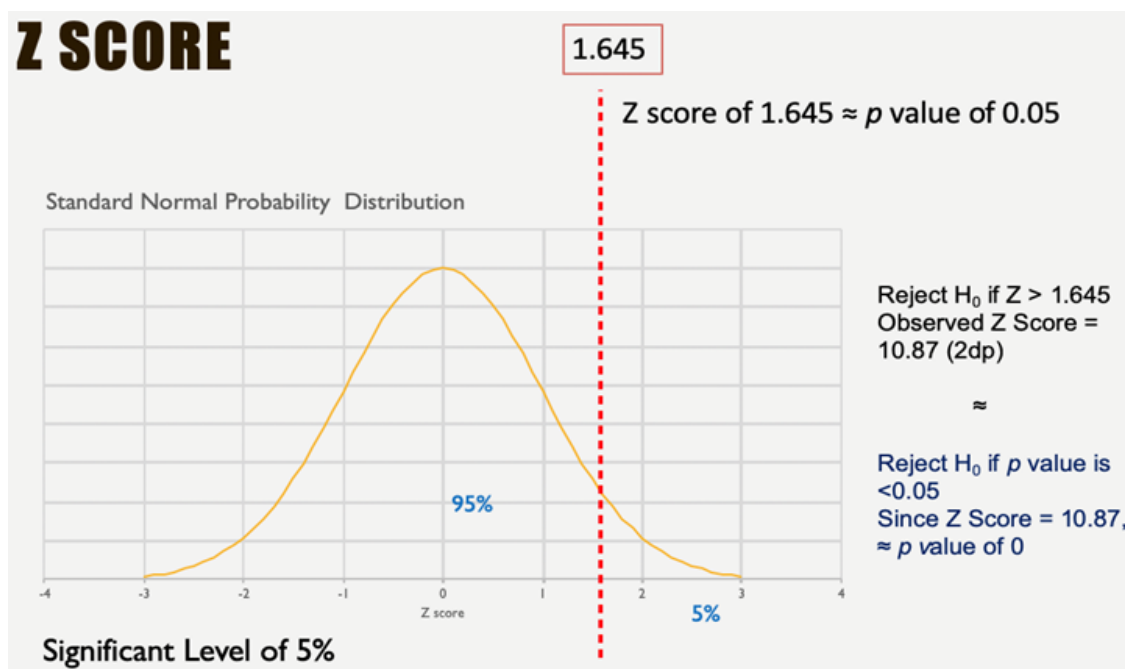


Figure 4b. Z Scores Across 1 Year

Based on the result obtained, we conclude that the English Main Literacy Programme (MLP) has resulted in a statistically significant improvement in the performance among students with Dyslexia across the one-year period. This finding is in line with the 2016 to 2018 longitudinal study conducted by Fitriya (2021), which found that students' mean scores increased from an average mean of 48.54 in 2016 to 62.43 in 2018 (Figure 5).

Exploratory analyses

In addition, to understand further the various factors influencing students' improvement following the curriculum, 1007 students' data were further analysed from the 1343 students aged 7 - 17 enrolled in the English Main Literacy Programme (MLP) for six school terms from 2016 to 2018. This would aid in establishing a more practical approach to remediation. Of the 1007 students, 662 had progressed, 44 remained unchanged, and 301 had regressed (Fitriya, 2021).

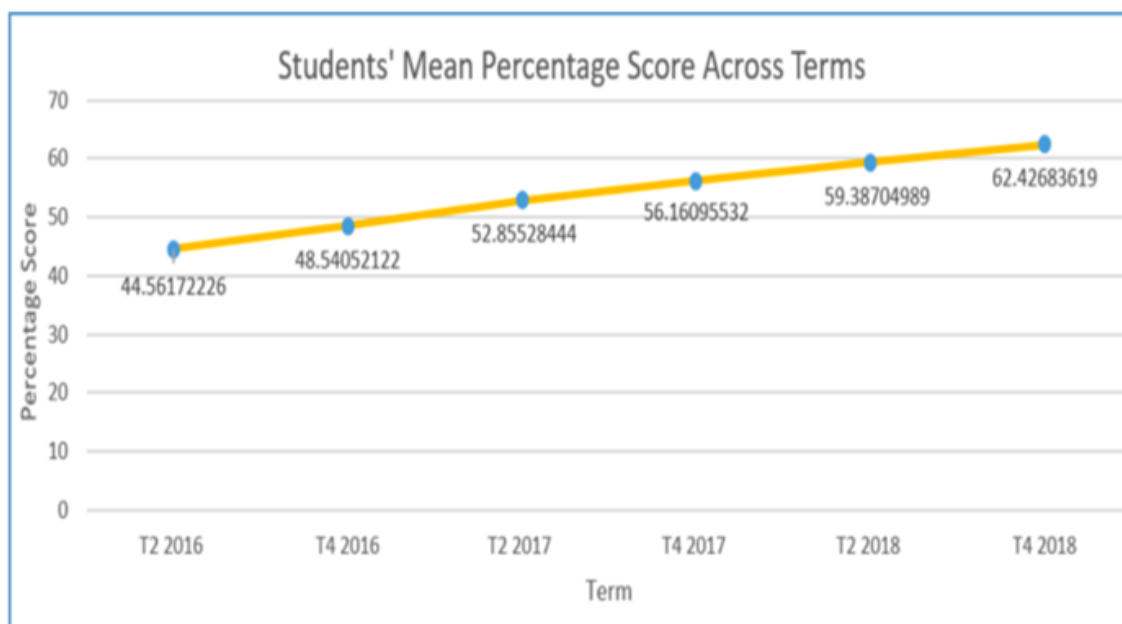


Figure 5. Progression of Mean % Scores Over Time, From Term 2 2016 to Term 4 2018 (Fitraya, 2021)

Bursary Type

Eligible Singaporean Citizen students attending government-funded Special education (SPED) schools may receive financial assistance by applying for the SPED Financial Assistance Scheme (FAS). The qualifying conditions are the Gross Household Income (GHI) of not more than \$2,750 per month or the Per Capital Income (PCI) of not more than \$690 per month (SupportGoWhere, 2021).

Over the years, a range of language and literacy support services, including Dyslexia remediation, have been made available to students attending mainstream and government-funded Special Education (SPED) schools.

The Main Literacy Programme is part-funded by the Ministry of Education (MOE). Students who meet the following criteria are eligible for the MOE financial assistance scheme for the MLP:

1. Singaporean students enrolled in a mainstream school
2. Primary 1 to Secondary 5
3. Diagnosed with Dyslexia

Table 1 below presents the breakdown of the number of students attending the MLP receiving or not MOE financial assistance. 40.03% of progressed students, 65.91% of unchanged students, and 50.83% of regressed students were under the Ministry of Education (MOE) bursary scheme. The results show that more than half of those students who remained unchanged and regressed received financial assistance to support the DAS Main Literacy Programme (MLP) fees. We can assume that students with Dyslexia from disadvantaged families may face more significant literacy challenges.

Table 1: Breakdown of students by bursary scheme

	No. of overall progress students	No. of overall unchanged students	No. of overall regress students
No Bursary	397	15	148
MOE Bursary	265	29	153

Specialised Educational Services (SES) Programmes

Overall Progress Students. Concerning students who had progressed, 94 students were enrolled in the SES programme. Among these students, nine students attended two SES programmes, and one attended three SES programmes. As a percentage, 15.24% attended the hourly Chinese Primary programme, 5.71% attended the Chinese Primary programme (2 hours), 11.43% attended the Chinese Secondary Bridging programme (2 hours), 10.48% were enrolled in the hourly Preparation for English Paper 2 PSLE programme, 0.95% participated in the iReaCH programme (2 hours), 19.05% attended the hourly Math programme, 13.33% attended the hourly Math Essential programme, 5.71% participated in the Speech and Drama Arts programme (1.5 hours), 17.14% participated in the Speech and Language Therapy (SLT), and 0.95% attended the Artventure programme (Table 2).

Overall Unchanged Students. For those unchanged students, two students were enrolled in the SES programme, specifically Speech and Language Therapy (SLT) (Table 3).

Overall Regress Students. Of those unchanged students, 31 were enrolled in the SES programme. 3.23% attended the hourly Chinese Primary programme, 12.90% attended the 2-hours Chinese Primary programme, 32.26% attended the 2-hours Chinese Secondary Bridging programme, 12.90% attended the hourly Preparation for English Paper 2 PSLE programme, 6.45% were enrolled in the iReaCH programme (2 hours), 9.68% attended the hourly Math programme, 6.45% attended the hourly Math Essential programme, 3.23% attended the Speech and Drama Arts programme (1.5 hours), and 12.90% attended the Speech and Language Therapy (SLT) (Table 4).

Table 2: Breakdown of Progressed Students by SES Programme

Specialised Educational Services (SES) Programme Name	No. of students enrolled
CHN/Chinese Primary (1hr)	16
CHN/Chinese Primary (2hr)	6
CHN/Chinese Secondary Bridging Prog (2hr)	12
EP2/Preparation for English Paper 2 PSLE (1hr)	11
IRE/iReaCH Programme (2hr)	1
MTH/Maths (1hr)	20
MTH/Maths Essential (1hr)	14
SDA/Speech and Drama Arts (1.5hr)	6
SLT/Group (Term/10 sessions)	18
STP/Artventure (3hr)	1

Table 3: Breakdown of Unchanged Students by SES Programme

Specialised Educational Services (SES) Programme Name	No. of students enrolled
SLT/Group (Term/10 sessions)	2

Table 4: Breakdown of Regressed Students by SES Programme

Specialised Educational Services (SES) Programme Name	No. of students enrolled
CHN/Chinese Primary (1hr)	1
CHN/Chinese Primary (2hr)	4
CHN/Chinese Secondary Bridging Prog (2hr)	10
EP2/Preparation for English Paper 2 PSLE (1hr)	4
IRE/iReaCH Programme (2hr)	2
MTH/Maths (1hr)	3
MTH/Maths Essential (1hr)	2
SDA/Speech and Drama Arts (1.5hr)	1
SLT/Group (Term/10 sessions)	4

Generally speaking, as a percentage, 14.20% progressed students, 4.55% unchanged students, and 10.30% regressed students were enrolled in SES programmes, apart from Main Literacy Programme (MLP). We can presume that students' improvement in their CBA scores could be partly accounted for by their participation in SES programmes in addition to MLP.

Approximate Number of Years Students are in the MLP

Due to missing data, one student from the overall progress group was excluded from the analysis. Hence the final sample comprised of 1006 students (Overall Progress: $n = 661$; Overall Unchanged: $n = 44$; Overall Regress: $n = 301$).

Table 5: Breakdown of Students' Progression by Number of Years Enrolled in the MLP

Approximate no. of years	No. of overall progress students	No. of overall unchanged students	No. of overall regress students
<1	1	0	0
1	26	1	11
1.5	26	0	8
2	33	3	21
2.5	71	3	19
3	37	3	9
3.5	82	2	53
4	31	2	14
4.5	101	4	34
5	48	4	25
5.5	78	6	31
6	34	4	20
6.5	41	6	29
7	11	3	5
7.5	14	2	10
8	7	1	5
8.5	18	0	5
9	1	0	2
9.5	1	0	0

Concerning Table 5, most progressed students were enrolled in the MLP within the range of 3.5 to 5.5 years. Most of those who remained unchanged was in the MLP for about 5.5 to 6.5 years. While for those regressed students, the majority attended the MLP for 3.5 years. Comparing students who had progressed to students who had regressed, most progressed students were enrolled in the MLP longer than students who had regressed.

MLP Attendance

Overall speaking, the majority of students' MLP attendance, as a percentage, ranged from 90 to less than 100 (Table 6). As students have different learning profiles, there may be individual and synergistic effects of potential factors influencing their literacy progression.

Table 6: Breakdown of Students' Progression by MLP Attendance

Attendance (%)	No. of overall progress students	No. of overall unchanged students	No. of overall regress students
70 - <80	12	1	7
80 - <90	59	6	42
90 - <100	378	24	151
100	211	13	101
>100	2	0	0

DISCUSSION

The current study sought to evaluate the efficacy of the DAS English Main Literacy Programme (MLP) as an intervention for remediating the literacy challenges faced by Singaporean school-aged children with Dyslexia. In line with our hypothesis, research findings revealed a significant gain in literacy performance among students with Dyslexia following one year of the English Main Literacy Programme (MLP), lending support to DAS English Main Literacy Programme (MLP) as an evidence-based practice. It is important to note this continuing improvement, despite the restrictions experienced during the period of Covid.

The DAS in-house curriculum has implemented strategies to address the students' reading, writing, and spelling challenges. In view of the research findings, educators should continue to employ the in-house curriculum and adopt teaching approaches appropriate for individual learning. Implementing an English Main Literacy Programme

(MLP) is not sufficient without proper teaching tools in place. To aid students in improving their reading, spelling, and writing skills, educators need to apply both face-to-face and specialised instructional materials. These strategies can help students with reading and writing challenges (Martínez-García et al., 2020).

As educators in schools may have an inadequate understanding of Dyslexia and how to manage students with Dyslexia, strengthening awareness of the educational needs of students with Dyslexia is therefore imperative. Hence, the education institutions should endeavour to ensure that teachers are equipped with the skills and knowledge needed to understand a student with a disability (Moats, 2019). Given that literacy difficulties in students with Dyslexia are a result of their phonological deficits, phonologically based training needs to be incorporated in teaching practice. Educators should understand the importance of the issue of phonological awareness and also receive phonological awareness training to develop an understanding of how they can implement strategies to help students with Dyslexia achieve positive outcomes. In such methods, students learn to comprehend a text and read and extract key messages to promote healthy development and cognitive skills (O'Brien, 2020).

LIMITATIONS

Several limitations of the present research should be noted. First, there is a disparity in the test administration dates, which is a potential limitation of any longitudinal studies. Accordingly, there may exist possible confounding variables such as history and maturation. The second limit of the research is the scores. As the “total” score is computed by summing all the three items incorporated in the Curriculum-based assessments, which is unique to each student, the actual differences in scores of each literacy skill may be diluted by differences in the progression of the different skills measured amongst the students. For instance, if student A made significant progress in reading while student B only progressed by a little, the overall change in the total reading and spelling scores could be significant. In other words, the results does not reflect students’ progression in each individual test component. To address the limits in measuring individual progress, future research could measure students’ performance in each of the Curriculum-based assessments test components to determine which components students have difficulty with the most when progressing to the next band level. The third limitation to be included could be the disruption of classes in 2020 due to the COVID-19 pandemic, all classes have switched mediums (e.g., moved online), which may have made an impact on the students’ reading, spelling, and writing performances.

FUTURE DIRECTIONS

Future research may examine the different aspects of students’ improvement following the intervention, such as by exploring the number of years that educators have worked in the special needs profession. Difficulties with spelling and writing are likely to continue,

despite improvement in reading, and it would therefore also be useful to break down progress into reading, spelling and writing separately, to provide further information on individual differences in progress.

CONCLUSION

The present research findings demonstrate that students' performance in the Curriculum-based assessments has improved over one year. It is pleasing to note that the intervention programme remained effective despite the many constraints on progress during this period, with the need to switch teaching online and deal with periods of illness.

This improvement could be credited to the English Main Literacy Programme (MLP). The intervention programme facilitates interaction between students and educators, allowing the educators to understand better the reading difficulties faced by students with Dyslexia. Besides, it allows for close monitoring and evaluation of the students to ensure that they meet their academic objectives. The educators discuss and address any setbacks encountered, thereby allowing the English Main Literacy Programme (MLP) to be implemented successfully. It was rewarding to note that performance improved overall despite the ongoing difficulties worldwide, a tribute to the flexibility of teachers at DAS.

Students with Dyslexia face difficulties in reading, writing, and spelling, which causes them to fall behind in their educational pathway. Therefore, it is the role of parents, teachers, and institutions to develop education plans to help identify students with Dyslexia and assist them in their academic pursuits. The DAS English Main Literacy Programme (MLP) is a crucial tool for supporting educators in remediating their difficulties. As a result, educational institutions should put in place relevant English intervention programmes and understand their practical application plans. Successful implementation of these intervention programmes can result in success within these institutions. Research has shown that educators and the Ministry of Education can implement educational support for students with Dyslexia in educational institutions. These platforms foster the development of an environment that could improve literacy skills amongst students with Dyslexia, even in difficult situations.

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Parenting during COVID-19: Stress of Fathers with and without Children with Special Needs in Singapore

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ABSTRACT

The COVID-19 pandemic has resulted in greater parental stress for parents worldwide. In this study, we focused on examining the parental stress of fathers in Singapore, during COVID-19. Comparing the parental stress of fathers with neurotypical children and fathers with children with special needs in Singapore, this study examined financial stress, work-family balance and resilience and their influence on fathers' parental stress as measured by Parental Stress Scale, APR Financial Stress Scale, Perceived Work-Family Balance Survey and Brief Resilience Scale respectively. A total of 171 fathers participated in the survey (42 fathers with children with special needs aged 0 to 18 years old, and 129 fathers with neurotypical children aged 0 to 18 years old). Results revealed that fathers with children with special needs tend to experience greater parental stress than fathers with neurotypical children. Parental stress also has statistically significant correlations with financial stress, perceived work-family balance and resilience. Financial stress, perceived work-family balance and resilience are statistically significant predictors of parental stress for fathers with neurotypical children, while only perceived work-family balance is a statistically significant predictor of parental stress for fathers with children with special needs. Differences exist between the parental stress of fathers with infants/young children (0-6 years old), school-aged children (7-12 years old) and teens with special needs (13-18 years old). Furthermore, the researchers shared these findings with a group of professional practitioners to seek their views and reported several practical recommendations for consideration.

Keywords: fathers, children with special needs, neurotypical children, parental stress, financial stress, work-family balance, resilience

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INTRODUCTION

SARS-COV-2 (also known as COVID-19) has resulted in a pandemic and has been termed as the deadliest of the 21st century viruses (The Straits Times, 2020). According to the World Health Organization (2020), the COVID-19 pandemic has impacted mental well-being and stress globally, and the pandemic has been declared as a Public Health Emergency of International Concern. A study by the Institute of Mental Health in Singapore, reported that 13% of over 1000 participants reported symptoms of anxiety and depression during COVID-19 (Goh, 2021b). Overall, the pandemic has greatly impacted mental well-being.

The COVID-19 pandemic has also caused greater parental stress for parents with neurotypical children (Chung et al., 2020a) and parents with children with special needs (Dhiman et al., 2020). Parental Stress is defined as the psychological reaction that occurs when parents encounter parenting-related challenges yet do not possess the resources (i.e., energy and time) to face these challenges (Holly et al., 2019). Children with special needs refer to children who have challenges which are more severe compared to a neurotypical child. The four main types of children with special needs include Physical (i.e., multiple sclerosis), Developmental (i.e., autism and down syndrome), Behavioral/Emotional (i.e., attention deficit hyperactive disorder) and Sensory Impaired (i.e., visually impaired) [Sowmya & Preethi, 2019].

International studies examined both parents with children with special needs and found increased parental stress during COVID-19 (Chen et al., 2020; Ren et al., 2020). Prior to the pandemic, most research focused on studying mothers' stress and neglected that of fathers' (Athari et al., 2013; Sowmya & Preethi, 2019). Yet, it should be noted that these days, traditional gender roles where fathers tend to be the sole breadwinner and mothers tend to be the homemaker are evolving in our dual-income society (Ho, 2021) and may be increasingly irrelevant as we move towards equal roles in parenting.

Parenting is stressful and arguably a culturally sensitive experience. For instance, there are unique stressors associated with living in Singapore (i.e., emphasis on academic achievement) compared to living in other countries (The Straits Times, 2013). Government-imposed measures and restrictions during the pandemic such as home-based learning for students (Ong, 2021) and work-from home arrangements (Mohan, 2021) are unique to our local context and may potentially affect the level and nature of parental stress during this period.

Furthermore, the studies conducted in Singapore examining the parental stress of both parents with neurotypical children during COVID-19 (Chung et al., 2020a; Chung et al., 2020b) may not be applicable to parenting children with special needs due to the differences in challenges. For example, children with special needs tend to also have co-occurring medical/psychological conditions, such as epilepsy and bipolar disorder, and

other behavioral challenges such as 'meltdowns' and tantrums (Morozov, 2018; Munir, 2016; Oldfield, 2012). In view of the differences in the challenges and experiences faced by parents, it is worthwhile to examine parent stress among these groups of parents.

The present study will be examining financial stress, work-family balance and resilience and its influence on fathers' parental stress comparing between fathers with children with special needs and father with neurotypical children.

Financial Stress

Fathers have greater parental stress when they experience financial difficulty (Athari et al., 2013; Ilias et al., 2018; Stack & Meredith, 2018). As explained by the Identity Theory of Stress, individuals identify more strongly with roles that are associated with a socially acceptable identity (Burke, 1991). Due to traditional Asian societal expectations, fathers tend to view themselves as the 'main financial provider' of the family, while mothers tend to view themselves as the 'home caregiver' (Yeng, 2010). Hence, when fathers experience financial difficulty, they tend to also have greater parental stress because they are not able to meet this role of 'main financial provider'.

Research has shown that it is costly to raise a child with special needs (Anderson et al., 2007). According to Shahat and Greco (2021), the annual cost of raising a child with special needs (till age 18) worldwide is approximately \$450 to \$69,500. Indeed, studies show that fathers of children with autism spectrum disorder tend to be more stressed about financial difficulty and have greater parental stress (Athari et al., 2013; Ilias et al., 2018). As experts highlight that the pandemic would have enduring after-effects on Singapore's economy (Khanna, 2021), this may suggest that financial stress may be a long-standing issue for Singaporeans and therefore worthwhile to examine the role of financial stress in parental stress among fathers with neurotypical children and fathers with children with special needs.

Work-Family Balance

Parents with neurotypical children, who report poor work-family balance may also have greater parental stress (Chung et al., 2020a). Work-family balance refers to an individual's ability to manage their employment problems with their family responsibilities (i.e., childcare arrangements) (Ten Brummelhuis & Bakker, 2012). According to the Work-Home Resources Model, work-family balance is a result of greater work-home enrichment and lesser work-home interference (Ten Brummelhuis & Bakker, 2012). The former occurs when contextual resources (i.e., social support from spouse or employer) increases one's personal resource (i.e., cognitive energy) to facilitate coping in the work/home domains. While the latter occurs when contextual demands deplete one's personal resource and affects how an individual copes in the work/home domains. Poor work-family balance may then lead to mental health issues such as parental stress and depression (Ten Brummelhuis & Bakker, 2012).

An online survey was conducted to collect data from 258 parents with neurotypical children in Singapore and results revealed that fathers were more likely than mothers to have higher levels of spousal/employer support and work-family balance, and hence lesser parental stress (Chung et al., 2020a). However, these findings may not apply to fathers of children with special needs because they tend to have more behavioural problems (Handwerk & Marshall 1998). For example, children with autism tend to be distressed over environmental changes (Hendricks & Palko, n.d.), resulting in frequent tantrums. Indeed, a study on a sample of 1584 parents with a child with autism, showed that 53.7% agreed that their child has aggressive behaviors (Mazurek et al., 2013). Another study also demonstrated that children with learning disabilities tend to also be more aggressive than neurotypical children (Handwerk & Marshall 1998).

Resilience

Resilience typically represents personal qualities that enable an individual to thrive in the face of adversity (Liu et al., 2018). Research shows that resilience is associated with stress. For instance, a highly activated medial prefrontal cortex (mPFC) tend to help manage stress pathways better (Liu et al., 2018).

A quantitative study was conducted by Vela and Manuel (2020) to examine resilience, stress and satisfaction of parents with neurotypical children (n=121) and parents with children with special needs (n=178). Results from regression analyses demonstrate that resilience is able to predict familial stress in a statistically significant way (Vela & Manuel, 2020). However, these studies were conducted prior to COVID-19 and may not be as relevant now. The government measures due to COVID-19 (as mentioned earlier) [Mohan, 2021; Ong, 2021] and the health concerns due to COVID-19 has led to social isolation and resulted in stress and frustration (Cheon, n.d.). Does resilience then play a role in helping fathers with neurotypical children and fathers with children with special needs to mediate parental stress amidst the challenges during COVID-19?

Parental Stress and Age group of Children with Special Needs

According to the Enabling Guide (n.d.), there are three main age-groups for children with special needs in Singapore based on their different life stages. They are 0-6 years old (infancy to pre-primary), 7-12 years old (primary) and 13-18 years old (Secondary to tertiary).

Firstly, children aged between 0-6 years old can be categorized as infants/young children, who will be primarily receiving early intervention services and/or Child-care (SG Enable, n.d.).

Secondly, children aged between 7-12 years old can be categorized as school-aged children, who will be primarily receiving primary school education in either mainstream

or special education schools (Enabling Guide, n.d.).

Lastly, children aged between 13-18 years old can be categorized as teens, who will primarily be receiving secondary to tertiary education in mainstream or special education schools (Enabling Guide, n.d.).

Do fathers of children with special needs then have different concerns due to the different developmental and psychosocial needs of children in the different age groups?

According to Rimmerman and Duvdevani (1996), when children with intellectual disabilities start schooling at 7 years old, parents may start to be more aware of the achievement differences between their child and other students. This then leads to greater parental stress. As parents may have different concerns for their children at different life stages, it is meaningful to fathers' stress in parenting a child with special needs between the different age-groups (0 to 6 years old, 7-12 years old and 13-18 years old) during COVID-19.

RESEARCH QUESTIONS

1. Do fathers with children with special needs experience more parenting stress than fathers with neurotypical children during the pandemic?
- 2a. What is the relationship between parental stress and the three variables (financial stress, perceived work-family balance and resilience) for fathers with neurotypical children during COVID-19?
- 2b. Can parental stress of fathers with neurotypical children be predicted by their levels of financial stress, perceived work-family balance and resilience during COVID-19?
- 3a. What is the relationship between parental stress and the three variables (financial stress, perceived work-family balance and resilience) for fathers with children with special needs during COVID-19?
- 3b. Can parental stress of fathers with children with special needs be predicted by their levels of financial stress, perceived work-family balance and resilience during COVID-19?
4. Do differences exist between the parental stress of fathers with infants/ young children, school-aged children and teens with special needs during COVID-19?

Table 1. Parental Stress Scale, APR Financial Stress Scale, Perceived Work-Family Balance survey and Brief Resilience Scale

Name of measurement	Description	Psychometric properties
Parental Stress Scale	18 items Low score = low level of parental stress high score = high level of parental stress	Good reliability, construct validity and convergent validity in a sample of 1096 parents from Norway (Nærde & Sommer Hukkelberg, 2020).
APR Financial Stress Scale	Affective dimension consists of 8 items measuring 3 subcategories (Depression, Anxiety and emotional exhaustion due to financial stress). Relational dimension consists of 8 items measuring work-related and non-work-related interpersonal behaviour due to financial stress. Physiological dimension consists of 8 items measuring six common systemic responses due to financial stress: respiratory, cardiovascular, gastrointestinal, nervous system, musculoskeletal, and endocrine system responses. Low score = low level of financial stress. High score = high level of financial stress	High internal consistency reliability between dimensions (Cronbach Alpha value of .95, .91 and .94 for the affective, relational and physiological dimensions respectively) [Heo et al., 2020].
Perceived Work-Family Balance survey	3 items Low score = high level of perceived work-family balance high score = low level of perceived work-family balance	Previously used to assess work-life balance and the well-being of working parents with a chronically ill or disabled child in New Jersey (Jang, 2008).
Brief Resilience Scale	6 items Low score = low level of resilience high score = high level of resilience	High internal consistency ($\alpha = .71$) amongst a sample of 511 Chinese (Fung, 2020).

METHODS

Participants

Participants included 171 fathers. They were recruited from organizations such as School of the Arts, Rosyth School, New Life Community Services, Asian Women's Welfare Association (AWWA), Early Childhood Development Agency and Dyslexia Association of Singapore.

Research measures

4 measures were selected to address the research objectives, with their description and psychometric properties outlined in Table 1.

Measurements

The items on the scales were scored on a 5-point likert scale ranging from '1' to '5' ('1 = strongly disagree', '2 = disagree', '3 = neutral', '4 = agree', '5 = strongly agree').

RESULTS

1. Do fathers with children with special needs experience more parenting stress than fathers with neurotypical children during the pandemic?

Due to the huge difference in sample size between the fathers with children with special needs ($n = 42$) and the fathers with neurotypical children ($n = 129$), we matched the participants according to the 'number of children' each participant has (case-matching). The following analysis was based on 42 fathers with children with special needs and 42 fathers with neurotypical children, both groups reported similar number of children.

Table 2. Results of independent samples t-test and Descriptive Statistics for Parental Stress Scores (Fathers with neurotypical children and Fathers with children with special needs)

	Fathers with Neurotypical Children			Fathers with Children with Special Needs			$t(82)$	p	Cohen's d
	M	SD	n	M	SD	n			
Parental Stress Scores	40.12	8.376	42	45.10	9.378	42	-2.565	.012	.56

Note. M = Mean, SD = Standard Deviation, n = total number of participants in the sample

Fathers with children with special needs experience greater parental stress ($M = 45.10$, $SD = 9.378$) than fathers with neurotypical children during COVID-19 ($M = 40.12$, $SD = 8.376$), $t(82) = -2.565$, $p = .012$. Cohen's d was also used to report the standardized mean difference of an effect (Cohen, 1988). Where, Cohen's $d = .2$ refers to small effect sizes, Cohen's $d = .5$ refers to medium effect sizes and Cohen's $d \geq .8$ refers to large effect sizes (Cohen, 1988). The effect size for Hypothesis 1 is Cohen's $d = .56$ (medium)

2a. What is the relationship between parental stress and the three variables (financial stress, perceived work-family balance and resilience) for fathers with neurotypical children during COVID-19?

Financial stress, perceived work-family balance, and resilience have statistically significant correlations with parental stress. (Table 3)

Table 3. Descriptive Statistics and Correlations Coefficients for Financial Stress, Perceived Work-Family Balance and Resilience with Parental Stress for Fathers with Neurotypical Children ($n = 129$)

Variable	<i>n</i>	<i>M</i>	<i>SD</i>	1	2	3	4
1. Parental Stress	129	40.22	9.166	-			
2. Financial Stress	129	48.93	20.747	.504*	-		
3. Perceived Work-Family Balance	129	10.08	2.879	-.418*	-.500*	-	
4. Resilience	129	22.27	4.040	-.370*	-.447*	.265**	-

Note. *M* = Mean, *SD* = Standard Deviation, *n* = total number of participants in the sample

* $p = .000$. ** $p = .001$.

2b. Can parental stress of fathers with neurotypical children be predicted by their levels of financial stress, perceived work-family balance and resilience during COVID-19?

Financial stress is the strongest predictor of Parental stress compared to the other two variables. The coefficient of determination indicates that the total variance that is explained by the independent variables is 31.4%. (Table 4)

Table 4. Regression Coefficients for Financial Stress, Perceived Work-Family Balance and Resilience in predicting Parental Stress for Fathers with Neurotypical Children ($n = 129$)

	Unstandardized Coefficients		Standardized Coefficients	<i>t</i>	<i>p</i>
	B	SE	Beta		
(constant)	48.609	6.281		7.739	.000
Financial Stress	.143	.041	.323	3.495	.001
Perceived Work-Family Balance	-.672	.273	-.211	-2.465	.015
Resilience	-.386	.188	-.170	-2.051	.042

Note. Dependent Variable: Parental Stress.

$R^2 = .314$

Table 5. Analysis of Variance (ANOVA) for Multiple Linear Regression

	Sum of Squares	<i>df</i>	Mean Square	<i>F</i>	<i>p</i>
Regression	3376.313	3	1125.438	19.068	.000
Residual	7377.609	125	59.021		
Total	10753.922	128			

Note. *df* = Degree of Freedom.

Dependent Variable: Parental Stress

Predictors: (Constant), Financial Stress, Perceived Work-Family Balance and Resilience

The model is a statistically significant predictor of the dependent variable, $F(3, 125) = 19.068$, $p = .000$. (Table 5)

3a. What is the relationship between parental stress and the three variables (financial stress, perceived work-family balance and resilience) for fathers with children with special needs during COVID-19?

Financial stress, perceived work-family balance, and resilience have statistically significant correlations with parental stress for fathers with children with special needs during COVID-19. (Table 6)

Table 6. Descriptive Statistics and Correlations Coefficients for Financial Stress, Perceived Work-Family Balance and Resilience with Parental Stress for Fathers with Children with Special Needs ($n = 42$)

Variable	<i>n</i>	<i>M</i>	<i>SD</i>	1	2	3	4
1. Parental Stress	42	45.10	9.378	-			
2. Financial Stress	42	56.50	24.261	.607*	-		
3. Perceived Work-Family Balance	42	8.81	3.373	-.548*	-.572*	-	
4. Resilience	42	20.74	3.306	-.485**	-.519*	.260***	-

Note. n = total number of participants in the sample, M = Mean, SD = Standard Deviation.

* $p = .000$. ** $p = .001$. *** $p = .048$

3b. Can parental stress of fathers with children with special needs be predicted by their levels of financial stress, perceived work-family balance and resilience during COVID-19?

Perceived work-family balance is the strongest predictor of parental stress compared to the other 2 variables. The coefficient of determination R^2 indicates that the total variance that is explained by the independent variables is 47.3%. (Table 7)

The model is a statistically significant predictor of the dependent variable, $F(3, 38) = 11.361$, $p = .000$. (Table 8)

Table 7. Regression Coefficients for Financial Stress, Perceived Work-Family Balance and Resilience in predicting Parental Stress for Fathers with Children with Special Needs ($n = 42$)

	Unstandardized Coefficients		Standardized Coefficients	<i>t</i>	<i>p</i>
	B	SE	Beta		
(constant)	60.744	11.629		5.223	.000
Financial Stress	.116	.063	.300	1.848	.072
Perceived Work-Family Balance	-.866	.400	-.311	-2.165	.037
Resilience	-.703	.391	-.248	-1.796	.080

Note. Dependent Variable: Parental Stress.

$R^2 = .473$

Table 8
Analysis of Variance (ANOVA) for Multiple Linear Regression

	Sum of Squares	<i>df</i>	Mean Square	<i>F</i>	<i>p</i>
Regression	1704.865	3	568.288	11.361	.000
Residual	1900.754	38	50.020		
Total	3605.619	41			

Dependent Variable: Parental Stress

Predictors: (Constant), Financial Stress, Perceived Work-Family Balance and Resilience

4. Do differences exist between the parental stress of fathers with infants/young children, school-aged children and teens with special needs during COVID-19?

Statistically significant differences exist between the parental stress of fathers with infants/young children, school-aged children and teens with special needs during COVID-19, $F(2, 39) = 3.775$, $p = .032$. The Eta Square (η^2) measures the proportion of the variation in the dependent variable that can be explained by the different groups defined by independent variable (Cohen, 1988). Where, $\eta^2 = .01$ refers to small effect sizes, $\eta^2 = .06$ refers to medium effect sizes and $\eta^2 = .14$ refers to large effect sizes. The η^2 for the ANOVA in Research Question 4 is .16 or 16% (large effect size).

Table 9. Analysis of Variance (ANOVA) for Fathers with Fathers with Infant/Young Children with Special Needs ($n = 12$), Fathers with School-aged Children with Special Needs ($n = 16$) and Fathers with Teens with Special Needs ($n = 14$)

				Fathers with Infant/Young Children with Special Needs		Fathers with School-aged Children with Special Needs		Fathers with Teens with Special Needs	
Dependent Variable	$F(2, 39)$	P	η^2	M	SD	M	SD	M	SD
Parental Stress	3.775	.032	.16	50.92	9.895	43.44	7.763	42.00	8.944

A Post-hoc test, known as Tukey's Honestly Significant Difference test (HSD) [Newcastle University, n.d.], was conducted (Table 10). A statistically significant difference ($p = .036$) can be seen between the means of parental stress for fathers with infants/young children with special needs ($M = 50.92$, $SD = 9.895$) and the means of parental stress for fathers with teens with special needs ($M = 42.00$, $SD = 8.944$).

Table 10. Tukey's HSD for Fathers with Fathers with Infant/Young Children with Special Needs ($n=12$), Fathers with School-aged Children with Special Needs ($n=16$) and Fathers with Teens with Special Needs ($n=14$)

(I) Group	(J) Group	Mean Difference (I-J)	SE	p
Fathers with Infant/Young Children with Special Needs	Fathers with School-aged Children with Special Needs	7.479	3.361	.079
Fathers with Infant/Young Children with Special Needs	Fathers with Teens with Special Needs	8.917	3.462	.036
Fathers with School-aged Children with Special Needs	Fathers with Teens with Special Needs	1.438	3.221	.896

Note. SE = Standard Error.

DISCUSSION

Do fathers with children with special needs experience more parenting stress than fathers with neurotypical children during the pandemic?

Fathers with children with special needs experience more parental stress than fathers with neurotypical children during COVID-19 [$t(82) = -2.565$, $p = .012$], with medium effect sizes (Cohen's $d = 0.56$).

The current findings are aligned with findings from past studies where both parents with children with special needs were found to have increased parental stress during COVID-19 (Chen et al., 2020; Ren et al., 2020). Hence, more support (workshop/resources/programmes) should be catered for fathers with children with special needs to help alleviate parental stress.

2a and 3a. What is the relationship between parental stress and the three variables (financial stress, perceived work-family balance and resilience) for fathers with neurotypical children/children with special needs during COVID-19?

Financial Stress and Parental Stress. Our results show that fathers with children with special needs have a stronger correlation coefficient ($r = .607$) for the relationship between financial stress and parental stress, compared to fathers with neurotypical children ($r = .504$).

Fathers with children with special needs may be worried about their finances due to the sudden poor economy because of COVID-19 [Tang, 2020], and the higher costs of raising a child with special needs compared to raising a neurotypical child (Shahat & Greco, 2021). They may, therefore, also have greater parental stress as they perceived that they are not able to fulfil their role as 'main financial provider' during COVID-19.

Interestingly, the correlation coefficient for the relationship between financial stress and parental stress for fathers with children with special needs ($r = .607$) is also the strongest. This suggests that greater financial support can be provided for fathers with children with special needs during COVID-19

In Singapore, there are insurance policies for children with autism and down's syndrome that provide a payout for the insured person (child) in the event of accidental death or permanent disability of the policy holder (parent), and cover accident expenses for the child (Goh, 2019). Despite so, hospitalization and critical illness expenses (which may be the bulk of the expenses) will not be covered. This is because insurance companies may not be keen to insure children with special needs due to their higher risk for medical conditions and self-inflicting behaviors that may require hospitalization (Oldfield, 2012). As such, community partners/government agencies may consider partnering with insurance companies to ensure adequate insurance coverage (hospitalization and critical illness) for children with special needs.

Perceived Work-Family Balance and Parental Stress. Our results show that fathers with children with special needs have a stronger correlation coefficient ($r = -.548$) for the relationship between perceived work-family balance and parental stress, compared to fathers with neurotypical children ($r = -.418$).

This could be because the changes due to COVID-19 may have resulted in children with special needs exhibiting more behavioral problems during COVID-19 (Cerebral Palsy Alliance Singapore, n.d). As stated earlier, children with autism tend to be distressed over environmental changes (Hendricks & Palko, n.d.). They may therefore, face difficulty in adapting to these new safe-distancing measures, which may result in poor emotional regulation and increased behavioral problems/self-inflicted injuries (Cerebral Palsy Alliance Singapore, n.d). For example, children with autism with sensory issues may be more resistant to wearing masks due to the tactile discomfort and hence, throw a tantrum. Fathers may then find it stressful to manage their child's behaviors while working from home. According to the Work-Home Resources Model (Ten Brummelhuis & Bakker, 2012), this may then increase work-home interference and result in poorer work-

family balance and greater parental stress.

Resilience and Parental Stress. Our results show that fathers with children with special needs have a stronger correlation coefficient ($r = -.485$) for the relationship between resilience and parental stress, compared to fathers with neurotypical children ($r = -.370$).

This could be because children with special needs tend to also have co-occurring medical/psychological conditions (Morozov, 2018; Munir, 2016), which may increase their susceptibility to severe COVID-19. For example, research shows that underlying mental health conditions (such as schizophrenia) and medical conditions (such as down syndrome) may increase the risk for severe COVID-19 (Centers for Disease Control and Prevention, 2021b). Relatedly, children with special needs tend to also have these high-risk mental health/medical conditions (Morozov, 2018; Munir, 2016). As such, fathers may be more protective of the child with special needs and may therefore, need to be more resilient to mediate the increase in parental stress.

2b and 3b. Can parental stress of fathers with neurotypical children/children with special needs be predicted by their levels of financial stress, perceived work-family balance and resilience during COVID-19?

Fathers with Neurotypical Children. Financial stress, perceived work-family balance and resilience have statistically significant predictions for parental stress for Fathers with neurotypical children during COVID-19. Financial stress is also the strongest predictor of parental stress (standardized coefficient = .323, $p = .001$). This suggests that we should focus on decreasing financial stress.

It should be noted, however, that our results suggest that perceived financial stress (not financial difficulty) is a statistically significant predictor for parental stress for fathers with neurotypical children. This suggests that fathers who are satisfied with their finances, may not have parental stress even if they are low on finances. Hence, we suggest that financial literacy programs be implemented for fathers with neurotypical children with an emphasis on the importance of 'financial satisfaction' or being satisfied with one's finances.

It is also noted that Resilience is a stronger predictor of parental stress for Fathers with neurotypical children (standardized coefficient = -.170, $p = .042$) compared to fathers with children with special needs (standardized coefficient = -.248, $p = .080$). According to the Walsh Family Resilience Theory, there are three domains that contribute to resilience in parents: family belief systems (i.e., maintaining a positive outlook), family organizational processes (i.e., positive interpersonal relationships) and family communication processes (i.e., collaborative communication) [Walsh, 2003]. This suggests that we should also consider the father as part of the family 'unit' and not as an individual. As such, we

suggest that family resilience workshops can be targeted towards fathers with neurotypical children to reduce parental stress overtime.

Fathers with Children with Special Needs. In contrast, perceived work-family balance is the only statistically significant predictor for parental stress for fathers with children with special needs during COVID-19 (standardized coefficient = $-.311$, $p = .037$). As such, we should focus on increasing perceived work-family balance.

In general, there is a lack of community awareness about special needs and social stigma in parenting a child with special needs in Singapore (Goh, 2020). This suggests that employers are also less aware of the difficulties that their employees faced in parenting a child with special needs. Hence, we suggest to increase employer's awareness of the difficulties that their employees face when parenting a child with special needs. This is in line with the Third Enabling Masterplan's goal (launched in 2019) in building a more inclusive society for persons with disabilities in Singapore (Goh, 2021a).

4. Do differences exist between the parental stress of fathers with infants/young children, school-aged children and teens with special needs during COVID-19?

Statistically significant differences exist between the parental stress of fathers with infants/young children, school-aged children and teens with special needs during COVID-19 [$F(2, 39) = 3.775$, $p = .032$], with large effect sizes ($= .16$). This suggests that Fathers may have different concerns for their child with special needs at different age groups.

Firstly, a father of an infant/young child with special needs (aged 0-6 years old) may be concerned about their child's developmental outcomes (Centers for Disease Control and Prevention, 2021a). For instance, they may be stressed if their child is not able to crawl by 9 months and walk by 2 years old.

Secondly, a father of a school-aged child with special needs (aged 7-12 years old) may be concerned about their child's educational pathways and academic achievements. This is supported by Rimmerman and Duvdevani (1996) who stated that when children with intellectual disabilities start schooling at 7 years old, parents may start prioritizing their child's educational attainments.

Lastly, a father with teens with special needs (aged 13-18 years old) may be concerned about their teen's work-readiness skills as they transition towards preparation for work or be concerned about their self-help skills as they transition towards long term care planning [i.e., living in an Adult Disability Home] (McGuirk, 2016).

It should also be noted that there is a statistically significant difference ($p = .036$) between the parental stress of fathers of infants/young children with special needs ($n =$

12, $M = 50.92$, $SD = 9.895$) and fathers of teens with special needs ($n = 14$, $M = 42.00$, $SD = 8.944$), with the former group having a higher mean parental stress score. This could be because children with special needs are often diagnosed during their infancy/childhood (0-6 years old) and their fathers may still be learning to accept their child's recent diagnosis. This is supported by Hornby (1992) who argued that fathers often react intensely to their child's initial diagnosis and often feel guilty and disappointed, which may decrease their overall well-being. On the other hand, it could be possible that fathers of teens with special needs may have eventually accepted their child's diagnosis over the years and thus, experience lesser parental stress.

Currently, there is a lack of workshop/resources on special needs awareness for expecting couples or new fathers with an infant younger than 1 years old. As such, workshops/resources may be provided for expecting couples/new fathers who are at high risk of having a child with special needs (i.e., strong family history of special needs, having a child born prematurely, child having a genetic risk for chromosomal disorders) [Erbeli et al., 2019].

Feedback from Industry Practitioners

We have suggested 6 recommendations in total (2 for fathers with neurotypical children and 4 for fathers with children with special needs). We then sought feedback from 5 industry practitioners (1 Special Education Lecturer, 1 Special Education Teacher, 1 Social Worker and 2 Educational Psychologists) regarding our recommendations.

Recommendations for Fathers with Neurotypical Children

Recommendation 1—More financial literacy programs that teach fathers on the importance of 'financial satisfaction' or being satisfied with one's finances.

Some of the Industry Practitioners suggested that schools can implement these financial literacy programs and share findings from surveys about the relationship between income and happiness, to teach 'financial satisfaction'. For example, a recent study from the Institute of Policy Studies demonstrated that income does not 'guarantee happiness' (Tan, 2021). The results of the poll suggests that the key to happiness is to be contented with one's level of wealth and financial literacy programs may emphasize this aspect of 'financial satisfaction'.

Recommendation 2—More family resilience workshops that emphasizes on positive family relationships and open communication.

The Industry Practitioners suggested involving role-play activities on how fathers can learn to communicate better with their family. While others suggested using movie clips from 'family-friendly movies' (i.e., Lilo and Stitch) to emphasize on the importance of healthy communication with their family.

Recommendations for Fathers with Children with Special Needs

Recommendation 1—More support should be catered for fathers with children with special needs to help alleviate parental stress.

Some of the Industry Practitioners suggested 'respite' programs for fathers with children with special needs. This may involve recruiting volunteers to entertain the children with games and activities, while the fathers engage in sports, such as soccer match, separately.

Recommendation 2—Extending insurance coverage for children with special needs.

The Industry Practitioners generally agreed that insurance companies will probably require funding from government agencies to even consider extending insurance coverage (hospitalization and critical illness) for children with special needs. Some also suggested that insurance (hospitalization and critical illness) can be provided for children with mild special needs who may be less prone to self-inflicting behaviors and/or medical conditions (Arkansas State University, 2019). The severity of the child with special needs can be determined by accompanying psychological/psychiatric reports or by looking at the Special Education School placement (i.e., schools catered for students with mild intellectual disabilities).

Recommendation 3—Increasing employer's awareness of the difficulties that their employees face when parenting a child with special needs.

Some of the Industry Practitioners suggested that community partners (i.e., SGenable) may consider spreading the awareness of special needs via public outreach programs.

Recommendation 4 - More workshops/resources for new fathers/expecting couples who are at high risk for having a child with special needs.

The Industry Practitioners suggested that special education schools collaborate with hospitals for this workshop. Fathers who are at high risk for having a child with special needs can then be informed of these workshops by the paediatrician. These workshops can involve teaching fathers on ways to take care of their child with special needs and ideas in supporting their spouses.

LIMITATIONS AND FUTURE RESEARCH

Firstly, the present study has a small sample size of 171 fathers (in total) and it is difficult for the results to be generalized to all fathers in Singapore. There was an even smaller sample size for fathers with children with special needs ($n = 42$) which could explain the non-significant results for Hypothesis 3b (Faber & Fonseca, 2014). Despite so, it should be

noted that this study is the first research of its kind in Singapore. As such, it may be used as an initial benchmark for future research involving more participants.

Secondly, the survey did not capture qualitative child-specific data, such as extent of child's functioning or common types of behavioural problems, which may also affect parental stress. Future research may, therefore, consider conducting focus group discussions and/or structured interview to collect more qualitative data to explore the other stressors that lead to parental stress in fathers.

Thirdly, the case-matching used for Hypothesis 1 is not very comprehensive because only one variable ('number of children') is used as a benchmark for selecting participants. This may influence the reliability of the results. Future research can consider recruiting more fathers with children with special needs for more reliable comparisons with fathers with neurotypical children. Hence, case-matching may no longer be necessary.

Future research may also consider examining parental stress of fathers post-covid to see if there are changes in parental stress levels compared to that seen during COVID-19 (data that was collected in our study). We can also look at the effect size of the t-test between parental stress of fathers with children with special needs and fathers with neurotypical children post COVID-19. Our results for hypothesis 1 had an effect size of Cohen's $d = .56$. If the post-covid effect size is smaller compared to our research's effect size (during COVID-19), it may suggest that the difference in parental stress is smaller after COVID-19. This could explain that COVID-19 is the reason for the increase in difference observed during COVID-19. If the post-covid effect size is larger than our research's effect size (during COVID-19), it may suggest that the difference in parental stress is greater after COVID-19. This may suggest that there may be other stressors that affect this difference post COVID-19.

CONCLUSION

This study aimed to compare the parental stress of fathers with neurotypical children and fathers with children with special needs in Singapore, during COVID-19. Results revealed that fathers with children with special needs tend to experience greater parental stress compared to fathers with neurotypical children. Their parental stress also has statistically significant correlations with financial stress, perceived work-family balance and resilience. Furthermore, all three variables studied are statistically significant predictors of parental stress for fathers with neurotypical children, while only perceived work-family balance is a statistically significant predictor of parental stress for fathers with children with special needs. Fathers with infants/young children also tend to have greater parental stress than fathers with teens with special needs. In view of the results, 6 recommendations were suggested (2 for fathers with neurotypical children and 4 for fathers with children with special needs). Despite so, this research has its limitations and future research can be conducted to address them. In overall, the parental stress of

fathers (with and without children with special needs) should not be underestimated and the general public should be made aware of the difficulties that they faced. In doing so, it is hoped that more support can be offered for fathers.

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ONE IN 10
people will have some form
of learning difference.

People with
dyslexia uses the
RIGHT BRAIN
more than the left
when learning.



People with dyslexia can find
UNIQUE SOLUTIONS
to problems.



Around **40%** of
people with dyslexia
also have **ADHD**.

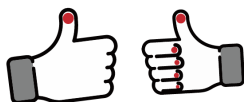


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**STRONG VISUALISATION
SKILLS.**



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RUNS IN FAMILIES.**
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of having dyslexia if one
parent has it.

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words in reverse. The
b & d
**LETTER
REVERSAL**
occurs when
they are unable to
name the letter.



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Effectiveness of Mobile Assistive Technology on Improving the Self-Perceptions of Students with Dyslexia in Singapore

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Abstract

Assistive Technology (AT) has become a prevalent form of dyslexia intervention for addressing students' challenges in reading and learning. Besides improved reading and learning outcomes, AT use can also help to address students' psycho-social and behavioural needs. Lexicaid is a novel mobile application that was developed collaboratively based on input from various dyslexia stakeholders. To determine the efficacy of Lexicaid, a preliminary user study was conducted with students undergoing formal dyslexia remediation at the Dyslexia Association of Singapore. As part of a home-based study, a final number of 31 students ($M_{age}=10.84$ years, $SD=1.39$) participated in a user study involving Lexicaid over a period of six weeks whilst completing daily reading and learning activities. Participants were assessed on their reading motivation, self-perception, and reading and language skills before and after the intervention period. Although no significant effects were found between the experimental ($n=18$) and control ($n=13$) groups' pre and post scores on measures of reading and language, we found significant improvements in students' self-perception of writing and overall findings suggest that students saw improvements in their self-perception of writing and reading capabilities as well as a greater value in reading after the intervention using Lexicaid.

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Keywords: dyslexia, Singaporean students, assistive technology, mobile intervention

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INTRODUCTION

Dyslexia

Dyslexia is a prevalent specific learning disability that approximately affects 10% of the population (Hulme & Snowling, 2016). According to the Ministry of Education, about 3.5% of Primary 3 students in Singapore were reported as having dyslexia, with an additional 1% of the population being diagnosed by Secondary 1 (Wee, 2021). Individuals with dyslexia typically experience impairments in the development of their reading and spelling abilities. Other deficits in phonological processing and decoding can contribute to inaccurate word reading, which subsequently impedes students' reading comprehension and other academic abilities (Snowling, 2012; 2013). Early and appropriate interventions are thus necessary to better address the academic and emotional consequences of dyslexia (Galuschka et al., 2014).

Socio-Emotional and Behavioural Outcomes

Dyslexic individuals face challenges in word decoding, which subsequently affects their reading fluency and comprehension. This conversely can negatively impact their reading motivation, reading self-concept and willingness to engage in reading-related activities (Barber & Klauda, 2020; Mihandoost, 2012). Thus, compared to their typically developing (TD) peers, dyslexic individuals also face a higher risk of negative emotional outcomes such as having higher anxiety and poorer levels of self-perception and motivation, which may further result in additional avoidance of reading activities and schoolwork (Carroll & Iles, 2006; Terras, Thompson, & Minnis, 2009). Such reduced exposure to reading and language further exacerbates the achievement gap between dyslexic students and their TD peers (Carroll & Iles, 2006; Terras, Thompson, & Minnis, 2009). Given the bi-directional relationship between student motivation and academic achievement, encouraging students' intrinsic motivation and sense of academic self-efficacy can contribute to improved academic outcomes (Niehaus, Rudasill & Adelson, 2012).

Assistive Technology

Assistive Technology (AT) can be defined as an equipment or software that enables one to overcome their disabilities, improve their functional capabilities or perform specific tasks (Ahmad, 2015). On one hand, ATs for dyslexic individuals that utilized technology such as Text-to-Speech (TTS) and Optical Character Recognition (OCR) reduce the need for decoding in word reading and have been used in existing inventions with promising reading outcomes for dyslexic individuals (Harper et al., 2017; Landulfo et al., 2015; Lindeblad et al., 2016; Nordström et al., 2018; Wood et al., 2018). On the other hand, ATs that utilized other technologies, such as smartphone applications, screen readers, flatbed scanners, e-Book readers, and embossers, are considered to have slow processing speeds, poor accuracy, cumbersome usability or limited functionality (Alghabban et al.,

2017; Nelson et al., 2003; Zakopoulou, et al., 2017). Although there is growing interest in technology-based interventions, as reflected in the large number of mobile apps available for download on various app stores (Dawson et al., 2016; Jamshidifarsani et al., 2019), many of the existing mobile applications have a limited or incomplete perspective of dyslexia and its interventions (Dawson et al., 2016; Wood et al., 2018). The use of more specialized assistive technologies is also limited by the lack of affordability, lack of skilled personnel for training support or lack of knowledge on implementing AT interventions (de Witte et al., 2018; LoPresti et al., 2008). Importantly, Dawson et al. (2016) found that not many apps had been developed with input or collaboration from dyslexia experts and stakeholders. Rather, a significant portion of apps has been developed with an oversimplified concept of dyslexia and failed to account for the importance of multisensory and holistic learning approaches.

In order to develop an AT platform that would accurately meet the needs of various dyslexia stakeholders, Yow et al. (2019) conducted focus group discussion sessions with Educational Therapists (EdTs) to better understand the challenges faced by dyslexic children, their experiences, feedback and concerns with AT platforms, as well as existing intervention methods. The lack of resources, knowledge, and support beyond the classroom were highlighted as the key challenges faced in the current classrooms for AT adoption. The EdTs highlighted that a customisable multi-sensory learning tool for efficient identification of word and meaning would increase user-engagement and knowledge retention. The overall recommendation was for an AT to provide options for the user to access different learning features, such as the word definition and examples in the forms of images or sentences. The AT output should incorporate both auditory and visual stimuli to facilitate multisensory learning. Auditory output should also be adjustable for aspects such as speed, volume, accent or gender of the voice output. Given these prior findings, Lexicaid was subsequently developed to enable single-word identification of printed texts with customisable word-learning features and multi-sensory design (e.g., provision of word definition, spelling, and flashcards). The present study thus aims to investigate the efficacy of Lexicaid as an AT platform for dyslexic students. Reading and language outcomes, reading motivation and student self-perception were explored following a six-week intervention using Lexicaid.

METHODS

Participants

Forty-five children, who were attending formal dyslexia remediation at the Dyslexia Association of Singapore (DAS), were recruited for the study at the end of their school year. At the point of participant recruitment, the students' grade levels ranged from Primary 2 to Primary 6. Throughout the study, eight families were no longer responsive and could not be contacted for further participation in the study. Six additional students dropped out of the study, citing a lack of time or did not complete the study, leaving a

final sample size of 31 participants ($M_{age}=10.84$ years, $SD=1.39$, range=7.96 -12.79 years; 20 males & 11 females). All participants were also attending mainstream primary schools in Singapore (see Table 1), and had been formally diagnosed with dyslexia.

Table 1: Demographic characteristics of participants.

	Experimental	Control
No. of Participants, n (%)	18	13
Primary 2	2 (11.1)	1 (7.7)
Primary 3	3 (16.7)	4 (30.7)
Primary 4	1 (5.5)	0 (0.0)
Primary 5	5 (27.8)	2 (15.4)
Primary 6	7 (38.9)	6 (46.2)
Mean Age in years (SD)	10.90 (1.48)	10.76 (1.37)
Gender, n (%)		
Female	6 (33.3)	5 (38.5)
Male	12 (66.7)	8 (61.5)

Materials

Technology Familiarity Questionnaire (TFQ)

The TFQ (see Appendix A) was adapted from the ICT Familiarity Questionnaire for Programme for International Student Assessment (PISA) by the Organisation for Economic Co-operation and Development (OCED) in 2018. The questions aimed to explore the different aspects of digital media and digital devices including age of access, type of ICT available at home and in school, as well as the frequency of ICT use at home and in school. The digital media and digital devices listed in the ICT Familiarity Questionnaire included desktop computers, laptops, smartphones, mobile or tablet devices and gaming consoles. In line with our study interest on the use of technology as a tool for facilitating reading and learning, we also included "specialised reading devices or tools - such as a reading pen" in our questionnaire. Scores for technology available for use range from 0 to 27, where higher scores indicate more technology available for the student to use, and scores for frequency of use range from 0 to 45, where higher scores indicate higher frequency of use.

Motivation to Read Profile-Revised (MRP-R) (Malloy et al., 2013).

The MRP-R is a two-part measure that consists of a self-report reading survey and a conversational interview. The reading survey consists of 20 items, where participants rated their perceptions on a four-point Likert scale. It measures an individual's perceived value of reading and self-concept as a reader. To facilitate the younger students' completion of the survey, the MRP-R response section was modified to include an accompanying smiley-face scale (see Figure 1). All items were read out loud to respondents, and they had to indicate which response was the best for them. Survey responses were all recorded via Qualtrics. Following the reading survey, a conversational interview was carried out to further understand the student's perception of reading, and complement the understanding of the child's reading survey responses. The interview also had two sections on the value of reading (e.g., "What kind of books do you like to read? Tell me about them (topics, genres, information and /or narrative?)") and reader's self-concept (e.g., "What kind of reader are you?").

1	2	3	4
			

1. My friends think I am:

A very good reader	A good reader	An OK reader	A poor reader
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Figure 1: Sample MRP-R reading survey item with smiley-face scale

Self-Perception Profile for Learning Disabled Students (SPPLD) (Renick & Harter, 2012).

The SPPLD is a self-report measure that assesses children's self-perception of their competency or adequacy in specific domains, as well as their perceived self-worth and esteem. The SPPLD was developed for use by learning disabled children, but can also be administered for normally-achieving students (Harter, 1988). It assesses children's self-perception on the following ten domains of General Intellectual Ability, Reading Competence, Writing Competence, Spelling Competence, Math Competence, Athletic Competence, Social Acceptance, Physical Acceptance, Behavioural Conduct and Global Self-Worth (see Appendix B). Two opposing statements (e.g., "Some kids are sure that they are pretty smart in school" and "Other kids are not so sure that they are all that smart in school") were read out loud to respondents, who had to determine which statement was more like them. Respondents had to subsequently determine if the

selected statement was “Really true for (them)” or “Sort of true for (them)”. Responses were all recorded via Qualtrics. Items were then scored to reflect their self-perception on a four-point scale with 1 being the least competent and 4 being the most competent.

Wechsler Individual Achievement Test, 4th Edition (WIAT-IV)

The WIAT-IV is an individually administered achievement test that can be used to measure academic achievement for young childhood to adulthood. Six selected subtests were used in this study for measuring reading and language: Spelling, Word Reading, Reading Comprehension, Orthographic Fluency, Pseudoword Decoding, and Decoding Fluency (see Appendix C). Due to Covid-19 restrictions, the WIAT-IV subtests were administered remotely via Zoom for 23 students. However, to accommodate the participants’ school restrictions and schedules, an allied educator administered the tests in-person for the remaining 8 students. Except for the spelling subtest, all other subtests were audio recorded to clarify participants’ responses where needed. All items were scored manually based on a standard procedure. The scoring was also discussed between researchers to ensure inter-rater reliability and to account for any discrepancies or disagreements surrounding ambiguous response items.

Lexicaid

Lexicaid is a mobile application developed by the research team that aims to facilitate independent word reading and learning among primary school-aged dyslexic students. Taking into account input from dyslexia professionals and intervention therapists, Lexicaid has two key uses – (i) a word scanning module and (ii) a flashcard module. The word scanning module enables the user to take a picture of a text passage or word (see Figure 2). Using OCR and TTS technology, the single word selected by the user can then

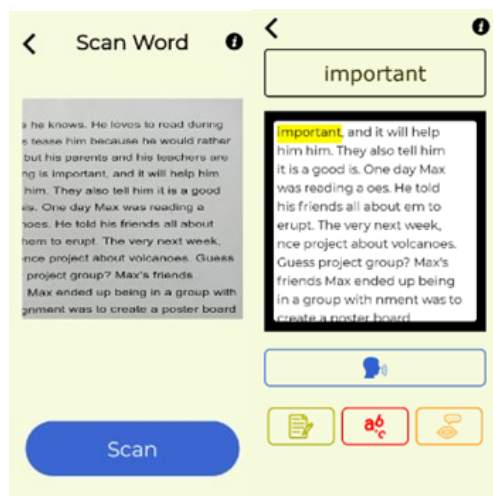


Figure 2: Word scanning module and selected word ‘important’

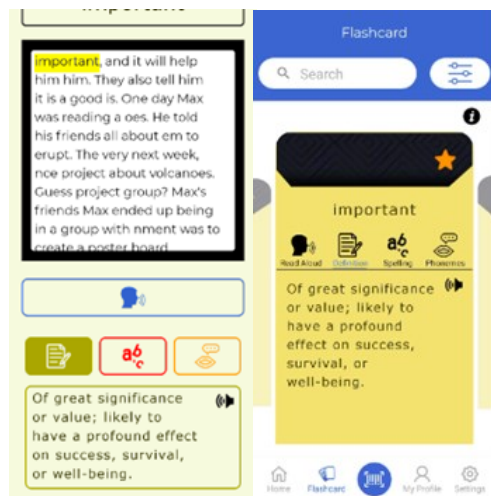


Figure 3: Definition learning feature in the word scanning and flashcard mode respectively

be extracted and identified. Supplementary learning features of pronunciation, definition, spelling and phonemic breakdowns, are provided to help the user identify and learn the word (Figure 3). The flashcard module integrates the practice of flashcard use in dyslexia intervention to reinforce word learning through repetition. Users are able to access previously scanned words, or input their own words for learning and revision (see Figure 4).

Lexicaid also allows for the customisation of audio output and font display to optimise the reading and learning experience for children with specific learning disabilities or dyslexia (Yow et al., 2019) (see Figure 5).

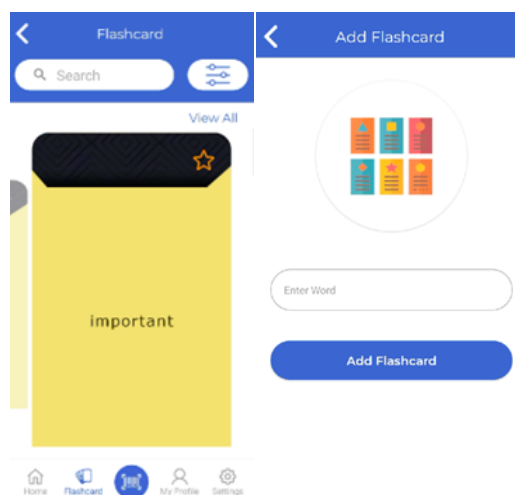


Figure 4: Sample flashcard and the 'Add Flashcard' feature

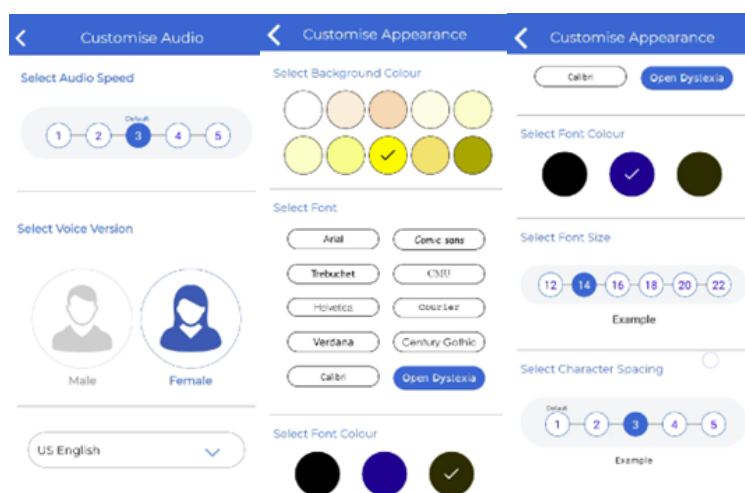


Figure 5: Audio and text customisation features

Mobile Phone Set Up

A Realme 6 Android Phone, running on Android OS 10, was used in the study as it met all the technical requirements for operating Lexicaid effectively. Each participant was also given a phone, a set of headphones and a charging unit. Lexicaid was pre-installed on all mobile phones. To ensure that the mobile phone would be used solely for the purpose of the study, all non-essential applications were deleted or removed from the home screen. Access to mobile functions and settings were disabled and restricted via a

password set by the research team. Parents were informed to reach out to the research team for support or technical assistance with the phone during the study period.

Lexicaid Feedback Questionnaire (LFQ)

To better understand participants' experience of Lexicaid use, a self-report feedback questionnaire was adapted from Form 4-1-3 of the Matching Person and Technology Assessment (MPT) (Scherer & Craddock, 2002) and conducted via Qualtrics (see Appendix D). The MPT assessment process consists of many different forms to determine the various personal and social factors that may impact the use of assistive, educational, workplace or health-care technologies. Form 4-1-3 is a follow-up assessment that explores an user's disposition and attitudes towards AT to identify any difficulties that the user may have experienced. Additional open-ended questions, such as which features were preferred or disliked, for what activities Lexicaid was most often used, areas of improvement or suggestions for further iterations, were included.

PROCEDURE

Letters of invitation were disseminated to parents to indicate their interest in having their child participate in the study. Upon responding to the letter of invitation, participants were first randomly assigned to either an experimental or control group. Participants in either groups were blind to the condition that they were in to minimize any expectancy effects of using the app (Rosenthal, 1987). As such, there were two separate sets of participant information sheets and consent forms that were then disseminated to the participants' parents in the respective conditions. Parental consent was then obtained, and participant demographics such as birthdate and socioeconomic status (SES) were also collected.

Besides being used at home, Lexicaid was initially expected to be used during school hours or during intervention sessions as well. However, given the ever-changing Covid-19 restrictions, there was uncertainty as to whether or not students would be engaged in remote or in-person learning. A home-based study was thus deemed more suitable and less likely to be disrupted. Measures were converted to online mediums using Microsoft Powerpoint or the online survey platform, Qualtrics, and most pre- and post-tests were thus conducted online over Zoom. However, to accommodate the school's requests and students' schedules, the WIAT-IV had to be administered in-person instead for eight participants.

Pre- and post-tests were conducted for all participants before and after a six-week study period. Students were assessed on their reading motivation, self-perception, and on measures of reading and language as part of each test. Given the number of tests, and to reduce the likelihood of participant fatigue, pre and post-tests were conducted over two days. The MRP-R, SPPLD and the TFQ were conducted on the first day, while WIAT-IV tests were conducted on the second day. The TFQ was only conducted during pre-testing.

At the end of the study, students in the experimental group were asked to complete the LFQ. Parents of students in the experimental group, who had the chance to observe their child's use of Lexicaid were also asked to provide their feedback on Lexicaid via the LFQ.

Each student in the experimental group was given a mobile phone with Lexicaid pre-installed, and a step-by-step instruction guide on how to set up the user account. The experimental group was instructed to use Lexicaid during the study period for reading activities or when doing homework for at least two and a half hours a week. The control group continued learning and reading as per their normal study routine without external assistance provided by the researchers during the same study period. All students (in both experimental and control conditions) were expected to complete at least two and a half hours of reading and learning activities a week. At the end of each week, participants or their parents were required to submit a log online to provide an overview of the child's reading activity and Lexicaid use, if applicable (See Appendix E1/2). All mobile phones were collected back at the end of the study. Pre- and post-tests of the 13 participants in the control group ($M_{\text{age}}=10.76$ years, $SD=1.37$; 8 males) and 18 in the experimental group ($M_{\text{age}}=11.28$ years, $SD=1.21$; 13 males) were scored and analysed in this study. The study has been approved by the SUTD Institutional Review Board (IRB #20-336)

RESULTS

Quantitative data were analysed using R version 4.0.5. The Shapiro-Wilk tests showed that the data were not normally distributed, as such non-parametric tests, i.e., Mann-Whitney U test, Kenward-Roger approximation and Wilcoxon signed rank test, were used to analyse the data. Mann-Whitney U test revealed that there were no significant differences in age between the experimental and control groups ($M_{\text{dExp}}=11.56$ years, $M_{\text{dControl}}=11.24$ years, $U=86.5$, $p=.226$). Similarly, the Chi-square test showed no significant difference in socioeconomic status (SES) ($\chi^2(3)=4.65$, $p=.20$). Therefore, data across age and SES were collapsed in subsequent analyses.

Tech-Familiarity Questionnaire

Mann-Whitney U test on the pre-scores showed no significant differences between participants from the control and experimental condition groups in the types of technology available for use at home ($M_{\text{dExp}}=19$, $M_{\text{dControl}}=20$, $U=107$, $p=.708$) or in school ($M_{\text{dExp}}=10$, $M_{\text{dControl}}=12$, $U=71$, $p=.968$), the frequency of technology use at home ($M_{\text{dExp}}=36$, $M_{\text{dControl}}=34$, $U=116$, $p=.984$) or the frequency of technology use in school ($M_{\text{dExp}}=13$, $M_{\text{dControl}}=15$, $U=74.5$, $p=.682$).

WIAT-IV Measures

Type III Wald F tests (also called the Wald Chi-Squared Test) with Kenward-Roger degrees of freedom were conducted to analyse the effects of Time (pre- vs post-test) and Condition (experimental vs control) on WIAT scores. Preliminary analysis showed that the medium of administration did not have a significant effect on the students' performance ($F[1,29] = 1.43, p = .187$). As such this factor was not considered in subsequent analyses. There was also no significant main effect of Time ($F[1,29] = 1.62, p = .201$) or Condition ($F[1,29] = 1.78, p = .177$) on the overall WIAT-IV scores as well as the individual subtests following the use of Lexicaid (Appendix F).

MRP-R

Similarly, the Type III Wald F test with Kenward-Roger degrees of freedom was used to analyze the scores of the MRP-R questionnaire. A significant Time x Condition effect ($F[1, 29] = 16.1, p < .001$) was found in the Value of Reading Section, where students from the experimental group had a higher value of reading post-study than students from the control group (see Figure 6).

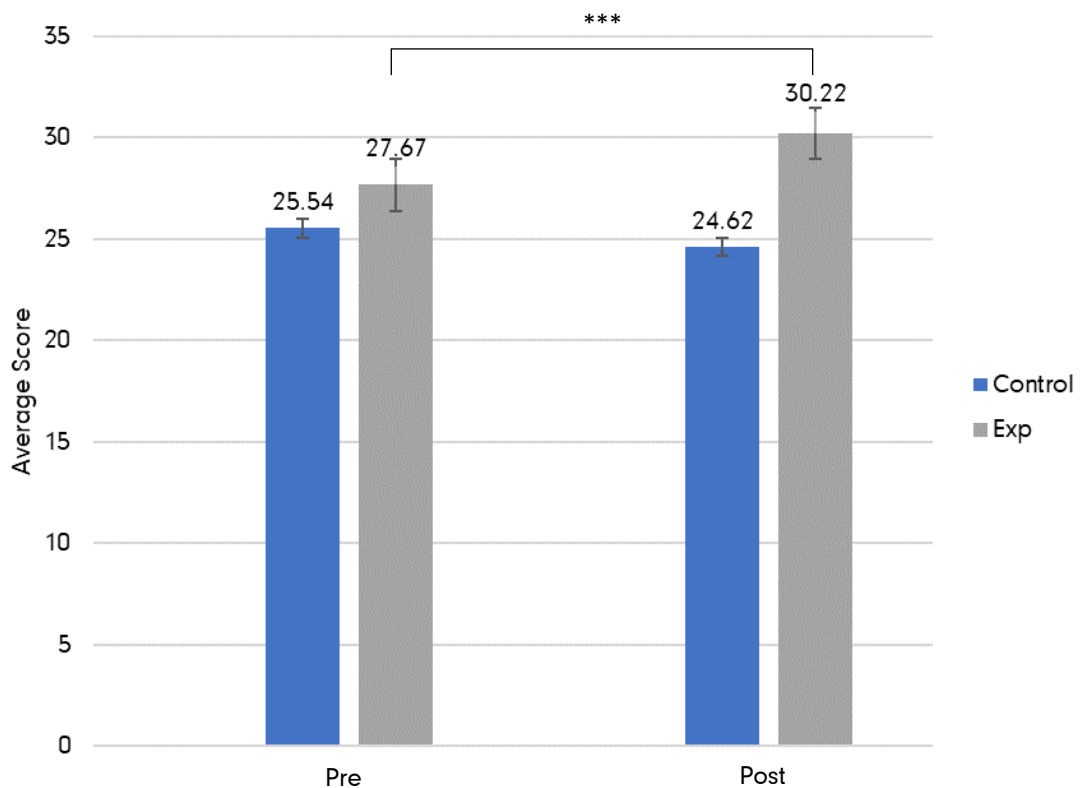


Figure 6: Reading Section by Condition. *** $p < .001$

SPPLD

Of the 10 domains, the pre- and post-scores of four domains: Writing Competence, Reading Competence, Spelling Competence, and General Intellectual Ability, were similarly examined using the Type III Wald F tests with Kenward-Roger degrees of freedom. The remaining domains, such as Athletic Competence, Social Acceptance, Physical Acceptance, Behavioural Conduct and Global Self-Worth, were not examined as past studies have shown that students' reading difficulties or poor performance at school did not have an effect on their self-perceptions of their social profile, athletic abilities and self-image (Burden, 2008; Frederickson & Jacobs, 2001).

Writing Competence. There was a marginal time effect, $F(1, 29) = 3.43$, $p = .072$, where both groups saw an increase in scores post-study. Importantly, there was a significant interaction effect of Time x Condition, $F(1, 29) = 18.2$, $p < .001$. Post-hoc Wilcoxon Tests showed a significant increase from the pre- to post-test scores compared to the pre-tests scores of the experimental group ($p = .0028$) but no significant increase in scores for the control group ($p = .634$). Thus, students from the experimental group felt more competent in writing following the use of Lexicaid compared to those in the control group (see Figure 7).

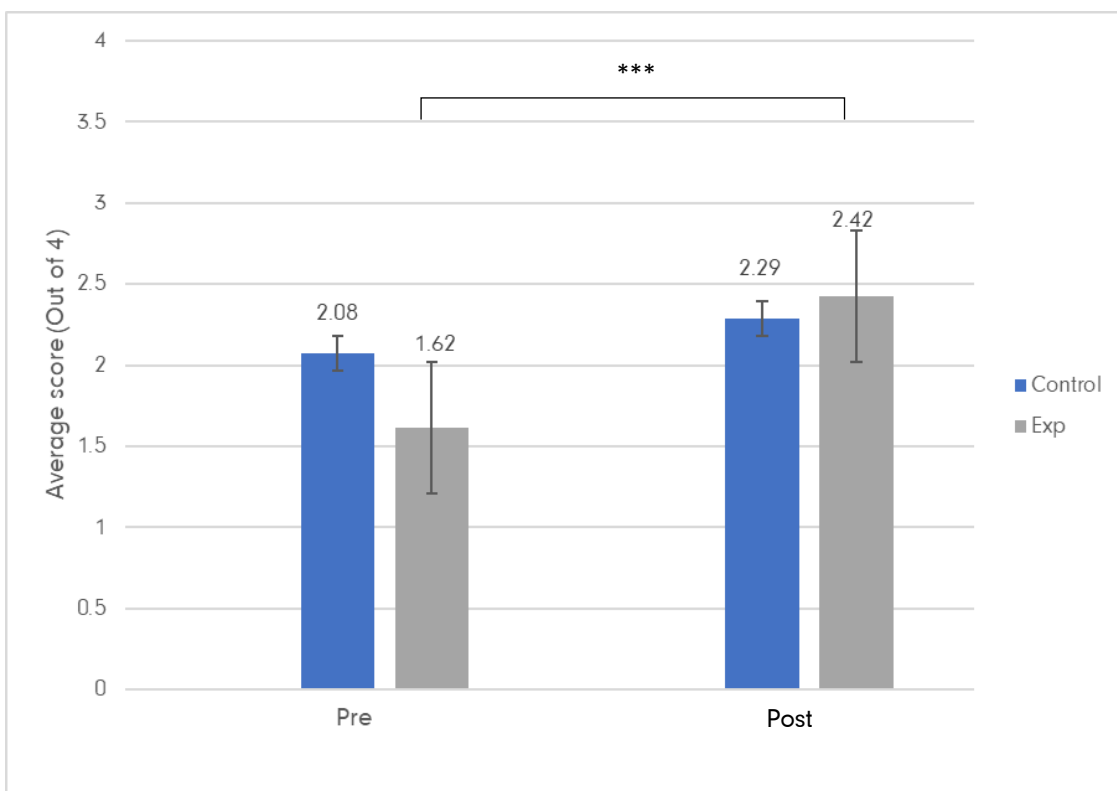


Figure 7: Reading Competence Domain by Condition. *** $p < .01$

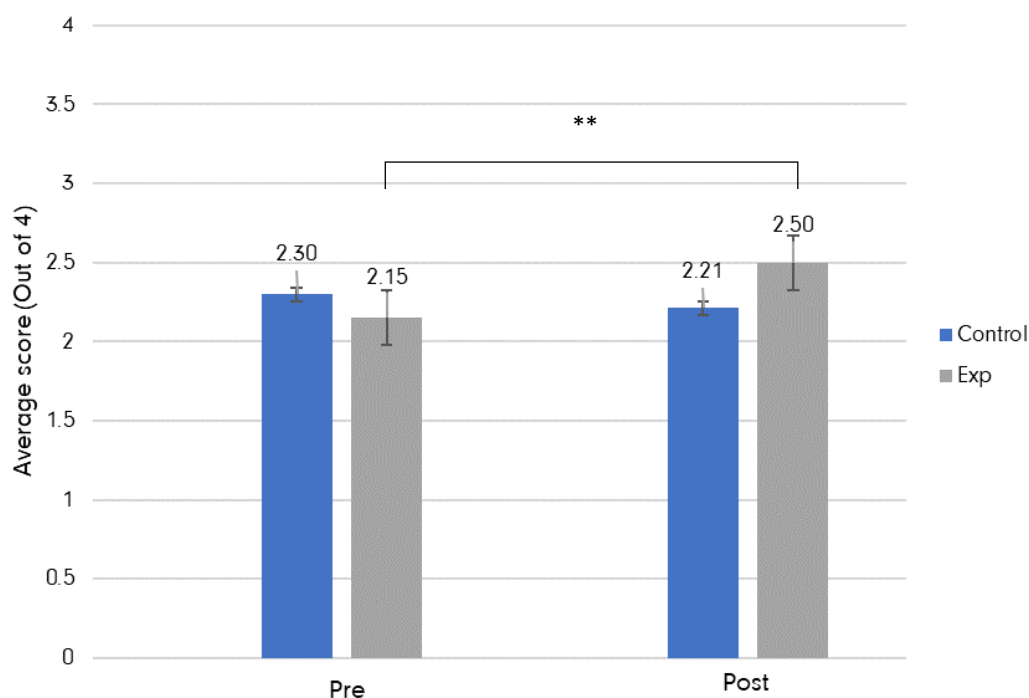


Figure 8: Reading Competence Domain by Condition. ** $p < .01$

Spelling Competence. Although, results showed students in the experimental condition felt more competent in their spelling abilities post- than pre-study ($M_{pre}=2.23$, $M_{post}=2.38$), the increase was not statistically significant, $p=.650$.

General Intellectual Ability. Students from the experimental group reported more confidence in their General Intellectual Ability post-study compared to the students from the control group ($M_{control}=2.3$, $M_{exp}=2.4$; see Figure 8). However, this increase was only marginally significant, $p=.083$. There was also a marginal Time x Condition effect, $F(1, 23)= 3.82$, $p=.078$.

Spelling Competence. Although, results showed students in the experimental condition felt more competent in their spelling abilities post- than pre-study ($M_{pre}=2.23$, $M_{post}=2.38$), the increase was not statistically significant, $p=.650$.

General Intellectual Ability. Students from the experimental group reported more confidence in their General Intellectual Ability post-study compared to the students from the control group ($M_{control}=2.3$, $M_{exp}=2.4$; see Figure 9). However, this increase was only marginally significant, $p=.083$. There was also a marginal Time x Condition effect, $F(1, 23)= 3.82$, $p=.078$.

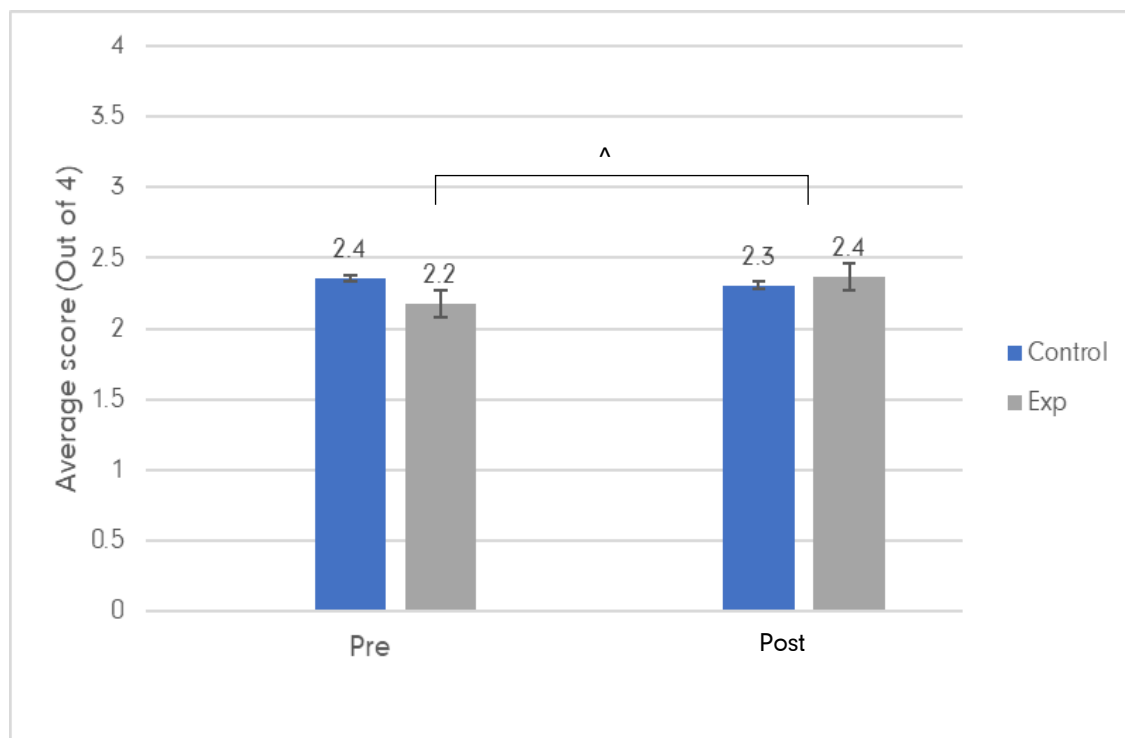


Figure 9: General Intellectual Ability Domain by Condition. $^{\wedge} p < .10$

DISCUSSION

Our study showed that our mobile app, Lexicaid, was effective in improving dyslexic students' self-perceptions of their reading and writing competency as well as the value of reading. Thus, the app, which included various features such as text-to-speech scanning, flashcard function, and customizable audio output and font display, displayed potential to improve dyslexic students' self-image and may in turn motivate struggling students to become more independent in their school learning. However, the app alone was not enough to efficiently improve the students' text-decoding and comprehension abilities to improve their WIAT scores during post-test. There are several possible explanations to our findings.

There has been an explosive growth of mobile apps developed to help people with dyslexia in recent times, but a majority of the apps have oversimplified the issues faced by dyslexic students and neglected to address that it is not a "one solution fits all" issue (Dawson et al., 2016; Jamshidifarsani, 2019; Vaughn et al., 2003). An app review study by Lerga, Candrljic and Jakupovic (2021) highlighted that intervention apps that have shown consistent effectiveness in the students' progress were developed together with the inputs of therapists, teachers, and parents. During the conceptualisation of these apps, common

requirements included a multisensory design with adaptive features that can be personalised by the users to address the variety of issues faced by students with dyslexia (Alghabban, et al., 2017; Zakopoulou, et al., 2017).

Our app, Lexicaid, was developed in conjunction with inputs from dyslexia experts to better facilitate independent reading and learning in dyslexic students. It incorporated multisensory designs with two key functions: (i) word scanning and (ii) flashcards, which are highly customisable. With the word scanning and flashcard features, together with the text-to-speech capabilities in Lexicaid, students could utilise the app independently while reading. The flashcard module in Lexicaid also gives students the opportunity to instantly create flashcards of difficult words they encounter while reading. Each flashcard comes with four text-to-speech options: Read Aloud, Definition, Spelling and Phonemes, which gives students a choice of how they would like to utilise the card to better suit their learning style. The freedom of choice could have made the students less anxious when attempting to read any passages using Lexicaid.

Students with dyslexia have limited ability to decode words. Studies have shown that speaking words aloud would be helpful when students are reading, as they would be able to hear (and thus recognise) the words they could not decode (Borhan et al., 2018). Text-to-speech technology has been shown to act as an aid to students with reading difficulties, compensating for the students' inability to decode words efficiently (Fälth & Svensson, 2015; Silvestri, Holmes, & Rahemtulla, 2021). By allowing students to listen to written words, the read-aloud function not only prevents misidentification of words, but also mitigates slow word reading, and the inability to connect words in a sentence for comprehension (Berkeley & Lindstrom, 2011). In a meta-analysis conducted by Wood, Moxely, Tighe, & Wagner (2018), there were a significant number of studies that showed that the use of text-to-speech tools had a significant positive impact on reading comprehension abilities. The Read Aloud function, in Lexicaid, which utilizes the Text-to-Speech technology would, therefore, allow students to easily decode the word through the audio feedback before matching it to the written word. In addition, the Spelling and Phoneme functions in Lexicaid can serve as a useful tool to enhance their decoding and spelling skills. By breaking down the word into letters or phonetic sections, the app provides a visual reference point for dyslexic students to review the word they had difficulties decoding. Apps utilising similar features, such as Grapholearn, have reported improvements in students' speed and accuracy of reading compared to their peers in the control groups (Kyle et al., 2013; Leloup et al., 2021; Mehringer et al., 2020).

Nevertheless, there are studies that found a lack of improvement in academic scores of students with dyslexia from using the text-to-speech technology (Kim, McKenna & Park, 2017; Meyer & Bourke, 2014; Young et al., 2019). In line with the results from this study, Stetter and Hughes (2010) found that text-to-speech technology did not impact adolescent students' academic scores, but students reported that they valued the increased independence that the text-to-speech software conferred on them. Silvestri,

Holmes and Rahemtulla (2021), reported that students with different cognitive competencies could have contributed to the varying effects of text-to-speech software. They found that while dyslexic students with severe decoding disability but above average listening comprehension skills benefitted most from the text-to-speech function, while students with moderate decoding abilities did not see any significant improvements in their scores.

Researchers suggest that there could be many non-cognitive processing reasons behind this absence of effect of text-to-speech technology on academic outcomes. Dyslexic students tend to have poorer self-perception and motivation towards reading due to the challenges they face with the metacognitive aspect of studying (Silvestri, Holmes and Rahemtulla, 2021). As they are unable to identify their learning styles and make the necessary connections (e.g., meaning and word pronunciation), they feel frustrated and are unable to progress (Fumes & Norman, 2018; Wood et al., 2018). The flashcard method has shown to mitigate these issues by introducing different types of learning through a repetitive revision process.

Physical flashcards, like the Orton–Gillingham Flashcards, help improve students' orthographic fluency through repeated exposure to the phonology of words and/or pictures to help students identify the meaning through contextual clues (Stevens et al., 2021; Lim & Oei, 2015). Similarly, by incorporating the Flashcard feature in Lexicaid, it enables students to store words instantly on the app for repetitive learning and to revisit words that they are unsure about or not confident in reading. This in turn could enhance students' self-perception of their orthographic fluency. Thus, these added features could have contributed to the post-test improvements of the students' self-perception of reading and writing as well as value of reading. However, despite the positive impacts of flashcards on a student's attitudes towards reading, this did not necessarily translate into academic related results (Nelson et al., 2003; Ritchey & Goeke, 2006; Tran et al., 2011).

Nevertheless, it is possible that students could benefit more from a longer intervention program than the present brief intervention study. Some studies noted that there was no direct impact on the children's education scores when examining the efficacy of apps, such as LexiPal (Risqi, 2015), EasyLexia (Skiada et al., 2014), and DysEggxia (Rello et al., 2014), over a shorter duration (6-8 weeks). Instead, researchers saw an increase in motivation to use the apps and attempt to complete the reading and writing tasks (Gooch et al., 2016; Rello et al., 2014; Risqi, 2015; Saputra, 2015; Skiada et al., 2014). On the other hand, other studies showed an improvement in both the academic and perceptions of self-image when the apps were tested over a longer period (6 months – 1 year) and had teachers integrate them into their lesson plans (Hall et al., 2015; Lim & Oei, 2015; Lindeblad, et al., 2016; Zakopoulou, et al., 2017). Thus, the short duration of our study as well as the inability to integrate the app into regular class lesson plans due to COVID restrictions could have limited the impact of the app on the academic outcomes of the dyslexic student who participated in the study.

LIMITATIONS

It is important to note that systematic reviews and meta-analyses have found the average effect size for overall treatment efficacy to be modest. Many intervention studies are further limited by their sample size due to challenges in recruiting a large number of participants. (Galuschka et al., 2014; Toffalini et al., 2021). A larger sample size will thus be needed to better assess the efficacy of Lexicaid. A home-based study also meant that it was more challenging to ensure that students fully adhered to the study requirements and expected duration of Lexicaid use. Additionally, due to Covid-19 restrictions and school requirements, the method of WIAT-IV administration had to be done differently for some students, which might have affected the WIAT-IV outcomes across participants. Finally, an extended intervention programme could provide students with the opportunity to acclimatise to using both the reading strategies taught in class and Lexicaid to improve their reading and writing abilities.

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Appendix A

Technology Familiarity Questionnaire

1. Are any of these devices available for you to use at home?

(Please select one response in each row.)

Device	Yes, and I use it a lot	Yes, and I use it some-times	Yes, but I do not use it	No
Desktop computer	☐	☐	☐	☐
Portable laptop or notebook	☐	☐	☐	☐
Tablet computer (E.g., iPad, Blackberry, PlayBook)	☐	☐	☐	☐
Internet connection	☐	☐	☐	☐
Video games console (E.g., Sony PlayStation, Xbox)	☐	☐	☐	☐
Cell phone (without Internet access)	☐	☐	☐	☐
Cell phone (with Internet access – i.e., smartphone)	☐	☐	☐	☐
E-book reader (E.g., Amazon Kindle)	☐	☐	☐	☐
Specialised reading devices or tools (E.g., C-Pen)	☐	☐	☐	☐

2. Are any of these devices available for you to use at school?

(Please select one response in each row.)

Device	Yes, and I use it a lot	Yes, and I use it some-times	Yes, but I do not use it	No
Desktop computer	☐	☐	☐	☐
Portable laptop or notebook	☐	☐	☐	☐
Tablet computer (E.g., iPad, Blackberry, PlayBook)	☐	☐	☐	☐
E-book reader (E.g., Amazon Kindle)	☐	☐	☐	☐
Specialised reading devices or tools (E.g., C-Pen)	☐	☐	☐	☐
Interactive Whiteboard (E.g., SmartBoard)	☐	☐	☐	☐

3. How old were you when you first used a digital device?

(Please think of different kinds of digital devices such as for example desktop computers, portable laptops, notebooks, smartphones, tablet computers, cell phones without Internet access, game consoles, or Internet-connected television.)

(Please select one response.)

3 years old or younger	☐
4 – 6 years old	☐
7 – 9 years old	☐
10 – 12 years old	☐
13 years old or older	☐
I have never used a digital device until today	☐

****If the student selects “I have never used a digital device until today”, the questionnaire will terminate as the proceeding questions will not be relevant to the student.**

4. How old were you when you first accessed the Internet?

(Please select one response.)

3 years old or younger	☐
4 – 6 years old	☐
7 – 9 years old	☐
10 – 12 years old	☐
13 years old or older	☐
I have never accessed the Internet	☐

***This is a filter question. If a student responds "6", I have never accessed the Internet, IC005, IC006, IC007 are not applicable, and students will proceed with IC150.*

5. During a typical weekday, for how long do you use the Internet at school?

(Please select one response.)

No time	☐
1 – 30 minutes per day	☐
31 – 60 minutes per day	☐
Between 1 hour and 2 hours per day	☐
Between 2 hours and 4 hours per day	☐
Between 4 hours and 6 hours per day	☐
More than 6 hours per day	☐

Only if students answered "1"-"5" in Q1-4.

6. During a typical weekday, for how long do you use the Internet outside of school?

(Please select one response.)

No time	☐
1 – 30 minutes per day	☐
31 – 60 minutes per day	☐
Between 1 hour and 2 hours per day	☐
Between 2 hours and 4 hours per day	☐
Between 4 hours and 6 hours per day	☐
More than 6 hours per day	☐

7. On a typical weekend day, for how long do you use the Internet outside of school?

(Please select one response.)

No time	☐
1 – 30 minutes per day	☐
31 – 60 minutes per day	☐
Between 1 hour and 2 hours per day	☐
Between 2 hours and 4 hours per day	☐
Between 4 hours and 6 hours per day	☐
More than 6 hours per day	☐

8. In a typical school week, how much time do you spend using digital devices during classroom lessons?

(Please select one response in each row.)

Subject	No time	1 – 30 minutes a week	31 – 60 minutes a week	More than 60 minutes a week	I do not study this subject
English	☐	☐	☐	☐	☐
Mathematics	☐	☐	☐	☐	☐
Science	☐	☐	☐	☐	☐
Mother Tongue	☐	☐	☐	☐	☐

9. In a typical school week, how much time do you spend using digital devices outside of classroom lessons (regardless of whether at home or in school) for the following subjects?

(Please select one response in each row.)

Subject	No time	1 – 30 minutes a week	31 – 60 minutes a week	More than 60 minutes a week	I do not study this subject
English	☐	☐	☐	☐	☐
Mathematics	☐	☐	☐	☐	☐
Science	☐	☐	☐	☐	☐
Mother Tongue	☐	☐	☐	☐	☐

10. How often do you use digital devices for the following activities outside of school?

(Please select one response in each row.)

Activity	Never or hardly ever	Once or twice a month	Once or twice a week	Almost every day	Every day
Playing online games	☐	☐	☐	☐	☐
Using email	☐	☐	☐	☐	☐
Communicating online or on social media (E.g., MSN, WhatsApp, Telegram)	☐	☐	☐	☐	☐
Participating in social media (E.g., Facebook, Instagram)	☐	☐	☐	☐	☐
Browsing the Internet for fun (such as watching videos) (E.g., YouTube)	☐	☐	☐	☐	☐
Reading on the Internet (E.g., books, comics, news)	☐	☐	☐	☐	☐
Searching for information on the Internet (E.g., facts, locations, date of events)	☐	☐	☐	☐	☐
Using apps on a mobile device	☐	☐	☐	☐	☐
Browsing the Internet for schoolwork (E.g., for preparing an essay or presentation)	☐	☐	☐	☐	☐
Doing homework on a computer	☐	☐	☐	☐	☐
Doing homework on a mobile device	☐	☐	☐	☐	☐

Using learning apps or learning websites on a computer	☐	☐	☐	☐	☐
Using learning apps or learning websites on a mobile device	☐	☐	☐	☐	☐
Using learning apps or learning websites for reading on a computer	☐	☐	☐	☐	☐
Using learning apps or learning websites for reading on a mobile device	☐	☐	☐	☐	☐
Using specialised devices or tools for reading	☐	☐	☐	☐	☐

11. How often do you use digital devices for the following activities at school?

(Please select one response in each row.)

Activity	Never or hardly ever	Once or twice a month	Once or twice a week	Almost every day	Every day
Communicating online at school	☐	☐	☐	☐	☐
Using email at school	☐	☐	☐	☐	☐
Browsing the Internet for schoolwork	☐	☐	☐	☐	☐
Practicing and drilling, such as for language learning or mathematics	☐	☐	☐	☐	☐
Doing homework on a school computer or mobile device	☐	☐	☐	☐	☐
Using school computers or mobile devices for group work and communication with other students	☐	☐	☐	☐	☐
Using learning apps or learning websites	☐	☐	☐	☐	☐
Using learning apps or learning websites for reading	☐	☐	☐	☐	☐
Using specialised devices or tools for reading	☐	☐	☐	☐	☐

Appendix B

Domains of the SPPLD and Description (Renick & Harter, 2012)

Domain	Description
General Intellectual Ability	The extent which individuals perceive themselves to be smart or good learners in school.
Reading Competence	The extent to which individuals feel at ease or adequate when completing reading, writing, spelling and math activities.
Writing Competence	The extent to which individuals feel at ease or adequate when completing writing activities.
Spelling Competence	The extent to which individuals feel at ease or adequate when completing spelling activities.
Math Competence	The extent to which individuals feel at ease or adequate when completing math activities.
Athletic Competence	The extent to which individuals feel competent at athletic activities.
Social Acceptance	The extent to which individuals perceive their self-attributes that contribute to social success (e.g., knowing how to make friends, getting other people to like you).
Physical Acceptance	The extent to which individuals are happy with or like the way they look.
Behavioural Conduct	The extent to which individuals are happy with or like the way they behave.
Global Self-Worth	The extent to which individuals like themselves as a person.

Appendix C

WIAT-IV Order of Administration, Selected Subtests and Description (Malloy et al., 2013)

Administration Order	WIAT-IV Subtest	Subtest Description
1	Spelling	Measures written spelling ability from dictation. Students either wrote down letter sounds or words that were dictated in the context of a sentence.
2	Word Reading	To measure letter and letter-sound knowledge and single word reading. Students either identified letters and matched letters to sounds. They also read aloud a list of regular and irregular words.
3	Reading Comprehension	Measures reading comprehension skills at the level of the word, sentence, and passage. Students either read a sentence or a narrative/expository passage and answered a series of questions.
4	Orthographic Fluency	Measures the orthographic lexicon or sight vocabulary. Students read aloud as many irregular words as possible in two timed trials.
5	Pseudoword Decoding	Measures phonic decoding skills. Students read a list of pseudowords aloud.
6	Decoding Fluency	Measures phonic decoding fluency. Students read aloud as many pseudowords as possible in two timed trials.

Appendix D

Lexicaid Feedback Questionnaire

Perceptions and Feedback Following Mobile Application Use (Child)

We would like to better understand your perception and feedback on the mobile application after using it. Please respond to all the questions in each section honestly. Remember there is no right or wrong response.

Section 1 – Student Motivation

There are four statements that describe your perception of your motivation following the use of the mobile application. Please respond by circling only one number for each statement below.

Following the mobile application use, do you assess that your:

	In no degree	In a very small degree	In a small degree	In a fairly high degree	In a very high degree
a. Motivation for schoolwork has increased?	1	2	3	4	5
b. Motivation for assimilating text has increased?	1	2	3	4	5
c. Motivation for communicating text has increased?	1	2	3	4	5
d. Motivation for traditional reading has increased?	1	2	3	4	5

Section 2 – Student Learning

There are seven statements that describe your perception of your learning following the use of the mobile application. Please respond by circling only one number for each statement below.

Following the mobile application use, do you assess that you:

	In no degree	In a very small degree	In a small degree	In a fairly high degree	In a very high degree
a. Have improved traditional reading skills?	1	2	3	4	5
b. Have improved the ability to assimilate spoken text?	1	2	3	4	5
c. Have increased the amount of text assimilated?	1	2	3	4	5
d. Have improved the ability to comprehend texts?	1	2	3	4	5
e. Are more autonomous while interacting with texts?	1	2	3	4	5
f. Are more autonomous in school work in general?	1	2	3	4	5
g. Can compensate for lack of reading skills by listening to spoken text?	1	2	3	4	5

Section 3 – Mobile Application as an Assistive Tool for Students with Dyslexia and/or Reading Difficulties (RD)

There are five statements that determine how you perceive the use of the mobile application as being a useful Assistive Tool for students with dyslexia and/or RD. Please respond by circling only one number for each statement below.

Do you assess the mobile application usage to:

	In no degree	In a very small degree	In a small degree	In a fairly high degree	In a very high degree
a. Enhance students' [with Dyslexia and/or RD] learning opportunities?	1	2	3	4	5
b. Enhance students' [with Dyslexia and/or RD] reading development?	1	2	3	4	5
c. Enhance students' [with Dyslexia and/or RD] text comprehension ability?	1	2	3	4	5
d. Improve students' [with Dyslexia and/or RD] ability to write text?	1	2	3	4	5
e. Be useful for your independent learning at home?	1	2	3	4	5

Section 4 – Frequency of Mobile Application Use

We would like to know how frequently you use the mobile application. Please respond by ticking only one box for each question.

a. During a typical weekday, for how long do you use the mobile app at school?

No time	☐
1 – 30 minutes per day	☐
31 – 60 minutes per day	☐
Between 1 hour and 2 hours per day	☐
Between 2 hours and 4 hours per day	☐
Between 4 hours and 6 hours per day	☐
More than 6 hours per day	☐

b. During a typical weekday, for how long do you use the mobile app outside of school?

No time	☐
1 – 30 minutes per day	☐
31 – 60 minutes per day	☐
Between 1 hour and 2 hours per day	☐
Between 2 hours and 4 hours per day	☐
Between 4 hours and 6 hours per day	☐
More than 6 hours per day	☐

c. During a typical weekend, for how long do you use the mobile app outside of school?

No time	☐
1 – 30 minutes per day	☐
31 – 60 minutes per day	☐
Between 1 hour and 2 hours per day	☐
Between 2 hours and 4 hours per day	☐
Between 4 hours and 6 hours per day	☐
More than 6 hours per day	☐

Section 5 – Feedback on Mobile Phone Use

We would like to better understand your use of the mobile application, and your thoughts about it. Please respond by circling only one answer for each row below. Do tell us how you really feel. Remember, there is no right or wrong answer.

	Question	Not at all (0%)	Sometimes (25%)	Half the time (50%)	Often (75%)	All the time (100%)	Not Applicable
a.	This mobile app is benefiting me and improving my quality of life.	1	2	3	4	5	NA
b.	I know how to use the mobile app and its various features	1	2	3	4	5	NA
c.	I feel more secure (safe, sure of myself) when using this mobile app.	1	2	3	4	5	NA
d.	This mobile app fits well with my accustomed routine.	1	2	3	4	5	NA
e.	I have the capabilities and stamina to use this mobile app without discomfort, stress and fatigue.	1	2	3	4	5	NA
f.	The supports, assistance and accommodations exist for successful use of this mobile app.	1	2	3	4	5	NA
g.	This mobile app physically fits in all desired environments (purse, pocket, desk, car, etc.).	1	2	3	4	5	NA
h.	I feel comfortable (and <i>not</i> self-conscious) using this mobile app around family.	1	2	3	4	5	NA
i.	I feel comfortable (and <i>not</i> self-conscious) using this mobile app around friends.	1	2	3	4	5	NA
j.	I feel comfortable (and <i>not</i> self-conscious) using this mobile app at school or work.	1	2	3	4	5	NA
k.	I feel comfortable (and <i>not</i> self-conscious) using this mobile app around the community.)	1	2	3	4	5	NA

Comments:

Section 6 – Additional Feedback on the Mobile Application

The following questions are to gain better understanding about your feedback on the mobile application. Do indicate your responses in the lines below. There are no right or wrong answers.

a. **What do you like most about the mobile application?**

b. **What do you like the least about the mobile application?**

c. **Which feature did you use the most?**

d. **What did you normally use the mobile application for?**

e. **Where did you normally use the mobile application?**

f. **When did you normally use the mobile application?**

g. **Are there any features that you think you need but are missing in the mobile application? Describe.**

h. **What do you think the mobile application should improve on?**

Appendix E1

Weekly Log Sheet for Control Group

Over the next 4 weeks, your child will continue learning and reading as per his/her normal study routine. Your child will be expected to complete a minimum of 2.5 hours of reading-related activity or homework per week (7 days).

For Questions 3 & 4, please fill in the estimated duration (specify in minutes or hours) spent on weekly reading-related activities or homework in the form below.

Thank you very much!

1. Name of Child:

2. Please select the appropriate week:

Week 1 (6 Feb 2021 - 12 Feb 2021)

Week 2 (13 Feb 2021 - 19 Feb 2021)

Week 3 (20 Feb 2021 - 26 Feb 2021)

Week 4 (27 Feb 2021 - 5 March 2021)

Week 5 (6 Mar 2021 - 12 Mar 2021)

Week 6 (13 Mar 2021 - 19 Mar 2021)

3. Please indicate the duration (specify in minutes or hours) spent on reading-related activities this week (e.g., books, comics, news, webtoons, web pages, online articles etc.):

4. Please indicate the duration (specify in minutes or hours) spent on homework, schoolwork or revision this week:

Additional Comments (if any):

Appendix E2

Weekly Log Sheet for Experimental Group

Over the next 4 weeks, your child will continue learning and reading using the mobile app Lexicaid as per his/her normal study routine. Your child will be expected to complete a minimum of 2.5 hours of reading-related activity or homework per week (7 days).

For Question 3 - Use of the app would include the child having the app available by his/her side as a learning aid.

For Questions 4-6, please fill in the estimated duration (specify in minutes or hours) spent on weekly reading-related activities, homework or using the app in the form below.

For Question 6 - Active use of the app will include actively scanning words, accessing the flashcards or learning features.

Thank you very much!

1. Name of Child:

2. Please select the appropriate week:

Week 1 (8 Feb 2021 - 12 Feb 2021)

Week 2 (13 Feb 2021 - 19 Feb 2021)

Week 3 (20 Feb 2021 - 26 Feb 2021)

Week 4 (27 Feb 2021 - 5 Mar 2021)

Week 5 (6 Mar 2021 - 12 Mar 2021)

Week 6 (13 Mar 2021 - 19 Mar 2021)

3. My child has been using the app for at least 2.5 hours to complete reading-related activities, homework, schoolwork or revision:

Yes

No

4. Please indicate the duration (specify in minutes or hours) spent on reading-related activities this week (e.g., books, comics, news, webtoons, web pages, online articles etc.):

5. Please indicate the duration (specify in minutes or hours) spent on homework, schoolwork or revision this week:

6. Please indicate the estimated duration (specify in minutes or hours) spent using the app's learning features or active use of the app:

Additional Comments (if any):

Weekly Log: Mean Duration Spent on Reading Activities per Student				
	Experimental		Control	
Mean time, Hrs	Reported Reading & Homework Activities	Recorded App Usage	Reported Reading & Homework Activities	Recorded App Usage
Week 1	7.64	2.76	7.76	NA
Week 2	8.89	2.95	9.70	NA
Week 3	7.94	2.65	8.08	NA
Week 4	8.50	3.83	8.02	NA
Week 5	9.52	3.63	11.4	NA
Week 6	10.87	3.98	9.07	NA

Appendix F

Participant Distribution and Mean Age

	WIAT-IV (Online)		WIAT-IV (In-Person)	
	Control	Experimental	Control	Experimental
No. of Participants	10	13	3	5
Mean Age in years (SD)	10.60 (1.54)	11.39 (1.24)	11.28 (0.17)	10.98 (1.34)
Gender, n (%)				
Female	4 (40.0)	3 (23.1)	1 (33.3)	2 (40.0)
Male	6 (60.0)	10 (76.9)	2 (66.7)	3 (60.0)

Mean Standard WIAT-IV Scores of Participants

	Experimental, M (SD)		Control, M (SD)	
	Pre	Post	Pre	Post
Total Achievement	81.0 (17.2)	83.7 (22.9)	87.0 (25.9)	86.7 (21.1)
Spelling	79.1 (16.9)	84.1 (16.8)	82.2 (15.9)	82.5 (14.5)
Word Reading	78.3 (18.3)	86.3 (22.6)	87.7 (11.3)	88.15 (13.3)
Reading Comprehension	81.9 (13.0)	86.9 (15.9)	89.6 (16.6)	86.92 (13.9)
Orthographic Fluency	81.6 (15.5)	82.8 (14.9)	85.2 (10.1)	85.6 (8.45)
Pseudoword Decoding	83.4 (14.5)	80.9 (14.1)	88.6 (11.2)	88.4 (14.5)
Decoding Fluency	83.4 (17.45)	84.3 (13.3)	88.9 (8.89)	88.5 (8.12)

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Dyslexia with language weaknesses: Recommendations to guide organisation-based efforts for school-going learners based on educational therapists' perspectives

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Abstract

Background: Children with dyslexia often also present with oral language difficulties. If identified, speech-language pathologists (SLPs) remediate these children's comorbid language difficulties through speech therapy. However, educators are still faced with the additional challenge of helping these children understand academic concepts on top of their language difficulties. Educational therapists (EdTs) are one group of educators who work closely with dyslexic children and teach them literacy. **Research aims & objectives:** This study aims to gain an understanding of current and future efforts of DAS for educational therapists working with learners who have dyslexia and language difficulties. Based on these EdTs' perspectives, recommendations to guide educators working with children who have dyslexia and language weaknesses will be provided. As such, the central research question is What can the Dyslexia Association of Singapore do in the provision of support for learners with dyslexia and language difficulties based on the perspectives of educational therapists of these students? **Method:** This study explores the teaching experiences of 7 EdTs with Primary 2–6 children (aged 8–12 years), who presented with both dyslexia and oral language weaknesses. Recommendations will be provided based on interviews with the EdTs and reflections by them. **Results:** From our qualitative analyses of the collected data, we found that all EdTs regardless of their knowledge and background face challenges while teaching students with both dyslexia and oral language weakness. It was also found that strategies used at the DAS by EdTs can be split into what is used in the classroom and what is done outside the classroom. Lastly, results suggest that not all EdTs are well aware of oral language weakness. **Discussion:** Thus, this study serves as a stepping stone towards the creation of a guide for EdTs working with such students. Additionally, this study suggests that more resources should be created to educate EdTs further on oral language weakness and ways in which they can better help these students.

Keywords: dyslexia; educational therapists, language weakness, oral language weakness

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INTRODUCTION

Dyslexia & oral language weakness

Language is a non-instinctive communication system that allows individuals to communicate ideas, emotions, needs and wants with each other (Sapir, 1921). It occurs in an array of modalities such as speech, written format and even signs and symbols (Bishop et al., 2016). Although the majority of people are able to pick up language with ease, there are still individuals who struggle and experience difficulties across several language areas and modes (i.e. written and spoken).

Dyslexia is a written language disorder with a population prevalence of 5-10% (Siegel, 2006). According to the International Dyslexia Association (IDA), dyslexia is marked by difficulties in accurate and fluent word recognition and spelling. These difficulties are typically due to deficits experienced in the phonological component of language (Lyon et al., 2003). Individuals with dyslexia lack phonological awareness, show poor verbal working memory and rapid naming which relates to poor reading acquisition and a lack of explicit awareness of language sound structure (Ramus, et al., 2013).

Specifically, a lack in phonological awareness often results in individuals being unable to explicitly categorise and manipulate language sounds, increasing the difficulty of tasks like applying alphabetic principles to decode and spell written or typed words (Gillon, 2000). It is also important to note that The Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; American Psychiatric Association, 2013) states no link between dyslexia, age and other cognitive abilities. Both dyslexic and children with developmental language delay (DLD) may also struggle with articulation, one of our most complex motor skills, and this impacts further on their literacy abilities. This may be evident in difficulty in repeating polysyllabic or nonsense words, as well as particular difficulties in reading them.

Another group of individuals who struggle with language are those diagnosed with developmental language disorder (DLD) or what was previously known as specific language impairment (Gough Kenyon et al., 2018). DLD is a neurodevelopmental disorder with a prevalence of about 7.5% in children. Individuals diagnosed with DLD are said to possess oral language difficulties. These individuals struggle with language comprehension and expressive elements of language despite normal levels of intellectual functioning, hearing and an adequate learning environment (Leonard, 2014). They also experience deficits in higher-level language skills like semantics, syntax and language discourse (Norbury et al., 2016; Tomblin et al., 1997) and have problems interpreting and producing certain phonological forms (Jakubowicz et al., 1998). Research has shown that children with DLD take more time to learn and master new vocabulary in comparison to their peers. They also show evident difficulty in some portions of grammar.

Although dyslexia and DLD affect different aspects of language in an individual, statistics show that these two disorders often comorbid with each other (Snowling & Melby-Lervåg, 2016). In a 2000 study by McArthur, Hogben, Edwards, Heath, and Mengler, 55 percent of children who had dyslexia were found to also have impaired oral language abilities. If identified, speech-language pathologists (SLPs) remediate the children's comorbid language difficulties through speech and language therapy.

Thus, with weaknesses in both language and literacy, this group of children are further disadvantaged in their learning of academic concepts. Comorbidity of dyslexia and oral language difficulties put children at a greater disadvantage academically. This is because, these children now not only struggle with the written language (i.e. reading and spelling) but have additional difficulties picking up vocabulary and understanding certain aspects of grammar like tense and agreement markers (Bedore & Leonard, 1998; Rice & Wexler, 1996; Tager-Flusberg & Cooper, 1999).

Additionally, while SLPs address the children's language difficulties, educators are faced with an additional challenge of helping these children understand academic concepts. This is especially since the area of language difficulty varies for all with dyslexia and DLD. Interventions and guidelines crafted for teachers currently available are mainly written in a general manner. One such example is the good practice guide developed by the National Education Psychological Service (NEPS). This guide was created by a team of NEPS psychologists and is essentially a compilation of suggestions for in-class support for teachers with children with language difficulties.

The guide begins with providing educators with general strategies they can use in the classroom. For instance, it explains that when working with children with language difficulties, teachers should alter their explanations and instructions by summarising, paraphrasing and simplifying. In terms of the teaching materials and strategies, the guide suggests the use of audio and visual stimuli as well as the need to work together with parents and encourage or support the child with praise where appropriate. After giving general strategies, the guide further elaborates on ways teachers can help a child with weak receptive and expressive language respectively. Although more specific teaching methods like the use of expansion, open questions, memory games etc. are suggested in this section, the guide reminds its users that deciding on which strategies to use depends on the profile of the student (i.e. age, ability, interests etc.).

BACKGROUND AND AIM OF THIS STUDY

At the Dyslexia Association of Singapore (DAS), even though all students attending classes are diagnosed with dyslexia, some of them have a comorbid diagnosis of language difficulty. A pre-research survey conducted by this author among educational therapists (EdTs) at the DAS found that EdTs have observed students who display language difficulty in expressive and receptive domains that adversely affect their

educational performance. Some examples include poor language proficiency such as improper use of words and their meanings, inability to express ideas, inappropriate grammatical patterns, reduced vocabulary and inability to follow instructions.

DAS EdTs are trained to provide a curriculum-based literacy intervention based on the Orton-Gillingham (OG) approach to children with dyslexia. The intervention programme includes phonetic instruction, reading comprehension, writing and vocabulary components, all of which taps heavily on language skills. For example, to learn a spelling rule such as “In a one syllable, one vowel, and one ending consonant word, double the ending consonant before adding a vowel suffix”, a child has to understand the words, the grammar, and the complex sentence structure used in that rule to learn and apply it effectively. This may be relatively more achievable for a child with only dyslexia and no problems with understanding language. In contrast, for a child with both dyslexia and language weaknesses, the EdT may have to use additional strategies or a completely different approach to help the child understand, learn, and apply the rule.

Hence, the impetus for this study is based solely on the observations made by DAS EdTs who face challenges teaching students with language weaknesses. Due to this, more research should be done to support their efforts so as to improve teaching and learning of both students and EdTs. The aim of this study is to offer recommendations to guide organisation-based efforts for school-going learners based on the perspectives of EdTs with the central research question:

What can the Dyslexia Association of Singapore do in the provision of support for learners with dyslexia and language difficulties based on the perspectives of educational therapists of these students?

The study is conducted to find out in greater detail the challenges that EdTs face when teaching this group of students, as well as the teaching methods that have helped them guide these students in the classroom. The objective of this study is to discover teaching methods and strategies that are useful to be shared with fellow EdTs, and for the organisation to offer recommendations that can be implemented in the classroom to support these learners.

METHODS

In order to learn about the challenges that EdTs face when teaching students who display language difficulties, a qualitative remote interview or questionnaire sent via email was conducted with 7 of them whose one particular student was identified to have scored extremely low on the verbal language component (composite score < 80) based on their educational psychological report. A similar trait among these students is that they all possess very weak language skills. In comparison, these students received scores that are average (composite score > 80) on their non-verbal language

component. These students were assessed by psychologists in 2019 and have received remediation for at least 6 months on the Main Literacy Programme (MLP) where basic literacy skills of reading and spelling according to the Orton-Gillingham principles were employed. Typically, a child who scores higher on the verbal component compared to the performance component is generally an underachiever - has normal intelligence but may not do well academically. At the DAS, students who received an extremely low score on the verbal language component are given the A1 banding based on the curriculum based banding categorisation. Students in this category are characterised by weaknesses in language skills which include vocabulary knowledge and oracy skill.

Participants

Seven EdTs with teaching experience ranging from 1.5 years to 8.5 years and whose students are actively enrolled on MLP and in the A1 band participated in the study. These students would have received more than 6 months remediation from the MLP.

Materials

A set of questionnaires (Appendix A) was created with questions that determine EdTs' teaching experience, knowledge of oral language weakness and experience teaching students with oral language weakness. The same questions set in this questionnaire were used for the remote interview.

Design

A remote interview was conducted with EdTs who were available at a specified day and time and a set of questionnaires was sent to EdTs who were unavailable for the remote interview. Both types of data collection are expected to yield consistent results as the questions asked during the interview and in the questionnaire are the same.

Procedure

EdTs who selected the remote interview were interviewed on the day and time which they had selected. Each interview session lasted approximately 30 - 45 minutes. All interview sessions were recorded and transcribed for analysis purposes. Whereas for EdTs who selected the questionnaire, they were expected to return the completed questionnaire within 5 days. All completed questionnaires were kept for analysis purposes.

RESULTS

Data collected from both interview and questionnaire provided sufficient information from the EdTs' perspective as questions that require in-depth answers had the statements please elaborate, elaborate with examples, elaborate with details or describe in them. To analyse the data collected from the interviews and questionnaires, we conducted a group case study. The results below are thus presented in two groups; Case study A and Case study B. The EdTs were divided into the two case studies base on their awareness

of oral language weakness. Case study A is made up of EdT 1, 2 and 3 who are unaware of what oral language weakness is while Case study B is made up of EdT 4, 5, 6 and 7 who are aware of oral language weakness as shown in Table 1.

Table 1. Case study classification

Case Study	Educational Therapist (EdT)	Awareness of oral language weakness
A	EdT 1	Unaware
	EdT 2	
	EdT 3	
B	EdT 4	Aware
	EdT 5	
	EdT 6	
	EdT7	

Part 1: Teaching experience

In this section, information about EdTs' general teaching experiences were compiled and represented in the four graphs (Figure 1, 2, 3 & 4). We gathered that all EdTs had varying years of teaching experience. The amount of interaction between EdTs and students was also varied.

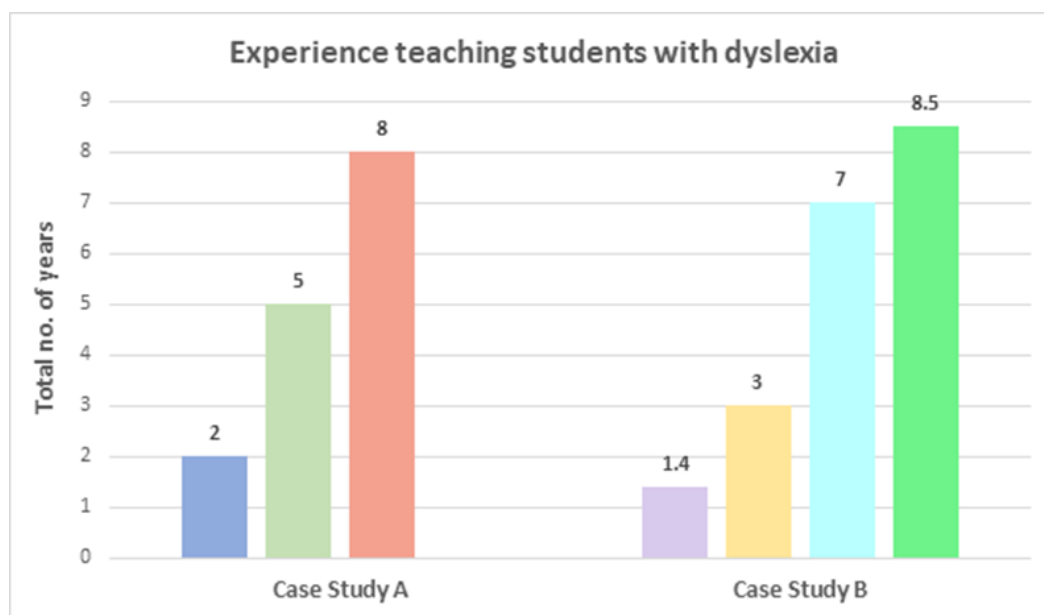


Figure 1. EdTs' total years of experience teaching students with dyslexia

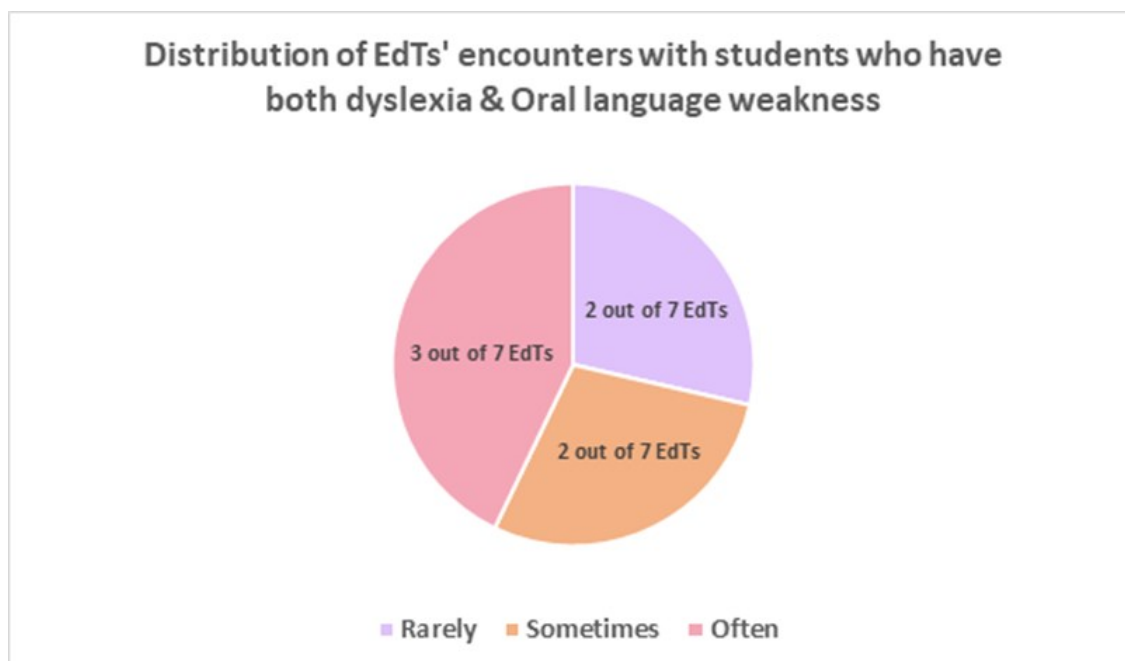
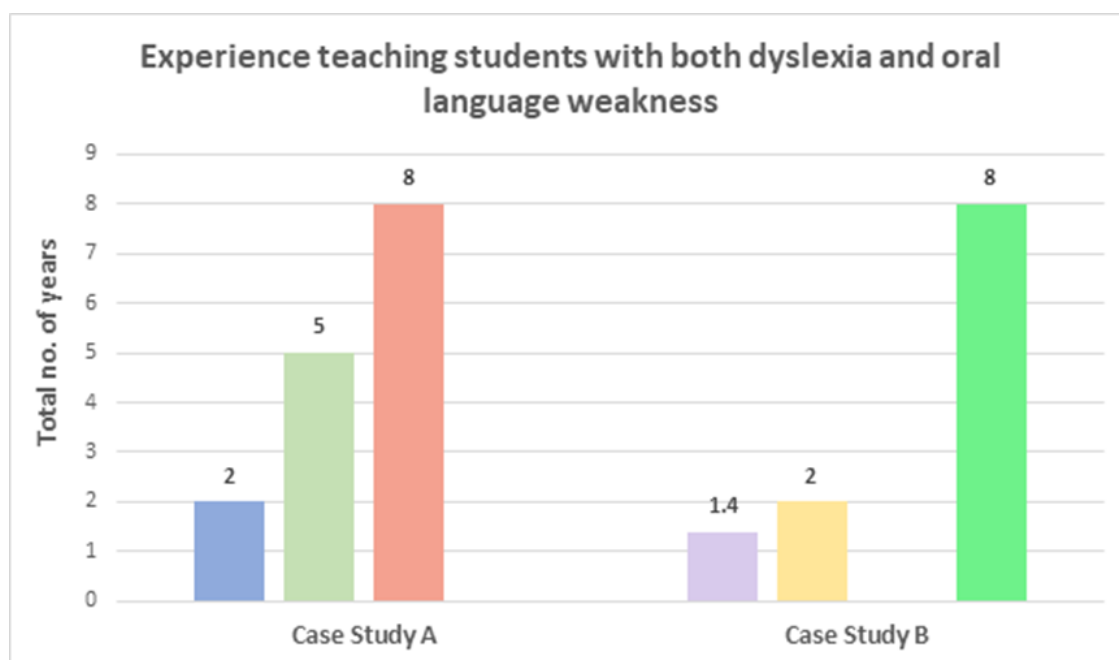
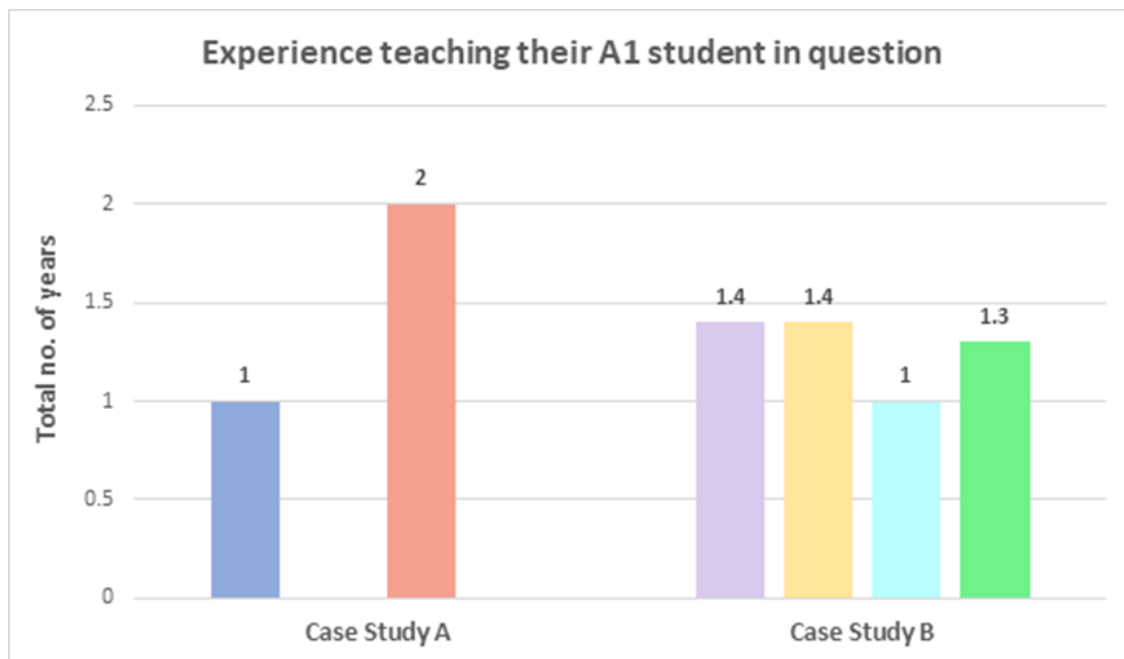


Figure 2. Distribution representing how often EdTs encounter students with dyslexia and oral language weaknesses



EdT 6 excluded as her answer was not specified

Figure 3. EdTs' total years of experience teaching students with both dyslexia and oral language weakness



EdT 2 excluded as this question was not included in her interview

Figure 4. EdTs' experience teaching their A1 student in question

Part 2: Knowledge of oral language weakness

In this section, information about the EdTs' knowledge of language (i.e. milestones and oral language weakness) was obtained. As previously determined, EdTs in case study A are unaware of oral language weakness while EdTs in case study B are aware of oral language weakness. In line with this, the EdTs in case study A were also generally unaware of language milestones, all three sharing that they only heard the term being used. When shown the language milestones table, they shared that they were not aware of the specific details outlined in the table. When asked about the importance of tracking language milestones in children, they all shared that language milestones should be seen as just a guide and that other factors should be considered before assumptions are made about a child's language development.

For EdTs in Case study B, their awareness of language milestones was varied with half of them aware of language milestones and the other half only hearing about the term language milestones but not knowing the details, despite all knowing what oral language weakness is. Regardless of this varied awareness, everyone in case study B shared the opinion that language milestones tracking is important as they help predict a child's language development and are useful to planning interventions. Two of them also added that language milestones should be used as a rough guideline as each child has

different rates of development. Thus, they believe that children should be given one to two years leeway before being taken to speech or language specialist for intervention.

Despite varied opinion and knowledge, EdTs in both case studies were able to explain their student's difficulties based on the different aspects of language as shown in Table 2 and 3.

Table 2. Case study A - Recount of student's language difficulties

Student's indicators of oral language weakness				
Case Study A				
EdTs	Phonology	Grammar	Vocabulary	Language discourse
EdT 1	Blending: Misses out certain sounds Vowel confusion	Auxiliary verbs: Only know how to use "is" & "are" Subject-Verb agreement: Plural vs. Singular Verb tenses: Uses "-ing" instead of "-ed" to indicate past tense	Limited oral & reading vocabulary	Difficulty processing info: Student takes very long to answer even simple questions and often looks confused
EdT 2	- NIL -	- NIL -	Limited vocabulary Inability to associate words to meanings: Unable to understand meaning of many words	Difficulty processing info: Forgets concepts taught very quickly. Requires many reminders & drills to help him process & understand concepts.
EdT 3	Pronunciation: Mispronounces words & makes speech errors	Sentence formation: Speaks in broken sentences & does not abide by grammar rules (e.g. only includes keywords to get meaning across)	Very limited vocabulary	Difficulty translating thoughts into coherent sentences: Unable to string his thoughts together into sentences, making it difficult for people around him to understand and communicate with him.

Table 3. Case study B - Recount of student's language difficulties

Student's indicators of oral language weakness				
Case Study B				
EdTs	Phonology	Grammar	Vocabulary	Language discourse
EdT 4	Pronunciation - mispronounces when reading & speaking	Sentence formation - sentences not grammatically accurate	Very limited vocabulary	Difficulty translating thoughts into coherent sentences - sentences often require additional substitution of words to properly understand thought process
EdT 5	- NIL -	Sentence formation - student needs guidance to form grammatically correct sentences	Inaccurate usage of words Inability to associate words to meanings - struggles to remembers words & corresponding meanings	Difficulty processing information - struggles with understanding what others say & thus struggles to carry out conversations
EdT 6	Ability varies based on aspects - able to read sounds on drill cards but unable to combine sounds to create new ones	Sentence formation - unable to construct grammatically accurate sentences in writing despite being able to in speech & conversations	Limited vocabulary Inaccurate usage of words - often uses words that are inappropriate to context/situation	Difficulty translating thoughts into coherent sentences - unable to communicate ideas & thoughts clearly despite having all of them in her head EdT believes it is due to her lack of vocabulary
EdT 7	Pronunciation - struggles to distinguish between "sh" & "ch"	- NIL -	- NIL -	Difficulty translating thoughts into coherent sentences - struggles in this area but EdT attributes it to student's lack of exposure to the English language, lack of confidence & student's less outspoken demeanour

Part 3: Experience teaching students with oral language weakness

In this section, more in-depth information about the EdTs personal experience teaching the identified A1 student was extracted. The tables (Table 4- 9) summarise information gathered on their relationship (past & present) with the student, personal struggles, current strategies employed and future plans for teaching the student.

Table 4. Case study A - EdTs' relationship with student

Teacher-student relations				
Case Study A				
EdTs	Initial observation		Current observation	
	Speech & language	Behaviour & emotional	Speech & language	Behaviour & emotional
EdT 1	Student is very weak; still needed to blend even CVC words	Initially, EdT believed the student was very quiet & reserved.	Still weak in communication skills	No behaviour or emotional issues Very participative in class (e.g. shares despite still struggling with communication
EdT 2	Student is very weak; struggles with - Blending of sounds despite having been taught explicitly - Short vowels (e vs a). - B & d reversals - Spelling: still dependent on finger spelling	NIL -	Still requires EdT to repeat & emphasise things	Very well behaved; listens to instructions well & follows lessons to the best of abilities
EdT 3	Student is very different from his peers; unable to communicate but able to read sentences smoothly whereas his peers are the opposite. Thus, he struggles to comprehend and follow instructions	NIL -	Still struggles to communicate	Although, it is still a challenge for EdT to communicate with child, in comparison to the beginning, their relationship is much better now

Table 5. Case study B - EdTs' relationship with student

Teacher-student relations				
Case Study B				
EdTs	Initial observations		Current observation	
	Speech & language	Behaviour & emotional	Speech & language	Behaviour & emotional
EdT 4	Very poor vocabulary - especially lacking vocabulary specific to emotions and feelings	Student initially did not enjoy coming to class - unable to communicate with people	- NIL -	Student is active in class - seeks out opportunities to speak and share. Overtime, the student has opened up to his teachers and allowed them to help him fill in the gaps in his oracy skills so he can be better understood.
EdT 5	Student has limited vocabulary Unable to follow instructions - had difficulty with work production and required constant prompts and guidance from EdT	- NIL -	- NIL -	Student displays no behavioural or emotional difficulties Student is eager to learn - takes the initiative to ask for help
EdT 6	EdT explained she noticed a huge disparity between student's reading and spelling abilities. Spelling: Unable to use phonetic skills taught previously to sound out words & spell (e.g. struggles to spell "black") Reading: Fairly well at 7-9 year old level	- NIL -	- NIL -	Student is polite; listens to instructions well Student seems to be interested in bettering herself
EdT 7	- NIL -	Very soft-spoken; needed a lot of prompting talk and participate in lessons	- NIL -	No issues - student is always punctual for class Student became more participative after online classes

Table 6. Case study A - EdTs' personal experience

EdTs' personal experience		
Case Study A		
EdTs	Struggles faced	Skills possessed
EdT 1	Difficulty altering lessons to fit needs of student: ♦ Had to think out of the box to find ways to simplify lessons, especially when teaching student vocabulary words/concepts that are abstract and not relatable to the student	Knowledge & experience: ♦ Years of experience teaching children with language difficulties & impairments have helped her learn the tell-tale signs of students and how she can best assist them
EdT 2	Personal struggles (EdT's response was inferred from her interview as an explicit answer was not given) ♦ Worried about not being able to help improve her student	- NIL: EdT was not asked this question-
EdT 3	Difficulty communicating with student: ♦ Hard for EdT to get even simple instructions across to her student. ♦ Feels like her student often misunderstands her intentions as in some cases she feels she might come across as angry to her student	Patience ♦ EdT explained that she relied on her patience the most as this student, out of all her other students has been the most challenging to work with because of his inability to communicate his thoughts and understand others. Genuinely wanting to help ♦ EdT explained that when it got very challenging teaching this student, she had to go back to the reason why she entered this line of work.

Table 7. Case study B - EdTs' personal experience

EdTs' personal experience		
Case Study B		
EdTs	Struggles faced	Skills possessed
EdT 4	Difficulty controlling student ♦ EdT was unable to prevent her student from throwing fits out of frustration when he could not understand others or communicate his ideas to classmates and herself	Prioritisation Skills ♦ Knowing what to prioritise when teaching a child has helped her work with this student
	Personal struggles ♦ EdT explained that while working with this student, she sometimes felt helpless, frustrated and guilty for not being able to understand & help her student more	
EdT 5	Difficulty altering lessons to fit the needs of student ♦ Found it hard to create different worksheets for this particular student and other classmates because of the varying abilities of her class.	Genuinely wanting to help ♦ Believes that the extra effort she takes to try and better understand the student's background and how he is coping in school has helped her in teaching the student
	Balancing this student with other students ♦ EdT found it hard to fully focus on this student due to presence of other students in class who are moving at a faster pace Personal struggles ♦ EdT explained that while working with this student, she sometimes felt helpless, frustrated and guilty for not being able to understand & help her student more	Knowledge & experience ♦ Her understanding of the student's difficulties & her knowledge of language & development milestones allowed her to identify the student's learning needs & better teach the student

Table 7. Case study B - EdTs' personal experience (Cont)

EdTs' personal experience		
Case Study B		
EdTs	Struggles faced	Skills possessed
EdT 6	Difficulty getting concepts across to students ♦ Unable to find a way to get her student to remember letter sounds (abstract concept) as it is not something that can be represented in a concrete manner Time management & class's schedule ♦ Feels that the 2 hour lesson once a week is not beneficial for her student and is a struggles: ♦ Student often forgets what they covered in the previous lesson by the next one. Issue is most prominent after public/school holidays/when student misses lessons Personal struggles ♦ Is unable to understand the great disparity between student's reading and spelling abilities	Open-mindedness ♦ EdT believes her open-mindedness to trying different teaching methods (aside from the OG method) has helped her to identify the student's learning needs & corresponding ways she can help her student overcome them
EdT 7	Personal struggles ♦ Biggest struggle came in the beginning when the student had just joined her class. EdT was worried she would scare off her student as she looked very timid & scared ♦ Student's lack of participation & responsiveness also made her question her teaching, she wondered if the student was actually understanding and absorbing content taught	Patience ♦ Believes she was able to help her student due to her patience and understanding. She explains that these values helped her avoid getting annoyed or irritated with the student even when student was too soft or was not participating the way she wanted

Table 8. Case study A - EdTs' employed strategies & future plans

EdTs' employed strategies & future plans			
Case Study A			
EdTs	Strategies employed	Effectiveness of current strategies and future plans	
EdT 1	Strategies employed in the classroom - Supports lesson with visual/auditory content - Includes at least 1 picture in every worksheet - For spelling practices, she googles pictures & uses them as prompters/a tool to elaborate and explain that word to student - Provides student with extra speaking opportunities - Ask for students opinions/preferences on things - E.g. For sight words, she usually times her students but for this particular student, she asks for permission before doing so - Providing a lot of encouragement & support to student where appropriate - Encourages and praises student where appropriate	Effective Now able to move on to vccv words and longer words in general Student is able to decode words on her own and remembers the steps needed to blend them Vocabulary: Student is now able to remember some of the words taught to her Believes the praises and encouragement has helped the child be happy in class	Plans to continue employing the strategies mentioned but will try to better scaffold her lessons to benefit both the student in question and her other students in the same class
	Strategies employed in the classroom - Supports lesson with visual/auditory content - Uses videos to explain things where possible - Teaching with the aid of games/ activities - Physical games - E.g. Since EdT believes her student's main weakness is his poor memory, she uses memory card games with him. She believes that without focusing on improving his memory, he will just continue to forget everything learnt, leading to no improvement - Tried using multisensory materials & activities but plans were stopped abruptly due to Covid-19	- NIL: EdT was not asked this question-	Plans to continue employing the strategies mentioned for the long run

Table 8. Case study A - EdTs' employed strategies & future plans (Cont)

EdTs' employed strategies & future plans			
Case Study A			
EdTs	Strategies employed	Effectiveness of current strategies and future plans	
EdT 3	Strategies employed in the classroom ♦ Word Families - groups of words that have a common feature or pattern - Runs through one word family at a time and then uses it to teach student vocabulary - From one word family, EdT picks 1-2 main vocabulary words & links it to themes e.g. "_et" family, she might pick the word vet and teach the student the idea of an animal doctor and then use that to introduce different types of animals & corresponding adjectives - In one lesson, she tries to introduce at least 5 words ♦ Supports lesson with visual/auditory content - Prints out pictures that represent the words she taught to students through word families ♦ Adapts to child spontaneously - Shifts focus when necessary - E.g. Since student is weak in grammar rules & strong in reading, she focuses on teaching grammar rules (i.e. punctuation & capitalisation) instead of reading techniques	Effective to a certain extent Effective because: Student is now able to communicate a little better compared to in the very beginning Ineffective because: EdT feels student is confused by the introduction of several vocabulary words every week as although he remembers the meanings, he attaches them to different words	EdT will continue employing such strategies while actively seeking ways to improve them to better benefit her student. However, as of now she is not sure of the changes she wants to make
	Strategies to aid learning outside of the classroom ♦ Provides student with extra work - Provides student with extra worksheets to help review & recap lessons at home		

Table 9. Case study B - EdTs' employed strategies and future plans

EdTs' employed strategies & future plans			
Case Study B			
EdTs	Strategies employed	Effectiveness of current strategies	Future plans
EdT 4	Strategies employed in the classroom ♦ Word Families - groups of words that have a common feature or pattern - Specifically focuses on teaching words that have to do with emotions & feelings as her student is weak in this aspect of vocabulary ♦ Supports lesson with visual/auditory content - Uses pictures and short videos to create talking opportunities for student to help improve overall oracy skills ♦ Adapts to child spontaneously Takes the extra time & effort to - Correct student's sentences one by one - Understand student's thought process - Learn student's behaviours i.e. his triggers & distractors	Effective to a certain extent Effective because: Strategies used have been helpful in encouraging student & in motivating student to continue learning vocabulary words which will eventually lead to him improving his speech & communication abilities Ineffective because: EdT feels student's improvement has a lot to do with him attending SLT and his increase in exposure to the English language	Plans to continue using the strategies mentioned for at least the next year but with improvements Plans to change the focus of conversations to topics that are of interest to student & increase the complexity of topics in general since student will be in P3 in 2021.
EdT 5	Strategies employed in the classroom ♦ Supports lesson with visual/auditory content - Provides student with visual cues/prompts when student get stuck ♦ Teaches with the aid of games/activities - Online games - Uses online quiz game platform Kahoot in class to recap lessons	Effective Effective because: Kahoot has worked as a form of review for the student: helped him understand & apply concepts & also helped motivate and boost student's confidence *EdT only shares benefit of teaching with the aid of the game, Kahoot*	Will continue to employ these strategies and tweak lesson materials based on student's progress so he can do them independently as much as possible

Table 9. Case study B - EdTs' employed strategies and future plans (Cont)

EdTs' employed strategies & future plans			
Case Study B			
EdTs	Strategies employed	Effectiveness of current strategies	Future plans
EdT 5	♦ Alters teaching/learning resources & lessons - EdT adapts reading comprehension exercises of student by giving him MCQ questions instead of open-ended ones ♦ Adapts to child spontaneously - EdT will observe student and devote more time to areas in which student needs most help in Strategies to aid learning outside of the classroom ♦ Involves parents in student's academic life - EdT recommends websites/online games to student's parents that she feels can help the student with spelling, reading and his phonological skills		
EdT 6	Strategies employed in the classroom ♦ Supports lesson with visual/auditory content - EdT noticed that during spell activities, student would often stray, and spell things based on what she feels is right - To try to fix this, EdT prints or writes letters that the student will need to use during spell activities, "forcing" the student to only use those few letters to spell the words given	Effective Effective because: She feels that the strategy (i.e. using letter cards/writing out the letters) has worked better than previous methods of conducting sound spelling (i.e. just leaving the child to spell on her own)	EdT explains that she plans on continuing using the strategies currently employed.

Table 9. Case study B - EdTs' employed strategies and future plans (Cont)

EdTs' employed strategies & future plans			
Case Study B			
EdTs	Strategies employed	Effectiveness of current strategies	Future plans
EdT 6	♦ Alters teaching/learning resources & lessons - For close passages, EdT blanks out certain parts of the words, e.g. she removes certain vowels and gets the student to fill in the blanks based on the context of the passage and the word's spelling		For using letter cards/ writing out the letters, she specified that she will employ this strategy until at least the end of term 1, 2021. She hopes that by then, student will be able to catch on and thus, when the physical cards are removed, student will still be able to spell correctly.
EdT 7	♦ Supports lesson with visual/auditory content - Uses visuals during "words to read" - Provides students with pictures to help facilitate learning & gain student's attention/interest - Uses videos when introducing new sounds as she feels videos make the sounds more salient for the student ♦ Teaches with the aid of games/activities - Online games - Uses the iPad and online quiz platforms to help boost her student's morale & confidence, e.g. Kahoot ♦ Provides student with extra speaking opportunities - Gets all her students including the student in question to answer her questions and have conversations about non-school related topics. - Does this to help them understand sentence structure & expose them more to the English language	Effective because Student now asks questions and does not keep everything to herself anymore	Plans to continue using these strategies because her other students also benefit from these strategies Will also continue to make the effort to talk to the student in question and have informal conversations Help student build her confidence and continue building a rapport so student continues to feel comfortable in class

DISCUSSION

The study conducted allowed us to understand the experience and ways in which EdTs at DAS work with students with both dyslexia and oral language difficulties. It was found that regardless of experience in years and whether or not EdTs knew about oral language weakness, they all face challenges while working with their students. Some struggled with more personal issues like feeling helpless, frustrated and guilty for not being able to understand their students, while others struggled with more teaching related issues such as communication difficulties, time constraints, difficulty in lesson planning and structuring.

General strategies in the classroom. Results from both groups of EdTs (Case study A & B), allowed us to identify the more common classroom strategies that work for these students. The most popular strategy identified was the use of visual and auditory content in the classroom. According to all EdTs, students were able to understand and absorb lessons better when they did this through various methods like, attaching pictures to worksheets, showing videos and pictures to describe words and even using voice clips to demonstrate proper pronunciation of sounds.

A majority of the EdTs also explained that they alter the teaching resources used. Specifically, EdTs explained that they often give their students simplified work. For example, some EdTs replace open-ended questions with multiple choice questions and others blank out only certain letters in a word in spelling exercises.

EdTs also largely avoid a rigid lesson structure and emphasise the importance of adapting to the child as one teaches. Some EdTs explained that instead of just doing pen and paper exercises, they create online quizzes on software like Kahoot to help recap a lesson. Others spend more time talking to their students because they feel the student needs more help in expressive language skills in comparison to reading skills.

General strategies outside of the classroom. In addition to the general strategies used by EdTs in the classroom, our study also helped gain insights on what can be done by EdTs outside of the classroom to better support their student's learning. A few EdTs mentioned the importance of parent involvement in their child's academic life and shared the idea that EdTs can only do so much in the short hour or two they spend with their students. Thus, EdTs often share their student's progress with the parents and also provide them with resources (i.e. websites and online games) that they can use to help reiterate concepts learned in the classroom.

Other possible implications. Information gathered about awareness of oral language weakness amongst EdTs was also useful. Since three out of seven EdTs are unaware of what oral language weakness is, it suggests that EdTs are lacking in knowledge of oral language weakness and that more should be done to increase this knowledge.

LIMITATIONS AND DIRECTIONS FOR FURTHER RESEARCH

Even though this study has furnished insights into the difficulties that EdTs face when teaching their students, there are limitations which need to be considered for future research. This study was conducted with a small sample of EdTs and thus, a small sample size of students. 7 EdTs who described their experience teaching their students is hardly sufficient to provide generalisations on the population of students at DAS. As stated above in the study conducted by McArthur and colleagues, 55% of children who had dyslexia were found to also have impaired oral language abilities. Thus, a bigger sample size of students at DAS would render a stronger study on students with dyslexia who may also face language difficulties. Although the responses derived from both the interview and questionnaire are adequate to gather an understanding of the EdTs' perspectives in teaching their students, the interview accorded more in-depth responses as the EdTs could be prompted and probed even after they had elaborated on their replies. Hence, future research might consider just an interview for data collection where information given by EdTs could be rich and wholesome.

CONCLUSION

In conclusion, this study achieved its purpose and allowed for a better understanding of the challenges that EdTs face when teaching this group of students, as well as the teaching methods that have helped them guide their students in the classroom. This study was also beneficial as it acts as the stepping stone towards creating DAS very own in-class good practice guide book with suggestions for in-class support. The information gathered about EdTs lack of knowledge on oral language weakness also prompts the need for resources that educate EdTs about DLD. These resources will help to increase overall awareness on the comorbidity of dyslexia and DLD, allowing EdTs to better understand and support such students.

Hence, here are the recommendations put forth:

Training. Currently, EdTs are trained deeply on the dyslexia profile. Moving forward, EdTs have to be given information on typical versus atypical traits of language acquisition in school-going children which calls for a more in-depth training of comorbidity such as oral language weakness. This can be achieved through the courses conducted at the DAS Academy where apart from dyslexia, focus can also be given to topics on oral language weakness.

Resources. EdTs rely greatly on resources that are suitable for their students. Thus, the creation of materials to tackle and teach language and vocabulary for different levels of students is necessary. For example, low language weakness among children spans various ages; students at different age groups will require different resources that will aid

their learning of language and vocabulary. This can be achieved through periodical review of the DAS curriculum such that teaching materials are relevant to the specific groups of students. Additionally, Speech and Language Therapists (SLTs) possess great knowledge and skills as they work with this specific group of students. Hence, greater conversations and collaboration with in-house SLTs are likely to enrich EdTs with language-teaching guidelines that they can utilise in the classroom when teaching their students.

Awareness and education. It is essential that all educational therapists, educators, and parents be more aware and educated on what low language weakness is and the distinct features that separates it from dyslexia. This can be conducted through the annual DAS UNITE SpLD Conference and other small scale presentations such as the Teams Teaching Teams, Centre Sharing, and Parent Talk sessions which are organised on a yearly basis. For educational therapists and educators, this will be a form of continual professional development.

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APPENDIX A

EdT Questionnaire/Interview questions

TEACHING EXPERIENCE OF EDUCATIONAL THERAPIST (EDTS)

This questionnaire aims to explore the perception of EdTs on teaching students diagnosed with dyslexia and oral language difficulties who have been given the A1 banding upon assessment. From this questionnaire, the SpLD Committee hopes to gain a better understanding of current and future efforts of DAS for EdTs working with learners who have dyslexia and oral language difficulties. Please **read the instructions carefully** and **answer all** of the following questions as detailed as possible and to the best of your ability. There are **no right or wrong answers**.

PART 1: TEACHING EXPERIENCE

The following set of questions seek to find out more about your general experience teaching children with learning difficulties. Please answer all questions by **filling in the blanks**.

1. How long have you been teaching children with dyslexia?

2. How often do you encounter students who may have an oral language weakness?

3. How long have you been teaching students with an oral language weakness?

4. How long have you been working with your student who was given the A1 banding?

MILESTONES IN LANGUAGE DEVELOPMENT (≥ 3 YEARS)		
Age	Expressive Language	Auditory Comprehension
3 - 4	• Uses 3 - 4 word sentences and knows approximately 600 - 1000 words. • Uses pronouns, adjectives, adverbs, prepositions, past tense and plurals. • Able to answer simply what, where and when questions.	• Understands 1500 words • Recognizes gender differences, plurals, pronouns, adjectives and colours •
4 - 5	• Uses 4 - 6 word sentences that are more detailed and vocabulary grows to 1000-1600 words • Uses 4-6 syllable words and articles appear in speech • Uses more adjectives, adverbs and conjunctions • Overall fluency increases	• Understands 1500 - 2000 words • Understands if, because, why and when • Able to follow complex instructions
5 - 6	• Vocabulary at 1500 - 2100 words • Uses complete 5 - 6 word sentences • Speech is fluent • Uses many multisyllabic words	• Understands 2500 - 2800 words • Able to understand more complex sentences
6 - 7	• Wide range of vocabulary allows the child to classify objects into more specific categories (e.g. form, use, composition and colour) • Able to use language at a higher level; make jokes, sarcasm, argue their point of view, recall and explain events/memories • Starts developing written language skills and ability to write a descriptive paragraph • Grammar is mature (resembles adult grammar)	• Able to follow multi-step instructions • Able to answer 5W1H questions • Listens and understands grade level stories read to them • Listening comprehension is demonstrated
7 - 8	• No specific milestones for vocabulary • Able to express their opinion well • Able to recall both imaginary and real-life events • Uses appropriate grammar in speech and written work • Will ask questions to clarify their doubts and queries	• Able to understand for extended periods of time (e.g. listen to speakers at school)

PART 2: KNOWLEDGE OF ORAL LANGUAGE WEAKNESS

The following set of questions seek to understand your level of knowledge of oral language weakness. Please answer by **ticking** the appropriate box or **writing your response in the boxes provided**.

1. Are you aware of the language milestones of children represented in the table above?

☐ Yes ☐ No

2. Do you think language milestones are important and should be tracked or noted?

Please elaborate.

3. Do you know what an oral language weakness is?

☐ Yes ☐ No

If you responded "Yes" to question 3 please move on to question 4. If you responded "No" please skip question 4 and move on to question 5.

4. With reference to your student, could you describe what a child with oral language weakness struggles with?

6 Affected Language Components		
Phonology	Morphology	Pragmatics
Refers to the sound system of a language. Phonology includes the study of how sounds are organized and the interaction between all these different sounds.	Refers to the study of words. Specifically, it focuses on the study of the forms and formation of words in a language.	Refers to the study of the ways in which context contributes to meanings. Pragmatics studies the relationships between linguistic forms and their users.
Grammar	Vocabulary	Language Discourse
Refers to the set of rules for word formation and sentence arrangement to ensure complete and correct meaning.	Refers to the meaning of individual words. Oral vocabulary → words we use in speaking or recognizing in listening Reading vocabulary = words we recognize in print	Refers to the way in which language is used socially to convey ideas and thoughts. It looks at language beyond a single sentence.

5. Do you think your student struggles with any of the 6 components outlined in table 2?
Please elaborate.

6. Are you able to provide examples of a child's speech that could possibly indicate an oral language weakness? **Please elaborate on your answer.**

**Take note that speech, in this case, refers to sentence structure, logical flow and meaning of sentences and NOT pronunciation or articulation of words.*

☐ Yes ☐ No

PART 3: EXPERIENCES TEACHING STUDENTS WITH ORAL LANGUAGE WEAKNESS

The following set of questions seek to explore your personal experience teaching student(s) with oral language weakness. Please answer the questions as truthfully as possible. There are **no right or wrong answers**.

1. Describe your relationship with the student(s) you will be sharing about.

General teaching experience

1. What do you observe (e.g. speech, language etc.) of this particular student when you first got him/her under your charge?

2. As this student's EdT what skills do you possess that enabled you to identify his/her learning needs? **Please elaborate.** **e.g. Knowledge of language milestones*

3. What are some of the struggles you faced when teaching students with oral language weakness? **Please elaborate in detail.**

Strategies used to address oral language weakness

1. Please share some of the strategies you have used to help with this student's learning.
Do elaborate with examples.

2. Have these strategies worked?
☐ Yes ☐ No ☐ To a certain extent

Please describe how they **have and/or have not worked** in the box below.

3. For strategies that have been successful, would you continue employing them with your student? Please elaborate.

**Include your reason, how you plan to continue doing so and for how long.*

PART 4: ADDITIONAL COMMENTS/FEEDBACK

1. Is there anything else interesting you would like to add?

2. Is there anything you feel you might have missed mentioning earlier?

3. Additional feedback or comments.

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UNITE SpLD 2022 CONFERENCE

Uniting Ideas in Teaching Excellence:
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ONLINE CONFERENCE

The UNITE SpLD Conference seeks to bring together parents, teachers and practitioners working with children with specific learning difficulties and special educational needs. This conference will be showcasing research that covers aspects of behavioural, literacy and social emotional support, intervention and assessment for children with special learning needs. Come and listen to our SpLD experts share their research. Research will be presented in short, engaging and entertaining sessions accompanied by poster presentations and the chance to talk directly with researchers who are making a difference in the Asian region.

Asia Pacific Journal of Developmental Differences
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International Forum Panel—Conference Day 1—23 June 2022



Don't wait for your child to fail—The Importance of Early Assessment and Diagnosis

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UNITE SPLD 2022, would not be complete without the coming together of international specialists for discussion on significant topics like this one. It is especially significant during these challenging COVID-19 times when we have all experienced challenges. The international forum gives us a chance to pause, listen, share and understand what we have been doing in our community for early intervention. This forum helps to provide perspectives on the importance and role that early assessment plays in supporting our children who may be at risk of specific learning differences such as Dyslexia, ADHD etc. It is our hope that through this panel discussion on topics that are close to our hearts in the work we do, we will provide some guidance and advice from our diverse forum on how to approach early intervention.

Keywords: COVID-19, early intervention, early assessment, screening, Dyslexia, Specific Learning Differences, ADHD

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The Role of Special Educational Needs Officers (SEN) in promoting a whole-school approach to SEN support?

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Abstract

Despite the growth of international research on paraeducator deployment, the understanding of its working in Singapore remains nascent. This research addresses the limited knowledge of paraeducator deployment in Singapore by examining how SEN (previously known as Allied Educators (Learning and Behavioural Support) [AED(LBS)] spend their time in school, how they work with the school community of teachers and school leaders, and the factors that affect the process of working together using Wenger's (1998) community of practice framework.

The findings encourage a reimagination of the SEN role in mainstream schools, moving from a role mainly concerned with student support to one with a growing influence on the school's inclusive culture. Beyond having a tangible impact on teachers and school leaders through practical support rendered, SEN were observed to exert an intangible influence on colleagues through their voice and visibility. This intangible influence won their colleagues' trust, facilitated their inclusion into school communities and encouraged teachers' willingness to participate in the support of students with Special Educational Needs (SEN). Through their voice and visibility, SEN enabled a whole school approach to support. Both leaders and SEN played a part in determining the extent of AEDs' (LBS) voice and visibility. Recommendations for increasing SEN voice and visibility will be provided.

Keywords: Special Educational Needs Officers (SEN), Allied Educators (learning and Behavioural Support (AED (LBS))), visibility and voice

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Dyslexia-associated cognition: Not a disorder, but an evolved Specialisation in Explorative Cognitive Search

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Abstract

This research provides a new and different view of dyslexia-associated cognition, reframing it not as a disorder, but rather, as an evolved specialisation in Explorative Cognitive Search, indicating that this form of cognitive processing plays a critical role in how our species adapts to change.

A new theoretical lens, namely information Search, is used to understand the cognition of individuals being diagnosed with developmental dyslexia. Regulating search is fundamental to adaptive success at both evolutionary and ecological (i.e. cognitive) time scales. Appropriately balancing this process is so central to survival that it is believed to be one of the most important selective forces operating in the evolution of cognition.

It has long been argued that individuals with developmental dyslexia possess a talent for global (versus local) information processing and enhanced abilities in realms such as creativity, divergent thinking and invention. These are all ways of processing information that are associated with global information search. It was therefore hypothesised that individuals with dyslexia are specialised in explorative cognitive search - since this would explain both the higher-level strengths and difficulties that have been observed.

The study predictions derived from a new scientific theory of human cognitive evolution - The Evolution of Complementary Cognition - which itself is grounded in complex adaptive systems theory. The purpose of this study was not to debate the existing evidence concerning developmental dyslexia; rather the aim was to use Search as a new framework from which to interpret the evidence. It was hypothesised that higher-level strengths observed in individuals with dyslexia reflect an underlying specialisation in

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explorative information search. This hypothesis makes two predictions. The first was that underlying cognitive and neurological differences favour global search. The second was that these would be clustered, i.e. a global search bias would be found in more than one area of cognition.

In general, whichever aspect of dyslexia-associated cognition was looked at, evidence indicated a relationship to explorative information search. Even some features previously understood as deficits, such as lower working memory, enhance explorative search. Areas of deficit on the other hand, are consistently related to local information search. The evidence concurs with the hypothesis that the cognition of individuals with dyslexia is specialised for greater explorative search. The importance of this cannot be over-emphasised. Specialisation by such a significant proportion of the population indicates that our species regulate search at the group level. In other words, it indicates that our species adapt through group-level cognition. This finding emphasises the urgency of changing educational practices and nurturing the strengths in this group of people, to both value individuals with this way of thinking and to enable us as a global community to move towards a more adaptive and sustainable society.

Keywords: dyslexia, complementary cognition, cognitive search, evolution, adaptation. ,

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Understanding the emotional and behavioural needs of primary students with specific learning disorders

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Abstract

Background: Specific learning disorders (SpLDs) are one of the most frequently occurring conditions among students with special educational needs (SEN). Although it may seem that SpLDs affect mainly learning, students with SpLDs frequently also experience emotional and behavioural difficulties.

Objectives: In this paper, we seek to understand the presentation of emotional and behavioural difficulties of primary children with SpLDs. We also hope to understand the extent to which these emotional and behavioural difficulties are related to cognitive processes and social outcomes.

Method: Data from approximately 100 participants will be drawn from a larger longitudinal study of students with SEN in Singapore schools. Emotional and behavioural difficulties measured by the Strengths and Difficulties Questionnaire (SDQ), cognitive processes will include parent completed inventories as well as findings from the Singapore Ability Scales. Social outcomes will be measured by the SDQ as well as a bullying survey.

Conclusion: The findings will be interpreted in the light of needing to understand and support students with SpLDs in a holistic manner.

Keywords: specific learning disorders, emotional and behavioural difficulties

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An insight into the experiences of Primary 6 students with dyslexia using the metacognitive-based approach of problem-solving for algebraic word problems

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1. *Dyslexia Association of Singapore*

Abstract

Students with dyslexia often struggle with word problems because of the mathematical language and multi-steps involved. At the Dyslexia Association of Singapore (DAS), the Problem Sums for Upper Primary (PSUP) curriculum was developed in 2016 to meet the needs of our primary school students who were firm with their basic mathematical concepts but lacked the appropriate strategies to solve higher-order word problems. The PSUP curriculum utilizes a combination of Polya's 4-step processes, the Concrete-Representational-Abstract approach (C-R-A) and the Try-Share-Learn-Apply approach as its primary teaching methodology. As the programme has yet to explore students' meta-cognitive abilities in planning, monitoring, solving and checking word problems, this study aims to understand the thought processes of eight Primary six students in solving word problems involving Algebra concepts through interviews and pre/post tests. Students were also given a questionnaire at the beginning and end of the intervention period to assess their confidence level in solving mathematics problem sums. To evaluate the effectiveness of the PSUP curriculum teaching approaches, the students' pre-test, review test and post-test scores were compared. The results showed that 75% of the students improved from Pre-test to Review test and from Pre-test to Post test for all the algebraic concepts. Responses from the questionnaires also showed that the students were more confident in solving word problems as compared to at the start of intervention. More findings will be included in the main research paper as students' input is currently being analysed. Limitations and instructional implications will also be discussed.

Keywords: meta- cognitive abilities, multi-step higher order word problems, Algebra concepts

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Fluency Dyslexia Speech Reading Sequencing Working Memory Positivity

Carol Allen^{1*}

1. Education advisor for ICT and Inclusion

Abstract

This session will consider the importance of fluency as an achievable aim for students who face daily barriers to literacy. So often when students are struggling to decode and comprehend the written word, fluency is almost an afterthought. Yet to be fluent in both speech and reading is a clear success indicator in education and life. Fluency also has a direct impact on confidence and thus self-esteem. We will consider the nature and impact of fluency before considering a range of low and high tech options for supporting work in this area. Practical ideas, apps and technology resources will be discussed with the aim of offering delegates ideas to replicate in their own practice.

Keywords: Fluency, Dyslexia, Speech, Reading, Sequencing, Working Memory, Positivity

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Educational assessment for a child with dyslexia- what is it & how does it help

Kalyani Balakrishnan^{1*} and Harini Mohan¹

1. *Madras Dyslexia Association, India*

Abstract

Assessment is the cornerstone for a child who is observed to be performing below his potential; it determines the way forward. The diagnosis that predicts learning potential, strengths and deficits paves way for concerted efforts for meaningful intervention. It is well known that dyslexia can affect academic skills like reading, spelling, writing, maths and also one's career, emotional well-being i.e. various aspects of life. Good intentions to support a child with dyslexia needs a starting point -which is assessment. Dyslexia could impact many aspects of a child. The areas are interwoven and are exhibited in many areas-some evident while some others are subtle. Co-morbidities and side-effects of dyslexia could lead to manifestations that add another layer to the problem i.e. identification of the primary source of the problem! The intensity of structured remedial classes, occupational therapy and other referrals required to help the child to cope with difficulties posed by dyslexia are determined by the degree of difficulty, individual's learning style, areas of difficulties and behavioural issues. Assessments done at Madras Dyslexia Association, strive to uncover the deficits in the underlying basic skills required for learning. This paper discusses the processes and the analysis of the data from multiple sources of information that leads up to a comprehensive assessment report. The report gives details on the status of the essential skills like Auditory, Visual and motor skills, and academic skills. The paper goes on to elucidate how this report gives a complete picture of the child to a special educator to plan and execute individualised remedial sessions making road maps to reach their abilities. Lastly, case studies would be discussed to showcase the holistic approach to intervention that was made possible by the educational assessment.

Keywords: Dyslexia, Assessment , Educational Assessment

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Profiles of literacy skills and cognition among Primary 1 children in reading intervention

Malikka Begum^{1*} and Beth O'Brien¹

1. *National Institute of Education, Nanyang Technological University, Singapore*

Abstract

Evidence suggests that most struggling learners exemplify one of several common profiles and patterns of reading difficulties (Cabell et al., 2011; Pennington et al., 2014). Understanding these profiles and patterns is key to early identification and intervention with struggling readers as well as effective educational practices for improving reading skills. However, currently, there is no study examining this variability in Singapore. The purpose of this study was to describe potential profiles of within-group variabilities in the literacy skills of children who are at risk for learning difficulties. Seventy-six primary 1 participants (aged 63 to 88 months) who were identified according to their schools as either typically progressing students or struggling learners (requiring extra support). Thirty-eight struggling learners (SL) were matched on chronological age with thirty-eight typically developing peers (TD). Measures of literacy, oral language, working memory and vocabulary and executive control were administered to both groups of children. Between group comparisons were conducted with Analysis of Variance (ANOVA). Significant differences between the scores of TD and SL groups were found for literacy skills, as well as phonological awareness, verbal working memory, verbal and non-verbal cognition and vocabulary. The prevalence of poor performance across the different measured skills and patterns of combined deficits were further examined within the SL group. This study highlights the considerable heterogeneity of literacy abilities of children in a learning support group. The resulting profiles have theoretical and practical relevance when examining concurrent relationships between patterns of performance in various domains and reading and spelling achievement.

Keywords: Intervention, struggling readers, heterogeneity

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The past and future of psychological assessment

Tim Bunn ^{1*}

1. Educational Psychologist, Singapore

Abstract

This opinion piece follows the history of psychological assessment of learning from the later 19th century to today, with glimpses of what neuroscience and AI may contribute. It argues that a more comprehensive model of assessment is now needed, to move away from but not abolish the model founded on IQ. Not all recent developments in psychology have yet been adequately incorporated into assessment practice, but there is already scope to develop a multi-level model into practice, which would enable psychologists to more clearly describe students strengths and weaknesses in learning, and to suggest ways to better help them. The model proposed would incorporate many hard science features of assessment but would ultimately be interpretive, and personal.

Keywords: Psychoeducational Assessment, Specific Learning Differences (SpLD), Dyslexia, Strengths and Weaknesses

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Classroom Documentation and the Disappearing “Incompetent Child”

Anna Cieczczyk^{1*}

1. Early Years Education Teacher, Australian International School, Singapore

Abstract

The image of the child as competent has become the staple of progressive ECE pedagogies which centre the curriculum on the child. Children’s explorations, projects, and joint efforts to problem-solve are shared with the wider community through teachers’ documentation of children’s learning journeys (Edwards, Gandini, and Forman 1998). The sentimentalized utopian vision of children as capable inadvertently excludes the “incompetent child”, a concept which in ECE can be viewed as an unthinkable abomination. “Incompetent children”, however, do exist. They might struggle to form relationships or understand social cues, they might not belong in group discussions, they may not have the cognitive tools to effectively address the tasks other children complete with ease and joy. Sadly, the mere existence of “incompetent children” does not seem to be sufficient enough to save them from disappearing from the classroom documentation (Bjerväs, 2011). The “incompetent child’s” unique skills, interests, and objectives simply do not match the quality standards preschools set for themselves (Margrain and Hultman, 2019). These children often do not belong in the mainstream pedagogies and the volume on their quiet, “unimpactful” explorations is muted and then silenced in documentation. This lack of representation and recognition of children’s unique, albeit unconventional, strengths excludes them from full participation. This presentation will look at practical examples of how ECE teachers can help children exist in classroom documentation, and the reasons why this is important. I was fortunate to get support for my own dyslexia whilst at school. This extra support enabled me to pass my exams, go onto university and now the workplace with the confidence of knowing I had achieved. Breaking down barriers for young struggling readers is an important part of my life mission. My presentation will talk about the importance of a toolbox approach when using assistive technology in everyday education and exams.

Keywords: incompetent child, image of the child, classroom documentation, ECE, early years, early childhood education, democracy, special needs

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What are the implementation challenges in supporting older students to access assistive technology?

Julia Clouter^{1*}

1. *SpLD Specialist, Scanning Pens, UK*

Abstract

International assistive technology company, Scanning Pens have seen an increase in requests for implementation support from both students and accessibility teams in colleges, higher and further education over the past year. Because dyslexia is recognised as a disability under the British Equalities Act of 2010, it is possible for a range of assistive technology tools to be applied for, funded and deployed through education providers. In the UK, the uptake of requests for these supports has increased in higher and further education, and this is perhaps due to the challenges of remote learning and reduced opportunities for direct contact with tutors and lecturers over the past eighteen months. The availability of disability support funding has increased and students who are confident and familiar with education technology tools, are using this opportunity to adopt a toolbox of supports that provide accessibility and increase productivity.

Keywords: Toolbox Approach, Implementation, Assistive Technology, Higher and Further Education, Disability Support, Equality, Accessibility.

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Say YES to the Phonics Screening Check

Jessica Colleu Terradas^{1*}

1. *Canberra and Goulburn Catholic Education, Australia*

Abstract

Australia's declining student achievement becomes more apparent with each release of standardised assessment results: over 15% of children leave school without the baseline literacy skills to participate fully in society (OECD, 2016)[i] and about 84,000 children were identified as struggling readers (below or at NMS) in Year 3 and 5 in 2019 NAPLAN Reading (Primary Reading Pledge, 2020). Year 3 is currently the first point at which systematic action can be taken in most states and territories. To address this, emerging education initiatives in Australia are implementing the Year 1 Phonics Screening Check (PSC), first run in the UK in 2012 after being piloted. Given that phonics knowledge and skills development is an integral part of learning to read, write and spell, the PSC helps identify students who are struggling to develop reading skills including those that may have a specific learning difficulty. It gives teachers and leaders vital information about decoding skills not gained from other systemic assessments and is neither burdensome for teachers nor stressful for students. Short and simple, the assessment takes only 5–7 minutes and is carried out by classroom teachers with each student individually. Educators then analyse the results and, if necessary, plan for any additional support that students might require. In this session, participants will learn about how to administer and score the Phonics check. They will analyse and interpret the data, and explore how to respond to the results by implementing targeted teaching practices accordingly.

Keywords: literacy, phonics screening test, reading, diagnostic assessment

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Dyslexia: ready to learn! Neuroactivation training before reading and writing

Professor Piero Crispiani¹ and Eleonora Palmieri^{2*}

1. Unilink University Rome, Italy
2. Psychological and Pedagogical Victor Center Macerata, Italy

Abstract

Actions such as riding a bicycle, kicking a ball or activities such as reading and writing are excellent examples of gestalt actions that involve the practical realization of an ideomotor automaticity with a prompt initiation phase.

From our research, the dyslexic group manifested a delay from initiation to execution, with slow neuro-activation in terms of:

- ◆ Lack of coordination in motor sequences
- ◆ Irregular timing and rhythm, with a lack of sequential proceduralization
- ◆ An alteration in the spatial-time input required

Based on Champion Pressing intervention, most dyslexic children may achieve great benefits from our neuroactivation training in terms of fluency and self-regulation processes. Easy and useful practices will be presented to the audience to improve their promptness before reading and writing.

Keywords: neuroactivation, timing, rhythm, synchronization

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Empowering Teachers, Empowering a Nation

Kristiantini Dewi^{1*}

1. *Dyslexia Association of Indonesia*

Abstract

In earlier research, a large-scale questionnaire study of 1781 teachers revealed a high degree of misunderstanding and belief in myths about dyslexia within the teaching population in Indonesia. In response to this perceived need, the Dyslexia Association of Indonesia undertook the development and dissemination of a training course for teachers, over a 5 year period, originally designed to be delivered in person, but most recently delivered online in 2021, in response to the limitations of Covid. 894 teachers in all benefitted from this training, delivered over 28 sessions that covering the topics of developmental milestones of a child, covering the areas of gross motor development, fine motor skills, language, social interaction, cognition and personal skill in carrying out daily activities. Participants were asked to commit to attending regularly and completed pre-tests, post-tests and reflection on the course. Those who had achieved solid results from this initial training were able to join a more focused bursary funded dyslexia workshop in which they learned how to differentiate cases of general learning difficulties and specific learning difficulties, differentiating between Delayed Development and Intellectual Disability, The Milestone of Dyslexia across life-span, Executive Function, Learning Strategies for Students with Dyslexia, Multisensory Approach Learning, Phonemic Awareness, Reading Comprehension, Socio-Emotional Problems in Dyslexia, Best Practice of Parenting for Children with Dyslexia, Handwriting and Dysgraphia, Dyscalculia, Comorbidities of Dyslexia, ie. Dyspraxia, ADHD and Gifted. In this article, the potential of this approach is discussed for reaching a wider population of teachers in order to increase dyslexia awareness and understanding, and ensure that appropriate support for dyslexia can be provided more widely in Indonesia.

Keywords: Explicit instruction, optimizing work load, classroom strategies, lesson design

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Supporting learners with dyslexia in grammar as they transit to secondary school

Tuty Elfira^{1*} and Siti Halimah¹

1. Dyslexia Association of Singapore

Abstract

As students transit from primary to secondary school, an area of difficulty they face is grammar. Our team has often received feedback from learners with dyslexia that they struggle to attempt the Editing component in their school activities, where students are required to edit grammatical errors in a short written text. Launched in 2018, a team of educational therapists from the DAS has designed a 6-hour pre-secondary curriculum to help students understand the rules of Subject-verb agreement (SVA). In this webinar, the team will be presenting topics ranging from understanding the basic rules of SVA, choosing the correct SVA in sentences where abstract nouns are used, to more complex rules of applying SVA in sentences with gerunds/gerund phrases, collective nouns and indefinite pronouns. Based on results of pre- and post- tests conducted in 2019, an 83% increase in scores was observed for the Grammar component of the pre-secondary curriculum. You will be given an opportunity to take a sneak peek into how we deliver these topics in a sequential, structured and cumulative manner that effectively engages and supports learners with dyslexia.

Keywords: Dyslexia, grammar, transit, secondary school

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Creating the DST-2, an online screening battery for dyslexia across the age-range

Angela Fawcett^{1*}

1. Dyslexia Association of Singapore

Abstract

We have revised our well-renowned screening tests for dyslexia, the DEST, DST and DAST batteries, published by Pearson Education. The plan was to introduce updated research in the area of executive function, as well as simplify the test and make it appropriate for all age groups from 4.5 years (pre-literacy skills) to 65+. We spent considerable time developing this revised test, evaluating this on a clinical sample and controls, establishing that all the tests worked well at all ages, were well received, and clearly discriminated between those at risk of dyslexia and those without. We were poised to start collecting the norms on over 1300 people, a major task, when Covid struck, schools were closed down, and it became clear that our only way forward was to put the screening test online. This involved developing different techniques, and further evaluation to check that all the tests worked online and spoken material could be heard accurately. We tried out all the new tests on children and adults online, made minor adjustments and revised the stimuli as appropriate. In September 2021 everything was in place including recruiting testers, developing videos for training and we were about to start collecting data. We then have to simply collate, tabulate and analyse the data, and publish the test which should capture the impact of the pandemic on learning. We are excited to share this breakthrough in screening with participants in Unite SpLD 2022, opening up new opportunities to screen remotely suitable for use with English speakers worldwide!

Keywords: Online screening, all ages, dyslexia

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Evaluating the longitudinal progress of a large sample of dyslexic children in reading, spelling, and writing.

Sharyfah Nur Fitriya^{1*}

1. Dyslexia Association of Singapore

Abstract

The purpose of this research was to demonstrate whether the reading and writing skills of dyslexic students improved following a period of English literacy intervention via the Main Literacy Programme (MLP) at the Dyslexia Association of Singapore. These improvements would be made using improved curriculum teaching methods and our intervention. A statistically significant result would validate the improvement of knowledge acquisition to the students as a result of the assessment tools as well as the MLP intervention. This study evaluated the progress made from 1,343 students, ages 7-17, who were enrolled in the (MLP) for six school terms from 2016 to 2018. All participants were assessed using a Curriculum-Based Assessment (CBA), which focuses on three test items: words to read, words to spell, and writing tests. The CBA test was developed in-house. The test items were analysed using the Central Limit Theorem (CLT) and hypothesis testing. The results indicated a significant improvement in literacy components. This supported the research hypothesis that attending the MLP can improve the reading, spelling and writing scores in a population of dyslexic students. The findings from this study show the importance of the in-house curriculum in the English Main Literacy intervention and these results support the efficacy of the MLP programme.

Keywords: progression, evaluative, assessment.

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An Overview of Dyscalculia

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Abstract

Dyscalculia is one of the specific mathematics learning disabilities characterized by persistent difficulties in numbers and arithmetic. Dyscalculia affects about 3–6% of the population. Pupils with dyscalculia are weak in numerosity comprehension, for example, they cannot perform subitizing and counting, late responses to give answers to mathematics questions, recalling simple mathematics facts, and writing symbols. This study presents a single case study of how a remedial mathematics teacher incorporated an instructional intervention into her teaching practices in order to teach numeracy to an at-risk dyscalculic pupil. This new theory-driven intervention which was named “Reconnecting Learning” blended Tall's (2013) theory of mathematical thinking and Feuerstein's (2015) structural cognitive modifiability theory. Data were collected through interviews, lesson observations, and reflective journals. The findings revealed that the proposed intervention has great potential to improve the at-risk pupil's numeracy skills.

Keywords: dyscalculia, learning disability, mathematics

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Profile of Children with Specific Learning Disabilities on the Griffith III Developmental Scale

Rima Natasha Hartanto^{1*}

1. *Dyslexia Association of Indonesia*

Abstract

Children with dyslexia can be known from pre-school. Early identification of dyslexia can be identified by the child's development from various aspects, long before reading instruction given, such as motoric coordination and language development. Language development predicts early signs of dyslexia. The Griffith III Developmental Scale provides a gap between Chronological Age (CA) and Developmental Age (DA) and a gap between Developmental Quotient (DQ) in subscales. The subscales consist of Foundation of Learning (A), Language and Communication (B), Eye-Hand Coordination (C), Social-Emotional (D) and Gross Motor (E). A cross-sectional study involved 35 children (mean age 41 months $\pm$ 16) with Specific Learning Disabilities and received Griffith III Developmental Scale to determine the potential for intelligence and developmental stage. The results are DQ subscale A (96 ± 16 , $p<0.05$) is higher than subscale B (76 ± 23), a gap between DA and CA in Subscale B is higher than A ($p=0.001$), higher than Subscale C ($p=0.029$), higher than D ($p=0.001$), and higher than E ($p=0.052$). Delayed motoric coordination, particularly in eye-hand coordination (subscale C), can predict difficulty in handwriting. Although this report found no significant differences between Subscale B to Subscale E ($p=0.052$), it might need further study with a larger subject pool. With profiling of dyslexia children, parents and teachers can intervene not only on language but also social skills, fine motor activity and gross motor.

Keywords: early detection, Griffith III, dyslexia profile, dyslexia at risk, early intervention

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Exploring the impact of the DAS Preschool Early Literacy Intervention for two kindergarteners during the pandemic

Raihana Binte Mohamed Hashim^{1*} and Suthasha Kelly Bijay¹

1. *Dyslexia Association of Singapore*

Abstract

This study investigated two kindergarteners who attended the Dyslexia Association of Singapore's (DAS) Preschool Early Literacy Programme (PELP). The study explores their learning journey as the children received continued literacy learning support during the unpredictable Covid-19 Safe Management Measures (SMM). Two preschool early literacy intervention teachers delivered literacy instructions to kindergarten-aged children with early literacy weaknesses within the PELP through the pandemic which combined both classroom, and home-based learning. This qualitative and exploratory case study was conducted from March 2020 to November 2021. Data was gathered from pre-and-post early literacy assessments, and anecdotal observations. This study's findings established that children at-risk of dyslexia and ADHD can continue to receive learning support during the pandemic and progress from receiving intervention through classroom and home-based learning support. The study also acknowledges that due to various challenges, online learning on its own is not the best way for pre-schoolers to learn. However, some modest benefits were discovered amongst the inadequacies of intervention online for preschoolers during the pandemic.

Keywords: Early Childhood Education, Identification and Intervention

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Holistic early intervention program supports children with multiple disabilities to achieve educational and therapy goals .

Mandy Lau^{1*}

1. *Reach and Match®*, Australia

Abstract

Reach and Match® Learning Kit is an award-winning Inclusive Education program helps students with sensory impairment and multiple learning needs to learn and engage with their peers through deepening cognitive understanding. It was developed by founder Mandy Lau through her Master's research for children with vision impairment and multiple needs to develop braille and print early literacy and social skills through tactile strategies and play-based activities. Research into braille literacy, early intervention skills, and inclusion in education informed the design of the Reach and Match learning kit and was developed with a range of educators, therapists and O&M specialises utilising a user-centric methodology and co-design approach.

Reach & Match has been partnering with international and local organisations and schools for years to research and evaluate the benefit of the program for individual learning and group play. The presentation will include case studies conducted with international organisations, the American Printing House for the Blind and BLENZ (Blind and Low Vision Education Network New Zealand)

Both case studies will share educational and therapeutic applications by educational teams and parents including Early learning, Orientation & Mobility, Physical therapy and Occupational therapy. The audience will learn a holistic program that was supported and tested by a group of educators and specialists for children with vision impairment and multiple needs. The audience will also receive valuable insight into how play enhances children's cognitive, physical, social and communication skills and the relationship between body movement and literacy development.

Keywords: Early intervention, Play-based learning, Inclusive Play, Inclusion

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Effectiveness of DAS speech-language therapy: A controlled evaluation.

Lee Er Ker^{1*}

1. *Dyslexia Association of Singapore*

Abstract

School-age children enrolled in the DAS speech-language therapy programme are often diagnosed with both dyslexia and language disorder. The current study shows the positive impact of language therapy on these children as it is practised by speech-language therapists (SLTs) at DAS. The study involved 23 children in mainstream education aged 5 to 12 who were diagnosed with dyslexia and subsequently with mild-severe language disorder at the start of the study. A small-scale quasi-experimental design with a control group was used without random assignment of participants to either an intervention condition (n=11), or a control condition (n=12). The intervention group underwent language therapy directly delivered by DAS SLTs in a group setting (1 SLT : 2-3 children) once a week, an hour per session, for at least a term (i.e. ≥ 8 sessions). Participants in the control group matched those in the intervention group overall on age and level of severity but did not receive any speech-language therapy for the duration of the study. All participants in both groups received the same level of literacy support from educational therapists in the curriculum-based DAS Main Literacy Programme (MLP) whilst the study was on-going. Participants in the intervention group showed performance improvements compared to those in the control group in the primary outcome measures of different language skills as measured by the core language subtests of CELF®-4UK, a standardised assessment tool. A statistically significant improvement were found in both the raw and scaled scores of the Formulated Sentences subtest. In addition, positive effect sizes ranging from small to large were observed for other subtests. The findings support the use of small-group intervention as effective for children with a range of severity in language disorders.

Keywords: speech-language therapy, SLT, DAS, language disorder, group therapy, language intervention

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Positive stress coping strategies in parents of children with special education needs .

Kitty Yuen Han Mo^{1*}

1. Hong Kong Shue Yan University, Hong Kong

Abstract

Parents of children with special education needs faced stress in managing the learning needs and daily behaviours of their children. The characteristics of children, the belief system of parents and the environmental system all contributed to parental stress. In fact, parental characteristics such as personality, value, competence, self-efficacy and belief system guided parents to take necessary actions about the management of stress. In a recent qualitative study, a total of 21 parents of children with special education needs were interviewed. The findings revealed that parents had used positive and practical strategies to cope with stress. Identified strategies included doing physical exercise, sharing with other parents who were encountering similar problems, actively seeking help from others such as teachers, asking for family support, discovering positive resources in the society such as services provided by social service agencies, and learning new knowledge and skills about child care and parenting. The findings recommended the building of a positive coping intervention system in schools by social workers or teachers which aimed at supporting parents to build their own stress coping strategies.

Keywords: parental stress, coping strategies, parents of children with special education needs

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International Observations: A Cognitive-Motor-Affect Perspective In Addressing SpLD.

Mary Mountstephen^{1*}

1. *Learning Differences Consultant, UK*

Abstract

This presentation is based on Mary Mountstephen's independent practice, academic study, professional development, and collaboration with international colleagues over the last twenty years. She will provide some insights into the relationship between dyslexic difficulties and the cognitive, motor and affect domains of learning and the implications this has for assessment and interventions in her practice and international training for early years and primary classroom practitioners. She aims to raise awareness of how teachers can fine-tune their thinking about dyslexia and provide information about actions that can improve student engagement and progress.

Keywords: cognitive-motor-affect domains, whole-child approaches, observational assessment

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Register of Educational Therapists (ASIA) RETA - Case Management Discussion - What's the hype with ADHD?

Hani Zohra Muhamad^{1*}, Safinah Hassan¹, Tina Tan² & Michelle-Lyn Yap³

1. Dyslexia Association of Singapore
2. The Society for the Promotion of ADHD Research and Knowledge (SPARK)
3. National Institute of Early Childhood Development (NIEC), Ngee Ann Polytechnic

Abstract

Attention Deficit Hyperactivity Disorder (ADHD) presented by its Predominantly Inattentive, Predominantly Hyperactive-Impulsivity or Combined traits can affect many children. If left unaddressed, ADHD can disrupt children's learning, motivation and socialization among family members and peers. Children with ADHD and a learning difficulty such as dyslexia are likely to struggle with academics and social interaction such that they become a big source of concern to parents and educators. What is more concerning, ADHD grows with the child – ADHD can develop as the child develops – and this may increase its severity if not tackled early on. While medication is an option to consider, this may not be the choice for many parents. How then can children with ADHD be helped? At the Dyslexia Association of Singapore (DAS), a group of students with dyslexia and a co-morbid diagnosis of ADHD are supported by Educational Therapists and Educational Advisors to help them with both literacy and behaviour management. Students are not only given phonics instructions and explicit teaching of language skills to remediate literacy difficulties, they are also guided with behaviour strategies to aid in impulse control and hyperactivity so that they can better assimilate in a group setting. This presentation will highlight case studies on students with dyslexia and ADHD, as well as invite experts in this area to share their knowledge in dealing with children with ADHD. The data on case studies were collected through classroom observations and interactions with Educational Therapists. Strategies and suggestions are provided to inspire educators and parents to adopt them so as to form a consistent structure between what is implemented in the DAS classroom and what can be done at home.

Keywords: ADHD, dyslexia, learning difficulties,

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Remediating Comprehension Deficits in Hyperlexia: The Scaffolding Interrogative Method.

Patricia Mui Hoon Ng^{1*}

1. Society for Reading & Literacy

Abstract

Children with severe reading comprehension deficits with no word recognition issues have traits associated with hyperlexia, which is an advanced word recognition ability in children. Scaffolding supports have been recommended for affected children as they have difficulties in the formation and organization of schemata for processing information. The Scaffolding Interrogative Method (SIM) is a remediation strategy developed based on this recommendation. Post-intervention results following six months of remediation indicated significant improvement in reading comprehension with a very large effect size for a sample of thirty-three subjects. Recommendations and limitations of the study are discussed for further research.

Keywords: Scaffolding interrogative method, reading comprehension, hyperlexia, cognitive impairment, savant children

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Response and Non-response to Intervention for Reading Difficulties: What Role do Cognitive Correlates Play?

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1. National Institute of Education, Nanyang Technological University, Singapore

Abstract

Within the field of learning disabilities, many intervention studies have found that some students do not respond adequately to treatment despite a better understanding of reading development and improvement in the treatment for reading disability (Fletcher et al., 2011). According to previous studies, cognitive measures, including phonological awareness, rapid automatized naming, verbal memory, and statistical learning were correlated with a lack of response to reading interventions (Al Otaiba & Fuchs, 2002). In our study, we compared good and poor responders in an intervention study for early primary learning support program (LSP) students. The intervention study was conducted as a randomized controlled design, wherein 147 children (Mage = 6.75) who were identified as at-risk for reading difficulties at primary school entry were allocated to either phonics or word reading based interventions. Students were assessed for reading accuracy and fluency after they had completed a tablet-based reading intervention. They were classified as responders vs. non-responders based on criterion-referenced scores for word reading and decoding accuracy and fluency. Students were classified as being responders if they attained above grade equivalent scores or if their scores were above a mean of typically developing peers. Students who did not attain age-based scores at post-intervention compared with their pre-intervention scores were categorized as being non-responders. Differences between the two groups were evaluated for (1) the rate of growth on reading/literacy measures over the intervention phase; and (2) their weekly in-lesson performance on the tablet-based intervention activities; and (3) cognitive attributes (nonverbal cognitive ability, statistical learning, rapid naming, and phonological and orthographic awareness). The findings from this study provide valuable information in predicting the different types of interventions children may require. This will help educators working with children to develop interventions which are targeted to the specific needs of individual students.

Keywords: Intervention, Reading Difficulties, Cognitive

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The impact of a Curriculum-Based Approach on Chinese Secondary 3 Trial Programme for students with dyslexia

Ong Yun Mei^{1*} and Loo Chien Ling¹

1. *Dyslexia Association of Singapore*

Abstract

Chinese language learning at the secondary school level focuses on increasing the proficiency of students in their reading and writing abilities. Given the variety of text types as compared to what they have been exposed to at primary school level, a student who has a language learning difficulty, such as dyslexia, would find learning Chinese in school an increasingly difficult task. Our Secondary Programme adopted a curriculum-based approach to help learners bridge the learning gap to access the mainstream curriculum. As we expanded into Secondary 3 trial Programme in 2021 with some adjustments to the teaching materials and literacy tests, progress of students were tracked for a year using measures such as literacy ability tests, school results, parent and student survey as well as teacher's observation. Results showed that students have improved in their overall language skills and our Educational Therapist played an important role in motivating the students to learn.

Keywords: Chinese, Curriculum-Based Approach, Dyslexia, Secondary

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Use of Technology by Singapore Educators to enhance learning for students with Special Educational Needs

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Abstract

The use of technology in special education helps break the barriers for students with special educational needs and enables educators to exercise higher flexibility and differentiation in educational methodologies. With modern technology, educators can adapt to the needs of their students more easily and are able to choose a number of available learning tactics designed to meet the needs of individual learners. This exploratory research looks into the use of technology by Singapore educators in the special schools and mainstream schools to enhance support for students with special educational needs in various academic subjects. It showcases the technological resources which Singapore educators have found effective in supporting and motivating students with special educational needs and illustrates how these educators combine various domains of learning to enable teaching and learning to be considered as effective for these students.

Keywords: Technology, Singapore educators, Special Educational Needs.

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Enabling online remediation using multiple intelligences - an online classroom approach

Padma Ramesh ^{1*} and Yashodhara Narayanan¹

1. *Madras Dyslexia Association, India*

Abstract

The proposed talk is about how at MDA, Multiple Intelligences (MI) was used to enable effective online remediation for children with specific learning difficulties (SLD). This presentation explains how MI is being used to create a nurturing environment focusing on the needs of the child in order to empower and enable their potential. It will also look at the impact of using MI in the classroom (offline and online). With the pandemic causing havoc in our lives, the lives of school-going children have been impacted the most. Their academic, social and emotional wellbeing has been severely impacted, more so for children with SLD. They were deprived of the social and emotional connection that they thrived on, and the hands-on learning that made remediation possible was also impacted. The remediation offered at our full-time facility Ananya Learning and Research Center needed to be reoriented to the online space, and using a multi-modal, multisensory approach incorporating Multiple Intelligences was the only way to effectively reach out to the children. For example, A colour coded Venn diagram (spatial intelligence) was created by the child to learn the differences between two animals. We will describe how we plan an IEP and Lesson plan based on MI, and how this helped in integrating the child into mainstream school after one year of remediation. We will use videos, and case studies to demonstrate the strategies used and how they impacted learning. Our aim is to demonstrate the reach of the MI model, in helping build the social, emotional and academic needs of the child of SLD, thereby providing holistic development in the online mode.

Keywords: Remediation, Multiple intelligences, emotional well-being, nurturing environment, empower, multisensory, multimodal, non judgemental environment, practical aspects, holistic development

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Parental first concern according to age and type in children with ASD

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Abstract

Parental concerns regarding children's developmental problems should be considered as a step in diagnosing children with autism spectrum disorder along. Further investigation is needed to gain a clearer picture of parental concerns of behaviours exhibited by their child. Studies that compare parental concerns of children with ASD and children diagnosed with other developmental disorders are limited. A cross-sectional study to examine the type and children's age when parental concerns first arise in children with ASD and other developmental disorders was conducted in the Child Developmental Centre in Surabaya Indonesia from August to December 2019. The T-test and chi-square tests were used to analyse differences in subject variables and types of concern. Most parents of both children diagnosed with ASD and non-ASD indicated the first parental concerns were in communication, social skill, and behaviour problems. The average age of parents' first concern of ASD children is 30.14 months and 31.39 months for non-ASD children. Significant differences were found between ASD and non-ASD groups in communications, behaviour, and sensory problem concerns. The main concern of parents of both groups is communication problems, socialization skills, and behavioural issues. Parents of children with ASD would first report concerns at an early age compared to parents of children with no ASD diagnosis.

Keywords: parent concern, autism, communication.

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Using the Cognitive Science of Learning as an Instructional Model to Remediate Dyslexia: Neuroscientific and Behavioral Results

Rosie Shand^{1*} and Angelica Benson²

1. Lindamood-Bell Learning Processes - Hong Kong & Singapore
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Abstract

The Cognitive Science of Learning offers a comprehensive view of addressing the full spectrum of language processing weaknesses, transcending a decoding only focus to help children with language and literacy difficulties, including those with dyslexia. We will present this paradigm, as contrasted to the current "Science of Reading" model, which we believe is necessary but not sufficient to comprehensively address the learning needs of all students. Based on 35 years of instructional experience, neurologic and behavioral intervention results substantiate the Cognitive Science of Learning model supported by a comprehensive theory of cognition of learning, Dual Coding Theory (DCT) (Paivio, 1979), which includes reading and serving the needs of dyslexics through differential diagnosis and individualized interventions. This evidence-based mental representational/language (DCT) model serves as a global foundation for reading, offering major hope to parents and educators addressing all the literacy needs of children with dyslexia so they can realize their full learning potential. (Lindamood-Bell Learning Processes, 2020, Eden et al., 2004, Oulade et al., 2013, Krafnick et al., 2015, Murdaugh et al., 2015, Murdaugh & Maximo et al., 2015, Christodoulou et al., 2015, Romeo et al., 2017, Huber et al., 2018).

Keywords: Reading Intervention, Cognitive Science of Learning, Evidence-based

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Effectiveness of an online learning model that delivers executive functioning and study skills curriculum to Upper secondary and Tertiary students with specific learning differences

Rosalyn Wee^{1*} and Serena Abdullah¹

1. Dyslexia Association of Singapore

Abstract

As students transition to higher education, the acquisition of study skills, executive functioning skills, as well as life skills, becomes an important set of transferable skills in enabling them to learn and work more efficiently, thereby maximising their potential as well as the full benefit of their time and effort. The English Language and Literacy Division (ELL) at the Dyslexia Association of Singapore (DAS) developed the iStudySmart™ programme, which adopts an online learning approach which includes e-learning, that aims to empower students with learning differences in the areas of time management and prioritisation, planning and organisation, tertiary writing and presentation skills. The aims of iStudySmart™ were not only to bridge the gap in intervention and resources catered for students with learning challenges at the tertiary level but also to keep abreast with changing times, demands and expectations observed in the education sector. As dyslexia is a life-long learning difference, specialist support should ideally continue into post-secondary. Certainly, with the acquisition of essential study skills and techniques introduced and covered in iStudySmart™, we hope to develop our students to become self-directed, independent and responsible learners (which are traits and characteristics expected at tertiary level) but more importantly, build a strong foundation for them to be able to reach their goals and aspirations not only in school but also in their future workplace. This paper evaluates the relevance and effectiveness of iStudySmart™ and also measures the students' self-confidence, motivation, and independence through the administration of pre-and post-questionnaires. Further, qualitative data comprising testimonials from parents revealed high levels of satisfaction and recognition of the value of the approach. Results indicate that all aspects of the iStudySmart™ intervention were effective, with moderate and large effect sizes for planning and organisation, tertiary writing and presentation, although the students had not yet learnt to consistently apply the time management and prioritisation strategies learnt on the programme.

Keywords: higher education, dyslexia, specific learning difficulty, study skills, executing functioning skills, motivation, independence, self-confidence, e-learning, online learning, flipped classroom, asynchronous learning, synchronous learning

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Orthograph: Multisensory, Computer-Guided Spelling Training – Efficient Even for Dyslexics

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1. Dybuster, Switzerland

Abstract

Orthograph is a novel, scientifically developed, web-based training tool for orthography and vocabulary. Originally developed for children with dyslexia, it was proven to be efficient both for children with and without learning difficulties. The presentation describes the private, interdisciplinary motivation behind Orthograph. The main concept - supporting and automating phonological processes through multi-sensory cues such as colors, shapes, structures, and tones - is explained. Afterwards, the presentation describes the scientific studies, which proved the effectiveness of Orthograph, in particular a reduction in spelling by more than 30% after three months of training. It continues to describe, how Orthograph is used daily by schools and children, and which English curricula are available. It finishes with an outlook on future work.

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Keywords: Occupational therapy, Dyslexia, Pre academic skills

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Asia Pacific Journal of Developmental Differences

Guidelines for Contributors

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The Asia Pacific Journal of Developmental Differences (APJDD) will be unique in addressing a range of special educational needs including dyslexia, autism, dyspraxia, dyscalculia, ADHD in the Asian context. The journal will cover theory into practice and will provide a showcase for research in the Asian context as well as highlighting research areas which have implications for further research within Asia and beyond.

Frequency of Journal

The Journal will be published twice a year in January and July.

Contributions Considered for the Journal

Primary consideration for publications will be given to manuscripts that are focused on developmental differences within the Asia Pacific region. Manuscripts will be peer reviewed and included in the journal on the following criteria:

- ◆ They contribute to the further understanding of developmental differences as well as the applications and implications in the educational, social and cultural environments.
- ◆ They include sound research methods, interpretation and validity of results
- ◆ They contain organised and clarity of writing
- ◆ They contribute to the local Asian context
- ◆ They should be original papers that have not been submitted to other journals or publications.

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The APJDD takes the issue of retractions very seriously. In line with requirements of major academic journals the APJDD will continue to monitor publications for retractions. No future citation will be permitted for articles that have been retracted and a correction will be issued if any such article is published in error. In the case of citations prior to retraction no such correction will be issued, in line with the policy for other journals of this type. Please contact the editor in the first instance if there are any concerns. COPE guidelines have been accessed in preparing this guidance.

Articles published in the APJDD should be original work that has not been published in this form elsewhere. In rare instances where previous publication has been made, this will be fully acknowledged.

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- ◆ **Dr Thomas Wilcockson**, Lecturer, Loughborough University, United Kingdom

Submission of Manuscripts

All manuscripts are to be sent in electronic copy (MS WORD) as well as a PDF copy of the final edited document. PDF copy is required to verify the word copy and for publishing purposes. There is no need to submit hard copies of manuscripts.

Images, charts and diagrams should be sent separately where possible to ensure high quality reproductions.

Submissions are to be emailed to the editor at both email addresses below:

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Preparation of Manuscripts

It is expected that all manuscripts be submitted using the American Psychological Association (APA) standard of referencing and publication. APA style is detailed in the Publication Manual of the American Psychological Association (7th ed), which offers sound guidance for writing with clarity, conciseness and simplicity. Authors should follow the APA style in preparation of their manuscripts.



Our Mission: Helping People with Dyslexia and Specific Learning Differences Achieve

Our Goal: To build a world class organisation dedicated to helping people with dyslexia and those with specific learning differences in Singapore.

Our Aims:

- ◆ To put quality first in delivering a comprehensive and effective professional service for dyslexic people and those with specific learning differences on a not-for profit basis.
- ◆ To provide an assessment service for individuals at risk of having dyslexia and/or specific learning differences.
- ◆ To provide educational programmes and other support services for individuals with dyslexia and/or specific learning differences.
- ◆ To raise public and professional awareness of the nature and incidence of dyslexia and specific learning differences.
- ◆ To enable others (teachers, parents and professionals) to help dyslexic individuals and those with specific learning differences.
- ◆ To assist and elicit financial and other support for people with dyslexia, those with specific learning differences and their families.
- ◆ To promote and carry out local research into dyslexia, specific learning differences and to disseminate results.
- ◆ To network with other organisations in Singapore and internationally to bring best practices to the DAS and Singapore.

DAS as a Social Enterprise

- ◆ We provide high-quality, professional, innovative and client-focused solutions to create and sustain services for the dyslexic community in Singapore and the region.
- ◆ We operate as a financially viable and cost-effective business which at the same time ensures that no dyslexic person is unable to access our services because they cannot afford it.
- ◆ We generate social returns on our investments through the development of a dynamic, motivated team of highly qualified and experienced professionals.
- ◆ We have a heightened sense of accountability to stakeholders through our professional management team.

Registered in 1991, the Dyslexia Association of Singapore (DAS) is today a vibrant voluntary welfare organisation with over 250 full-time staff who provide a wide array of services for dyslexics not only in Singapore but in the region. DAS Specialist Psychologists conduct assessment and diagnosis for preschool students to adults. DAS Educational Therapists, Speech and Language Therapists and Specialist Teachers provide support for over 3,500 preschool, primary and secondary school students in 14 venues all over Singapore. Increasingly, DAS provides support for dyslexics who also suffer from other Specific Learning Differences such as ADHD, Dyspraxia, Dyscalculia and Non-verbal Learning Differences.

The DAS Academy is a Private Education Institution (PEI) registered with the Council for Private Education (CPE). It is a wholly-owned subsidiary of the Dyslexia Association of Singapore (DAS).

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Asia Pacific Journal of Developmental Differences

Volume 9 ♦ Number 2 ♦ July 2022

Contents

- 154 Editorial Comment
Angela J. Fawcett
- 158 Developmental Dyslexia—a useful concept?
John Stein
- 172 Investigating the Impact of the Preschool Intervention Programme on Struggling Learners
Shakthi Sathiasilan, Yiyao Weng and Angela J. Fawcett
- 194 Dyslexic Strengths in Times of Adversity
Thomas G. West
- 204 The effectiveness of reading, spelling and writing support for a large sample of school-aged children with Dyslexia: factors influencing efficacy.
Sharyfah Nur Fitrya
- 224 Parenting during COVID-19: Stress of Fathers with and without Children with Special Needs in Singapore
Eugene Lim Wen Jie and Heidi Chong
- 248 Effectiveness of Mobile Assistive Technology on Improving the Self-Perceptions of Students with Dyslexia in Singapore
Yee Ning Tan, Tharshini Lokananthan and W. Quin Yow
- 280 Dyslexia with language weaknesses: Recommendations to guide organisation-based efforts for school-going learners based on educational therapists' perspectives
Hani Zohra Muhamad and Hannah bte Shafiq Abdullah
- 310 UNITE SPLD 2022 Presentation Abstracts

