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Decoding skills, rapid automatised naming and dyslexia screening methods in Malaysia

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ABSTRACT: Dyslexia is a learning disability that is neurobiological in origin. Besides, it typically results from a phonological awareness deficit, leading to difficulties with word identification, spelling, and decoding. Dyslexia could lead to secondary consequences such as reading comprehension problems, reduced reading experience, anxiety, and low self-esteem. Recent research has provided strong evidence that congenital brain abnormalities, such as the impaired magnocellular system, play a crucial role in dyslexia. Nonetheless, since 2011, the Ministry of Education Malaysia (MOE), via its Special Education Division, has defined learning disability as pertaining to individuals with similar or higher intellectual functioning in relation to typical students of similar age yet experiencing profound difficulty in spelling, reading, and writing. This definition fails to capture the current findings on dyslexia, and the shortcoming is evident in the question design of the Instrumen Senarai Semak Disleksia (ISD), the dyslexia checklist instrument currently used by MOE for screening students at risk of dyslexia at the entry level of primary schools. The inaccuracy in the definition adopted by MOE may further hinder an accurate understanding of dyslexia among Malaysians. In light of this, this paper aims to explain dyslexia and discuss the associated theories. This paper will review dyslexia screening methods in Malaysia and other countries as well as explain the importance of decoding skills and Rapid Automatised Naming (RAN) using the model of Simple View of Reading (SVR), advocating for increased emphasis on decoding skills and Rapid Automatised Naming in the ISD as a conclusion.

Keywords: Dyslexia; Rapid automatised naming; Decoding skills; Screening methods; Simple view of reading

1.0 INTRODUCTION

Dyslexia is a learning difficulty that has adverse impacts on an individual's reading and spelling skills (Snowling and Hulme, 2024). Stein (2023) outlined the historical origin of the term "dyslexia". "Dyslexia" is a term coined by Rudolph Berlin in 1884 from the Greek 'dys' (disordered) and 'lexis' (words). It was initially used to describe patients whose reading and spelling abilities were impacted as a result of brain trauma or stroke, but they managed to preserve intact speech and oral comprehension. This condition is now called "acquired dyslexia". The term was later used by Hinshelwood in 1895 and Morgan in 1896 to depict a developmental form of dyslexia. The term "developmental dyslexia" is

now applied to children who fail to develop normal reading abilities but have acquired normal speech and oral comprehension. In this mini-review, the term "dyslexia" is used to refer to the condition of "developmental dyslexia," while "acquired dyslexia" will not be discussed.

In recent years, the issue of dyslexia has emerged as an escalating concern in Malaysia, with the number of dyslexic students increasing from 13,302 in 2020 to 15,118 in 2022 (The Ministry of Education Malaysia, 2020, 2022). Despite the burgeoning population of dyslexic students, the concept of dyslexia remains largely unclear to the majority of the public in Malaysia (Gomez, 2000). Suffiah and Lee (2022) concurred with the observation, reporting that many teacher trainees demonstrated insufficient understanding when faced with questions related to the causes, symptoms, screening methods, and interventions of dyslexia.

The Ministry of Education Malaysia (MOE), via its Special Education Division, defined dyslexic students as individuals with intellectual functioning equal to or higher than their typically developing peers, yet suffering from pronounced challenges in spelling, reading and writing, and the definition remains unchanged since 2011 (Dzulkifli, 2023). This definition requires a review in order to reflect the current findings on dyslexia. The deficiency in the definition has negatively impacted the validity of the Instrumen Senarai Semak Disleksia (ISD).

Given the current need to review and correct the misunderstood notions of dyslexia among teaching professionals in Malaysia, this paper aims to review the screening methods in Malaysia and other countries. Subsequently, as a conclusion of this mini-review, it advocates for more emphasis on decoding skills and RAN within the ISD.

2.0 WHAT IS DYSLEXIA?

This mini-review adopts the definition of dyslexia proposed by the International Dyslexia Association (IDA) because it has been widely accepted in research, practice, guidelines, and legislation (Catts et al., 2024).

International Dyslexia Association (n.d.-a) defines dyslexia as a specific learning disability that is neurobiological in origin. Its reference to a neurological origin excludes the mistaken views of environmental factors such as poor instruction and lack of learning motivation from the picture (Catts et al., 2024). Recent research provides strong support for the definition of dyslexia as a learning disability with neurobiological origins. In a functional MRI study with 132 children being the sample, Di Pietro et al. (2023) reported that dyslexic children showed altered feedback connectivity between the inferior parietal lobule and the visual word form area of the brain, which is involved in fluent reading.

Dyslexia is also associated with problems with word identification, spelling, and decoding (International Dyslexia Association, n.d.-a). In a review and meta-analysis, Reis et al. (2020) agreed with the definition by reporting that dyslexic individuals struggled with pseudoword reading, phonological awareness, and orthographic knowledge in general.

Furthermore, International Dyslexia Association (n.d.-a) proposed that dyslexia typically results from a deficit in phonological awareness. This statement is supported by a huge body of research supporting the link between dyslexia and difficulties in the storage, retrieval, and awareness of sounds in a language (Catts et al., 2024). Nevertheless, the association between phonological awareness and dyslexia has been inconsistent. To illustrate, in a longitudinal study on 237 children at risk of reading difficulties at the ages of 5½ and 6½ years old, Snowling and colleagues (2018) observed weak support for the hypothesised causal relationship between speech perception and the development of reading skills. In other words, the phonological awareness deficit is a result of but not a reason for dyslexia.

International Dyslexia Association (n.d.-a) also states that dyslexia leads to secondary consequences, including reading comprehension problems and reduced reading experience, subsequently hindering the development of vocabulary and background knowledge. Stevens et al. (2022) have conceptualised dyslexia as a learning disability marked by difficulties with word-level skills and reading comprehension, advocating for classroom instruction that prioritise the acquisition of meaning-centred knowledge and skills. The negative repercussions of dyslexia, however, are not limited to reading skills. Zuppardo and colleagues (2021) showed that dyslexic children tend to exhibit psycho-affective symptoms, especially anxiety and low self-esteem, in social and academic situations compared with the control group

3.0 THEORIES RELATED TO DYSLEXIA

Over the years, an abundance of theories about the causes of dyslexia have been proposed. The

phonological deficit suggests that children fail to read because they lack phonological knowledge. In other words, dyslexic individuals generally fail to develop reliable knowledge of grapheme-phoneme relationships (Snowling, 1989).

The Double Deficit Theory (Wolf et al., 2002) posited that most dyslexics have RAN deficits, where they display slow word identification, and phonological problems, where their decoding skills are impaired. In addition, most dyslexics are reported to display impaired visual attention (Valdois, 2022). Short-term memory impairment is also one of the factors contributing to dyslexia (Wokuri et al., 2023).

An impaired magnocellular system is also an important characteristic of dyslexia. It is reported that most dyslexic individuals displayed atypical eye movement (JothiPrabha et al., 2022). Moreover, poor speech-in-noise recognition is another characterising feature of dyslexia (Mari et al., 2022). A temporal processing deficit is also reported to be found among people with dyslexia. Temporal processing refers to the brain's ability to perceive and process information about the timing and rhythm of speech stimuli. In a study on perception of filtered speech, dyslexic children tend to show impaired discrimination of amplitude rise times when compared with the control group (Goswami et al., 2016).

Without efficient speech-in-noise recognition and temporal processing, dyslexic individuals fail to sequence the sounds of the spoken words they hear correctly. In other words, the impaired magnocellular system causes impaired grapheme-phoneme relationships, subsequently causing dyslexia. These findings prove that congenital brain abnormalities are likely the reason for reading problems (Stein, 2023).

4.0 WHAT IS A DYSLEXIA SCREENING METHOD?

Dyslexia screening methods are a set of assessments of children's reading skills to predict their later reading proficiency. An efficient screening measure can distinguish students needing reading intervention and students with normal reading abilities. To achieve a high screening accuracy, a screening method must focus on specific skills highly correlated with broader reading measures of reading achievement among proficient readers (International Dyslexia Association, n.d.-b).

4.1 Dyslexia screening methods in other countries

Most states in the United States of America (USA) require the inclusion of critical skills that underlie dyslexia risk in dyslexia screening, from phonological awareness and rapid automatized naming to alphabetic principle and word reading (Ives et al., 2019).

In accordance with the directives of the Alabama State Board of Education (2016), a kindergarten dyslexia screening method must measure the skills of letter naming, letter sound, phoneme segmentation, and nonsense word fluency. In Grades 1 and 2, word reading, spelling skills, phonemic decoding efficiency skills, and sight word reading efficiency are necessary for the dyslexia screening.

International Dyslexia Association (n.d.-a) suggested that dyslexia screening should be divided into three levels. At the kindergarten level, it is recommended to include the assessment of phonological awareness, rapid automatic naming, letter-sound association, and phonological memory. At the first-grade level, the universal screening suggests including phoneme awareness, letter naming fluency, letter sound association, phonological memory, oral vocabulary, and word recognition fluency. At the level of second grade, the screening assessment includes word identification, oral reading fluency, and reading comprehension.

The use of the screening tool known as Dynamic Indicators for Basic Early Literacy Skills (DIBELS) is reported in the dyslexia screening guidelines of 17 states in the US. The screening measures of DIBELS include word reading fluency, letter naming fluency, phonemic segmentation fluency and nonsense word fluency. These measures allow DIBELS to identify children with deficits in phonological awareness, rapid naming ability and alphabetic principle (Ives et al., 2019).

In Sweden, a study investigating the effectiveness of eye tracking as a dyslexia screening method was conducted. Ekstrand et al. (2021) investigated the relationship between eye-tracking screening systems and cognitive assessments. On average, the subjects' performances across nine cognitive domains were 0.47 standard deviations below the mean for the age group, indicating their inferior overall performance. The cognitive domains of reading/decoding and RAN were assessed during the study. Since both RAN and decoding skills are predictors of reading skills, the subjects' performances in the two domains were expected to be almost parallel. However, the subjects' performances in these two domains differed significantly, defying the early expectations.

The deviation could be explained by a study conducted by Torgesen and colleagues (1997), which suggested that rapid naming performances are inversely related to age. To illustrate, after third grade, they reported that children's RAN performances failed to predict significant variance in their reading measures, whereas the predictive power of phonological awareness persisted.

This observation was confirmed by Ekstrand and colleagues (2021), who reported that their subjects were attending third grade by the time of the cognitive assessments. At this stage, the subjects might have automatised the naming of letters in the alphabet but were still struggling with word decoding and reading, hence the significant differences between the domains of RAN and decoding/reading in the study. In brief, aside from showing that eye tracking is an efficient dyslexia screening method, Ekstrand and colleagues (2021) agreed with Torgesen and colleagues (1997) that the screening measure of the RAN test is only effective for children before the third grade, while the decoding test can serve as an efficient dyslexia screening measure for children before, at and after third grade.

Eikerling and colleagues (2022) examined the effectiveness of the MuLiMi Screening Platform as a web-based dyslexia screening platform for multilingual children in Italy. The web platform provides a computerised battery of screening tests for language and reading disorders in multilingual children. The test battery involves assessing the children's reading fluency, decoding skills, and rapid automatised naming (RAN). The findings showed that the children's performances in reading fluency, decoding skills, and RAN could contribute to the early detection of dyslexia.

In a study devising a screening tool for dyslexia among university students in France, Cavalli and colleagues (2024) examined the diagnostic properties of a set of seven tests: (a) 1-min reading test, (b) a 2-min pseudoword reading test, (c) a phonemic awareness test, (d) a spelling test, (e) the Alouette reading fluency test, (f) a connected-test reading fluency test, and (g) the self-report Adult Reading History Questionnaire (ARHQ). The sample includes 60 university students with dyslexia as the clinical validation group and 65 with no dyslexia as the normative group. The results indicated that the combination of text reading fluency, phonemic awareness, pseudoword reading and ARHQ is a powerful screening tool with an accuracy of approximately 90%.

It should be noted that the aforementioned dyslexia screening instruments are conducted in different languages. However, the difference in languages should not obscure that RAN and decoding skills are integral to dyslexia screening

4.2 Dyslexia screening methods in Malaysia

The Ministry of Education Malaysia collaborated with professionals from the Universiti Putra Malaysia (UPM) to devise a dyslexia screening measure for all Standard-1 students at risk of dyslexia (Gomez, 2004). The checklist is known as Instrumen Senarai Semak Disleksia (ISD). The checklist consists of a set of 42 Yes/No questions. It is divided into three elements: (a) students' proficiency in reading and writing, (b) students' oral proficiency, thinking skills, self-management and motivation, and (c) students' weakness in motivation, self-management and spatial awareness. Children at risk of dyslexia will be further referred to healthcare services for proper diagnosis (The Ministry of Education Malaysia, 2011).

Besides, Hazawawi and Hisham (2014) proposed an online dyslexia screening test known as the Malaysian Young Adults Dyslexia Screening Test (MaDIST). MaDIST is an online Malay-language screening tool targeting young adults between 16 and 25. The test consists of a questionnaire and a reading assessment test. The questionnaire consists of 16 yes/no questions about the participants' records of learning difficulties. During the reading assessment, participants must record the time they take to finish reading an article from a Malay-language newspaper.

Che Pee and colleagues (2016) also proposed an online dyslexia screening tool called DycScreen for children between 9 and 12 years old in Malaysia. The screening test has five sections: (a) questionnaire, (b) spelling, (c) vision and cognitive skills, (d) direction, and (e) mathematics and time. The questionnaire is a set of 10 yes/no questions. These questions are answered by students' parents, teachers, or guardians. Children answer the remaining sections. However, the authors did not provide detailed information about the questions in the test. Therefore, the diagnostic value and validity of the questions cannot be evaluated.

In addition, a rapid computerized dyslexia risk screening tool based on fuzzy logic is proposed by Jumadi and colleagues (2018). The input of the computerised tool involves scores from a manual screening test developed by the Malaysian Dyslexia Association (Persatuan Dyslexia Malaysia). The manual screening test is known

as Ujian Pengesanan Awal Disleksia Malaysia (Early Detection Test for Dyslexia Malaysia). Although the manual screening test comprises ten assessments of different measures, the computer-based screening tool managed to achieve 94.1% accuracy by only using scores from the tests of rapid naming, one-minute reading, two-minute spelling, and pseudowords as input for the identification of dyslexic students (Jumadi et al., 2018).

Malaysian Dyslexia Accommodating Screening Test (MYDAST) has also been developed for English language teachers to identify dyslexic pupils. This assessment instrument is a combination of 15 subtests that measure various aspects of dyslexia screening, such as phonological awareness, phonological memory, letter naming ability, word reading, non-word reading, spelling, reading comprehension, oral comprehension, reading aloud and rapid automatised naming. Ahmad and colleagues (2022) conducted a content validation of the instrument using the Fuzzy Delphi Method. The study was conducted using a survey design by distributing questionnaires to 15 experts in related fields, ranging from professional experts at public universities and clinical psychologists to English language teachers and teachers of dyslexic pupils. The findings of their study showed that the experts' consensus agreement on the content validity exceeds 75%, with the threshold (d) < 0.2 and α-cut value exceeding 0.5. They concluded that MYDAST could be promoted as a psychometric test for identifying dyslexic students.

In summary, the rapid computerised dyslexia risk screening tool proposed by Jumadi and colleagues (2018), the Early Detection Test for Dyslexia Malaysia by the Malaysian Dyslexia Association, and the MYDAST require testing of RAN and decoding skills, while ISD by the Ministry of Education Malaysia, MaDIST, and DycScreen do not.

From the review, it is recommended that the ISD should include RAN and decoding skills as part of the testing measures because screening tools which incorporate them as testing criteria, such as the computerised dyslexia risk screening tool and MYDAST, can achieve 94.1 % accuracy (Jumadi et al., 2018) or over 75% experts' consensus agreement on the content validity (Ahmad et al., 2022). Furthermore, the dependence of yes/no questions in the ISD could potentially comprise its validity for several reasons: (a) the questions might be oversimplified for respondents' comprehension, failing to capture the nuances or subtleties of children's difficulty in reading, (b) the respondents might be influenced by their subjective interpretations or biases when answering the questions, and (c) the binary nature of yes/no questions forces respondents to choose between two extreme options, disregarding the fact that it is tough to set a cut-off point on the continuum of some experiences or behaviours.

Apart from that, concerns about the validity of ISD arise because a large proportion of its questions are reflective of "the mistaken view that dyslexia is caused primarily by environmental factors or by lack of motivation" (Catts et al., 2024) such as self-management, motivation, parents and teachers' perception and creativity.

5.0 SIMPLE VIEW OF READING AND DECODING SKILLS

Decoding skills are important because they are an indispensable component of reading. According to the Hypothesis of a Simple View of Reading (SVR), Hoover and Gough (1990) suggested that reading is a multifaceted process consisting of two components: decoding and comprehension. It is presented as R = D x C, using the terms reading (R), decoding (D), and comprehension (C).

The term "decoding" is later changed to "word recognition" to reflect two routes of lexical access: (a) the lexical access linking orthography to meaning via phonology and (b) the lexical access directly linking orthography to meaning. In this mini-review, the term "decoding" is maintained for ease of discussion, and it is used similarly to "word recognition". Meanwhile, the term "comprehension" is clarified as language comprehension, which involves linguistic competence and the ability to extract and construct literal and inferred meaning from speech. Additionally, "reading" is defined as reading comprehension - the capacity to extract and construct literal and inferred meaning from print (Hoover, 2023).

The SVR proposes a revised equation, RC = WR x LC, where RC stands for reading comprehension, WR for word recognition and LC for language comprehension. The multiplicative relationship between the components of the equation denotes that both WR (or decoding skills) and LC are indispensable to each other for successful reading (Hoover, 2023). As stated succinctly, an individual would have reading difficulties if he or she had problems with either WR (or decoding skills) or LC.

6.0 NAMING SPEED AND THE MAGNOCELLULAR SYSTEM

The double-deficit hypothesis posits that naming speed is defined as the rate at which children can recognise orthographic patterns due to exposure to printed materials (Wolf & Bowers, 1999). In other words, naming speed is related to the speed of lexical retrieval at the dyslexic individuals' orthographic lexicon. According to this hypothesis, slow naming speed may cause reading failure in three ways: (a) by hindering the linking between phonemes and orthographic patterns at the levels of sub-word and word representations (the dyslexic individuals' decoding ability), (b) by degrading the quality of orthographic codes in memory due to insufficient orthographic, semantic and phonological information of the lexical items in the short-term memory buffers, and (c) by requiring more practice to unitise codes for adequate lexical quality.

The importance of naming speed is supported by the SVR model, which argues that the fast speed of word recognition (decoding skills) is essential for reading comprehension. If people cannot recognise each word encountered (slow RAN), their limited working memory and cognitive capacity, such as attentional resources, will negatively affect their reading comprehension. To illustrate, people with slow word recognition (decoding skills) tend to forget what they read initially before integrating their understanding of what they have read with the remaining text. Put simply, since cognitive resources are limited, people will have fewer cognitive resources for constructing comprehension from print if they spend too much cognitive resources on effortful word recognition (Hoover, 2023).

Furthermore, Wolf and Bowers (1999) put forward that dyslexic individuals' impaired magnocellular system negatively affects visual discrimination and letter and letter pattern identification, negatively impacting their serial automatic naming speed. In a study measuring the lateral geniculate nucleus (LGN) of dyslexic individuals using high-resolution proton-density weighted MRI scans, Giraldo-Chica and colleagues (2015) reported that the LGN of individuals with dyslexia was significantly smaller in volume compared to the control subjects. It shows that dyslexic individuals suffer from a deficient early visual system. Other than that, in a study on the temporal processing thresholds of dyslexic children and neurotypical children, it is discovered that dyslexic children displayed a significantly lower ability to detect flicker at high temporal frequencies, both at low (5%) and high (75%) temporal contrasts (Peters et al., 2020).

These findings of low flicker contrast sensitivity are in line with the hypothesis that dyslexic individuals' impaired magnocellular processing reduces their saccadic suppression between each fixation, hence the images obtained during the previous fixation might persist and interfere with those acquired during the next fixation (Breitmeyer, 1993).

To encapsulate, naming speed is important for reading as it allows swift and efficient linking between the orthography of a lexical item and its phonological and semantic information, leaving enough cognitive resources for reading comprehension.

7.0 CONCLUSIONS

In conclusion, a dyslexia screening method identifies students at risk of future academic difficulties. It is an essential part of prevention-oriented approaches in early education. The notion of dyslexia screening assessments may aptly be likened to the procedure of measuring blood pressure during a medical check-up for cardiovascular conditions. With data from dyslexia screening, educators can identify children susceptible to reading difficulties and administer necessary interventions with confidence before the emergence of significant academic hurdles (Fletcher et al., 2018).

This mini-review of prior related studies highlights the questionable validity of ISD adopted by the Ministry of Education Malaysia in two aspects: (a) the reliance on binary yes/no questions and (b) the inclusion of an excessive number of questions related to environmental factors and insufficient learning motivation. Stated differently, ISD is not in line with the definition that dyslexia is a learning disability which is neurobiological in origin and associated with word identification, spelling and decoding (International Dyslexia Association, n.d.-a). Moreover, the ISD also fails to keep up with the current strong findings that congenital brain abnormalities, such as an impaired magnocellular system, are the main reason for reading problems (Stein, 2023).

As a result, there is an urgent need to enhance the predictive power and screening accuracy of ISD to identify students at risk of dyslexia successfully. This concern resonates with Dzulkifli (2023), who pointed out the underreporting of Malaysian children with learning disabilities due to the absence of accurate statistics on the total number of dyslexic children in Malaysia.

To attain a high screening accuracy, the ISD must prioritise skills that show a strong correlation with reading measures of proficient readers. The SVR model suggests that word recognition (decoding skills) and the speed of word recognition (RAN) are integral elements in reading comprehension (Hoover, 2023). Hence, it is highly recommended that decoding skills and RAN tasks be included in the assessments of ISD.

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