



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

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ABSTRACT

The purpose of this research was to demonstrate whether the reading and writing skills of dyslexic students in the English Main Literacy intervention programme in Singapore could be improved in a statistically significant manner using improved curriculum teaching methods. A statistically significant result would validate the improvement in the transfer of knowledge to the students due to the educational intervention. This study evaluated the progress made from 1343 students aged 7-17 enrolled in the English Main Literacy intervention programme 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 test items were analysed using the Central Limit Theorem (CLT) and hypothesis testing. Test scores were analysed comparing means across three years, with a Z-score calculated to determine the findings' statistical significance. The mean scores of the students increased from an average mean of 48.54 in 2016 to 62.43. The calculated Z score of 1.65 yielded a probability of $p < .05$, with a probability level of 95%. Therefore, the Z score did indicate a significant improvement. This supported the research hypothesis that the literacy program demonstrates a statistically significant improvement in reading and writing scores in a population of dyslexic students. The findings from this research show that the English Main Literacy intervention programme is an evidence-based practice, and the results increase the validity of the intervention.

Keywords: assessment, statistical significance, dyslexia, Central Limit Theorem (CLT), hypothesis testing

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INTRODUCTION

Dyslexia is identified when a person has trouble with recognising words accurately, comprehending, writing, and spelling and is a result of deficits in the phonological component of language; often related to other cognitive abilities that can cause behavioural or emotional problems (Rutter, Kim-Cohen & Maughan, 2006; Lyon et al., 2003). Characteristic features of dyslexia include difficulties with phonological awareness, verbal memory, and processing speed. With dyslexia, students may often experience co-occurring challenges in language, motor coordination, mental calculation, concentration, and personal organisation (Rose, 2009). The literacy difficulties associated with dyslexia can result in those students with dyslexia becoming less motivated (Gooch et al., 2016). This becomes more common when students begin the transition to secondary education, where literacy forms a huge component of many lessons, especially since it is assumed that these students have acquired the necessary reading skills.

At the Dyslexia Association of Singapore (DAS), students are taught the basic concepts of reading, spelling, and writing by adopting the Orton Gillingham (OG) principles of structured, sequential, multi-sensorial and phonics-based teaching (Ritchey & Goeke, 2006; Rose & Zirkel, 2007). The DAS have their integrated curriculum that is undertaken in-house to cater to students of all abilities. This study evaluates the progress made by 1343 students aged 7-17 enrolled in the English Main Literacy programme 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.

LITERATURE REVIEW

The study highlights that reading and writing difficulties have a significant relationship with children diagnosed with dyslexia. In the DAS English Main literacy intervention programme, assessment of transcription issues and follow-up discussions can help understand the plan's effectiveness.

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). A collaborative approach between parents and teachers helps identify the dyslexic problems in students and provides a platform for successfully implementing the English main literacy intervention programme. (Daniels & Share, 2018). Dyslexia, therefore, is a difficulty evident in children and causes challenges in reading and writing, that may be exacerbated during exposure to a noisy classroom environment (Calculus et al, 2016, 2018). Scholars further indicate that students with dyslexia are low on their reading or writing exercises, making dyslexia a deficit in phonological skills (Sümer Dodur & Altındağ Kumaş, 2020). 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 on their understanding. These are cognitive comprehension abilities. Spelling and reading involve different reciprocal parts of one task, which are essential since they connect letters and reading sounds.

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 it comes to spelling unknown words, encoding, students require practice and need to apply different strategies taught by the teacher. Students also have difficulties remembering long sentences, as students with dyslexia tend to have weak working memory (Alloway et al., 2017). It is through these reasons that the student's spelling abilities end up predicting their reading abilities.

With difficulty in reading and spelling, it is not a surprise that students with dyslexia will manifest difficulties in writing as well. Students with dyslexia will have poor spelling, lack of vocabulary and poor organisation skills that is also due to their reading abilities and spelling abilities (Hebert et al., 2018). In DAS, we have the English Main literacy intervention programme that addresses all these challenges in students. This study aims to evaluate the progress made by these students.

Dyslexia and the Integrated curriculum

The old curriculum based on the Orton Gillingham approach adapted for Singapore, included reading, spelling and writing. However, the new concept for the day was not integrated throughout the lesson. In the DAS improved curriculum, we integrate the lesson's new concept into reading, spelling, comprehension, and writing. The aim of integrating the new concept in different components of the lesson plan is to create a more holistic literacy instruction. The in-house curriculum has applied strategies to address the students' reading, writing, and spelling difficulties through the English Main Literacy programme.

Dyslexia and the English Main Literacy intervention

The MLP intervention is supported by evidence-based research and instruction from the National Reading Panel (US), Professional Practice Guidelines (SG) and the Rose Report (UK). The programme provides individualised group lessons taught in accordance to the Orton-Gillingham principles (Ritchey & Goeke, 2006; Rose & Zirkel, 2007).

- ◆ Diagnostic and prescriptive - where learning needs and profiles of the learners are the backbone of our lessons.
- ◆ Emotionally sound - where lessons are also geared towards helping the learners experience successes while bridging any learning gaps they have.
- ◆ Cognitive - every lesson includes both basic and advanced literacy skills and strategies essential in reading, spelling, reading comprehension and writing.
- ◆ Structured, cumulative and sequential - the knowledge and skills taught are built upon from previous lessons to ensure that the learners are not only competent but also confident in applying what they've learnt and acquired (Ritchey & Goeke, 2006; Rose & Zirkel, 2007).

Apart from incorporating the OG principles, writing and reading comprehension skills, the following approach is adopted. The concepts are also taught and delivered to students according to PPP (Presentation, Practice, Production) stages: The Presentation stage facilitate the pre-activity discussions through modelling. The Practice stage scaffolds and guides students in a structured, cumulative and sequential manner to enhance learning and the Production stage provides opportunities for students to be independent in applying the concepts/skills learnt (Criado, 2013)

PURPOSE OF RESEARCH

The purpose of this research was to demonstrate whether the reading and writing skills of dyslexic students in the DAS English Main literacy programme could be improved in a statistically significant manner using improved curriculum teaching methods. A statistically significant result would validate the improvement in the transfer of knowledge to the students due to the educational intervention.

RESEARCH HYPOTHESIS

On average, students' performance in the Curriculum-Based – Assessment has improved in the last three years.

RESEARCH DESIGN AND PROCEDURES

A total of 1343 students aged between 7 -17 were sampled. All students had been formally assessed and diagnosed with dyslexia, either at the DAS or elsewhere in Singapore, based on full scale IQ and problems in literacy leading to lowered achievement in comparison with non-dyslexic students. These students were enrolled in the English Main literacy programme for six terms from 2016 to 2018, attending 2 hours

weekly in small groups of 3 to 4 students. A random sampling method was used in this study. (Ramus, Pidgeon & Frith, 2013). The evaluation was done using Curriculum-Based Assessment (CBA). The CBA focused on three main tests assessing the words to read, words to spell, and writing tests (Ramus, Pidgeon & Frith, 2013).

The Curriculum Based Assessment(CBA)

All students in the DAS were assessed using the Curriculum-Based Assessment (CBA) to track their transfer of knowledge and progression in the English Main Literacy programme. The CBA focused on three main tests assessing the words to read, words to spell, and writing tests. Some examples of the CBA words to read and words to spell test are shown below:

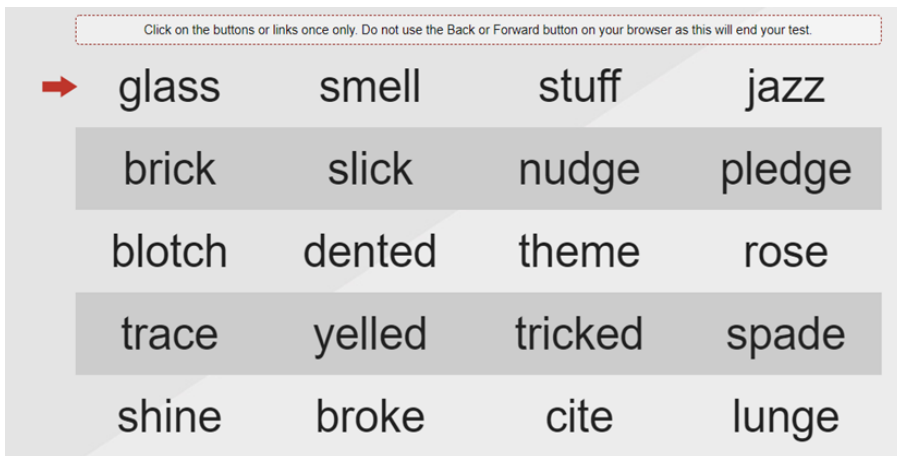


Figure 1. An example of Words to read

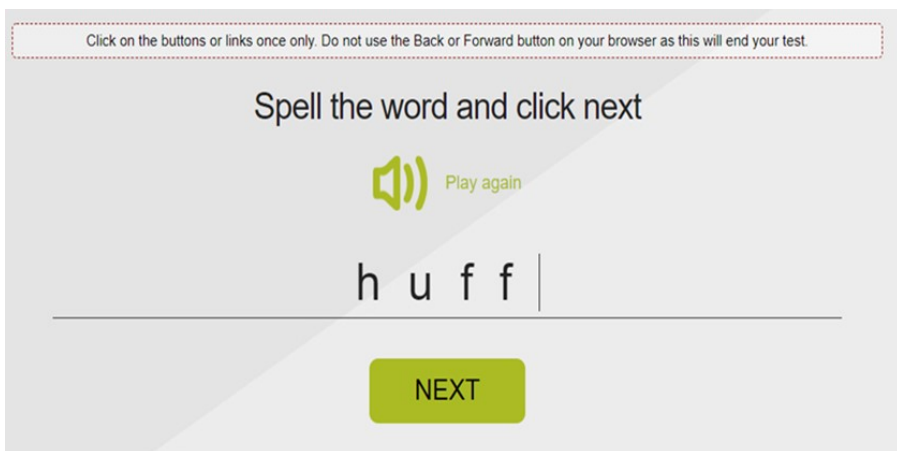


Figure 2. An example of Words to Spell

For the CBA words to read, students will be given five minutes to read as many words as possible, and the words progress from easy to challenging.

Students can press the play again button to hear the spelling words for the CBA words to spell. Students then will type the words in the given space. These are a few examples of CBA assessments.

RESULTS

The percentage scores

An evaluation of progress was undertaken in term 2 and term 4 annually over 6 points from 2016 to 2018, with a period of 6 months interval between the two test dates. Measures of performance in reading single words, spelling single words, and writing sentences were undertaken and the overall score for each student included in the data set as a percentage of the total score possible.

DATA ANALYSIS

The research data was analysed using Central Limit Theorem (CLT), and hypothesis testing. The reason for using hypothesis testing is because this method helps to evaluate two mutually exclusive statements about a population to determine which statement is best supported by the sample data.

In this study our hypothesis is:

'On average, the performance of students in the Curriculum- Based – Assessment has improved in the last 3 years'

We know that students in 2018 will improve from 2016 but there are also students in 2018 who had scored below the mean in 2016.

The Hypothesis testing method helps to find out the statistical significance of the research undertaken, this is to prove that the data did not happen by chance alone.

By statistically significant we precisely mean that if we select multiple independent random samples, of 100 students each, who appeared in the CBA test in 2018, then what is the probability that most of those random samples will have an average mean higher than 2016 ($\mu_{18} > \mu_{16}$)

The Hypothesis testing method is used to find out whether or not the research has been successful. The Null hypothesis would be that there is no statistically significant increase in the average marks scored by the students in 2016 and 2018.

Null hypothesis $H_0 : \frac{\mu_{18} - \mu_{16}}{S / \sqrt{n}} = 0$

Research hypothesis $H_1 : \frac{\mu_{18} - \mu_{16}}{S / \sqrt{n}} > 0$

Figure 3. The formula for hypothesis testing

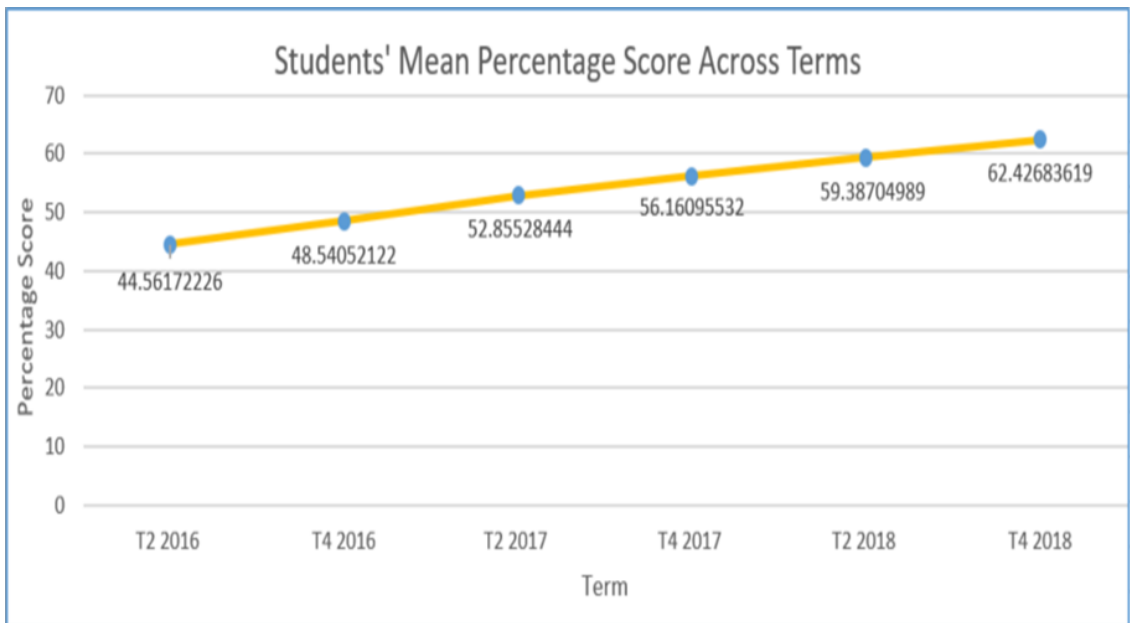


Figure 3a Progression of mean % scores over time

Figure 3a above shows the progression of students' mean percentage scores across terms in the three test items: words to read, words to spell, and writing tests. The students' mean scores increased from an average mean of 48.54 in 2016 to 62.43 in 2018.

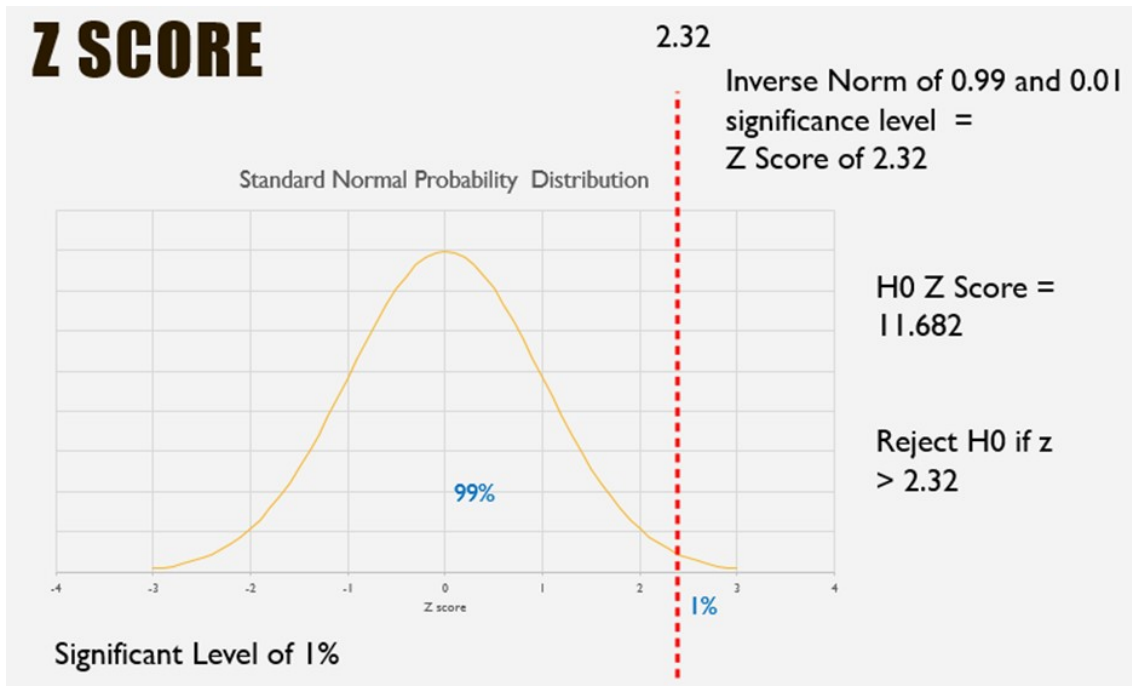


Figure 3b. Z scores across 3 years

Figure 3b test scores were analysed by comparing mean scores that cut across three years using the Z score. The analysis shows that the students' mean scores increased from 48.54 in 2016 to 62.43. The calculated Z score of 1.65 yielded a probability of $p < .05$, with a probability level of 95%. Therefore, the Z score did indicate a significant improvement and we reject the Null Hypothesis. This supported the research hypothesis that the literacy program demonstrates a statistically significant improvement in reading and writing scores in a population of dyslexic students. A descriptive research design was applied to help answer the hypothesis and research questions

DISCUSSION

This research shows that the DAS English Main literacy programme is an evidence-based practice, and the results increase the intervention's validity. The in-house curriculum has applied strategies to address the students' reading, writing, and spelling difficulties through the English Main Literacy programmes.

The research findings and analysis indicate that teachers should continue to use the in-house curriculum and use teaching methods suitable for individual learning. Implementing an English Main Literacy programme is not enough without proper teaching tools in place. These techniques can help address children with reading and

writing difficulties in the English Main Literacy programme (Martínez-García et al., 2020). However, teachers from schools may have limited ability to understand dyslexia and handle students with dyslexia, and therefore it is important to increase awareness of the needs of dyslexic children in education. The education institutions need to strive to ensure teachers can understand a student with a disability (Moats, 2019). Face to face and specialised instructional materials need to be applied by the instructors to help the students improve on their reading, spelling, and writing challenges.

Teachers should understand the importance of the issue of phonological awareness. Phonological awareness training needs to be incorporated when children have dyslexia. In such strategies, students will learn how to comprehend a text, reading and extracting vital messages from the text to bring about healthy development and cognitive skills (O'Brien, 2020). Teachers should also be trained on phonological awareness to understand how they can use the strategy and generate positive outcomes in students with dyslexia.

CONCLUSION

The research study overall shows that students' performance in the Curriculum-based assessment has improved in the last three years. The DAS English Main literacy programme is credited towards helping the student's performance increase. Through the intervention programmes, students and teachers interact, which allows the teachers to understand the reading challenges faced by dyslexic students.. The DAS English Main literacy programme also allows for close monitoring and evaluation of the students to ensure they focus on the academic goals. Any setback encountered can be discussed and addressed by the teachers, which allows for successful implementation of the English Main Literacy programme.

Dyslexic students have difficulties in reading, writing and spelling. These challenges make students lag in their educational pathway. It is the role of parents, instructors, and institutions to develop programmes to help identify students with dyslexia and help them in their academic pathway. The DAS English Main Literacy programme is a vital tool towards helping instructors in addressing challenges for students with dyslexia.

The improved English Main Literacy programme increases the validity of the intervention. Therefore, institutions should develop appropriate English intervention programs and understand the plan for their practical application. Proper implementation of these intervention programmes can result in success within these institutions.

Research studies of this type prove that instructors and the ministry of education have an opportunity to implement educational support in institutions of learning. These platforms allow the development of an ambient environment that they can use to improve dyslexic students reading, spelling or writing capabilities.

Future research aims to explore different aspects for students' improvement, following curriculum, this research seek to understand the number of programmes the students joins in the DAS and explore the number of years the educators have been in the special needs field.

LIMITATIONS

The first limitation of this study is the difference in the dates that the test was administered, a potential limitation of all longitudinal research. The test administrations were undertaken over a three-year period. It is a limitation because there are also possible confounding factors of history and maturation. The second limitation is the scores. It is stated that the scores are a "total" score which is extracted from having the addition of all the three items incorporated in the test, and they are from each student. The differences in progress on the different skills measured may dilute the actual differences in scores on each of the skills. If Student A made a great deal of reading progress while Student B made only a little, the overall change in a total reading + spelling score might be significant. However, the improvement in each skill may not be significant, so to counter this, the next evaluation will set out to measure students skill in test components and see which test components students struggle with the most when progressing to the next level. The third limitation is that the set of words administered to a student in 2016 may not be the same as words administered in 2018. This is a possible confound that could underlie the significant difference in terms of difficulty, although words are matched each year for level of difficulty.

FUTURE DIRECTIONS

For future research, we aim to explore different aspects of students' improvement, following curriculum and intervention. This research seek to understand the number of programmes the students joins in the DAS and explore the number of years the educators have been in the special needs field in order to establish the most effective approach to remediation.

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