Educational Insights into Dyslexia

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Abstract
Dyslexia is a specific learning disorder characterized by difficulties in reading, writing, and spelling due to compromised phonological processing skills. Treatment of dyslexia solely with medical support is far-fetched. However, it can be surmounted by the combination of special education interventions and supportive psychosocial care. Suitable approaches coupled with beneficial learning strategies enable dyslexic learners with consummate linguistic achievement. Although dyslexia research offers an increased understanding from a biological standpoint, the knowledge gap on the educational front is unfortunately persistent. To this end, this paper revisits the teaching-learning aspects of dyslexia. Teaching principles and approaches, strategies to support learning, and personalized educational plans are discussed in detail. Acknowledging the difficulty, familiarizing with the approaches, and attaining successful outcomes via essential practices emphasize the inclusiveness of dyslexic learners in the curriculum. We contend that the educational insights into dyslexia will provide informed teaching and learning solutions.

Keywords: Dyslexia; Education; Teaching; Learning; Curriculum

1. Introduction

Dyslexia is a specific learning disorder that is neurological in nature. It is characterized by difficulties in reading, writing, and spelling due to compromised phonological awareness and phonological processing skills. Deficits in phonological skills lead to challenges in decoding sound segments into words and encoding letter to word correspondences. This eventually affects the whole reading and learning experience of individuals with dyslexia. Other than decreased reading, they also have poor vocabulary and obsolete schema (Lyon, Shaywitz, & Shaywitz, 2003). Owing to the heterogeneity of the disorder, people with dyslexia present with varied difficulties in skills necessary for both language and literacy gains. They face challenges not only related to language sub-skills but also associated cognitive skills that are distinct from but related to phonological skills.

When dyslexics accumulate decreased reading experience the deficits in phonological skills are accompanied by labored verbal working memory, processing speed, long-term retrieval like rapid automatic naming, etc (Kramer, Knee, & Delis, 2000; Smith-Spark & Fisk, 2007). For instance, when a dyslexic learner reads an unknown word, the letter/sound associations stored in the long-term memory are transferred to working memory either slowly or in a deteriorated form due to deficits in phonological processing and/or speed. In this

process, the required information does not make it to the working memory and the deteriorated information is eventually stored in the long-term memory. Recalling the deteriorated information again becomes strenuous and affects the whole reading experience. On the other hand, when attention is diverted due to overwhelming and irrelevant information from the input along with affective filters, identifying and processing the information becomes slow owing to the difficulty in the long-term memory retrieval (Romania, Tsouknida, Betta, & Olson, 2011). Thus, the labored automaticity in word reading eventually affects comprehension and the whole reading and learning experience.

The etiology of dyslexia is linked to various factors like genetic, neural, and social (Rahul & Ponniah, 2021). Although the exact causes of dyslexia are still unclear, the brain physiology of people with dyslexia manifests differences in development and functions. Deficits in the wide network of brain areas responsible for phonological skills cause reading difficulties (Norton, Beach, & Gabrieli, 2015). People with dyslexia manage to overcome these difficulties and learn skills related to early reading and learning to a certain extent with sublime education. However, as they grow and get exposed to more complex language skills, they struggle to cope and fail to achieve both academically and socially. Therefore, it is crucial to identify the difficulty and provide appropriate intervention as early as possible.

Early identification and timely instruction are key to tackle dyslexia (Snowling, 2013). A battery of tests comprehensively evaluating the academic and intellectual achievement, essentially analyzing the underlying language and phonological skills report the presence of dyslexia. Examples of commonly used tests to analyze the language, reading, achievement, cognitive, and motor skills are Clinical Evaluation of Language Fundamentals, Fifth Edition (CELF-5), Woodcock Reading Mastery Tests-Revised (WRMT-R), Woodcock Johnson-III Tests of Achievement (WJ III ACH), Woodcock-Johnson III Tests of Cognitive Abilities (WJ III COG), and Peabody Developmental Motor Scales - Second Edition (PDMS-2). Like early identification, providing timely instruction is equally important. For instance, Bowyer-Crane *et al.* (2008) demonstrated the successful learning of dyslexic children at the school entry level. Results of their randomized controlled trial confirmed significant gains in phoneme awareness, letter-sound knowledge and reading, and spelling skills of children at risk. Even after the intervention period, it was found that 50% of the children were still in need of literary support. Therefore, it is crucial to identify and provide appropriate interventions at the early stage.

Dyslexia associations all over the world assert that one cannot overcome dyslexia solely with medication. However, a combination of special education interventions and supportive psychosocial care improves their learning gains. Proper diagnosis, appropriate instruction, required practice, and necessary social and emotional support help dyslexic learners to succeed in their academic and social life.

Dyslexia, being a specific language impairment that is persistent over life, lays out a downward spiral of language achievement, especially reading, spelling, and writing. It is, therefore, a major concern in terms of language learning, reading to be precise. It is highly crucial to sift through the etiologies of dyslexia not only to understand but also to intervene appropriately and ameliorate the language capacity of the affected individuals. Contextualizing dyslexia in the realm of research in language education reveals a dearth in comprehension and evidence that is suggestive of adapting appropriate methods by language educators to enhance the language gains of dyslexics. It is imperative that language educators must be informed about the nuances of teaching and learning aspects of dyslexia. To this end, this article revisits the teaching-learning principles of dyslexia education. The principles of

teaching learners with dyslexia along with appropriate approaches are discussed in detail. Also, beneficial learning strategies that support learning are presented in tandem. A brief discussion on personalized educational plans, essential practice, and assistive technology emphasizes the inclusiveness of dyslexic learners in the curriculum. We believe, this paper provides a foundation for informed teaching and learning solutions to dyslexia.

2. Teaching and Learning

Learning is a cognitive process. It involves various cognitive functions like short- and long-term memory processing, the speed, and style of processing, the use of new information, schema, etc (Cook, 1977). For successful learning, a learner must comprehend new information in connection with the background knowledge that they already have. Making this connection becomes tricky for learners with dyslexia. They face difficulty in raising appropriate questions to make the required connections and rely greatly on the simple and prompt cues that the facilitator or the learning material could provide. Therefore, it is highly significant that learners with dyslexia are given due attention either with the input they receive or with the choice of structured techniques and strategies the facilitator offers for successful learning.

Dyslexic learners engage in a divergent learning process. Research into brain lateralization shows that the language component is often reflected in the left hemisphere (Vigneau *et al.*, 2006). This posits that people usually prefer the 'left brain route' for learning language and its sub-skills. However, in people with dyslexia, the choice of learning route is quite the opposite i.e., they mostly prefer the 'right brain route' (Vlachos, Andreou, & Delliou, 2013). This fundamentally means that they engage in a different way of thinking and processing the information they receive and possess.

Processing information occurs in three different stages i.e., exposure to the input, processing the input cognitively, and delivering the output. There is a wide range of inputs, cognitive processing, and outputs a learner may encounter, experience, and deliver. Inputs like visual, auditory, tactile, kinaesthetic, etc., cognitive processes like memory processing, comprehension, making connections, etc., and outputs like reading, writing, speaking, etc. play crucial roles in a person's overall learning experience. However, people with dyslexia face difficulties in all these stages. Information presented in the input is sometimes overwhelming for dyslexics. They often get distracted by the myriad of information the input carries and lose track of processing the same. Therefore, tailored input with minimal and required information is optimal for a successful process. The information can be presented in meaningful chunks so that it becomes easy to process. Also, it is essential to present the key points of the input to the dyslexic learners and monitor them frequently to ensure they comprehend the input. Likewise, in the cognitive stage, firstly, it is important to locate the information gathered from the input in a meaningful framework. And then utilizing organization and memory strategies like mind mapping and mnemonics help in better processing of information. Frequent monitoring and assessment are crucial in the cognitive processing stage too. In the output stage, the dyslexic learners are provided with supportive topics and subtopics that act as structures in producing the desired output - irrespective of the form i.e., writing, speaking, or reading. Techniques like summarizing, paraphrasing, describing, etc, are recommended for enhanced output. And most importantly, monitoring and assessing the learning at each point assures a better output. Only when teaching, assessment, and the curriculum ensure such support during all three stages, can we bolster the learning process of dyslexic learners.

3. Teaching Principles

Both teaching and teachers play a vital role in the learning process of dyslexic children. In a common classroom, most teachers tend to overlook learners with the difficulty and often continue to support the learners with better literacy skills to improve their academic achievements. The same is the case with the methods of teaching adopted in a usual classroom. Commonly used methods do not serve learners with dyslexia, and they are left behind with no or very minimal support. Although this is not a conscious effort, teachers and the academic setup must be aware and accommodative of dyslexic learners in the classroom. To facilitate the learning process of dyslexics, teachers need to accept and embrace the fact that a wide range of flexible approaches and methods help in supporting the taxing learning processes of dyslexics. Such approaches and methods, catering to the needs of an individual, eventually aid in overcoming the difficulty and benefit learners with dyslexia significantly.

The principles of teaching dyslexic learners accommodate various aspects. The most important ones are multisensory instruction, structured learning, overlearning, metacognitive aspects, and automaticity (Reid, 2019, Figure 1).
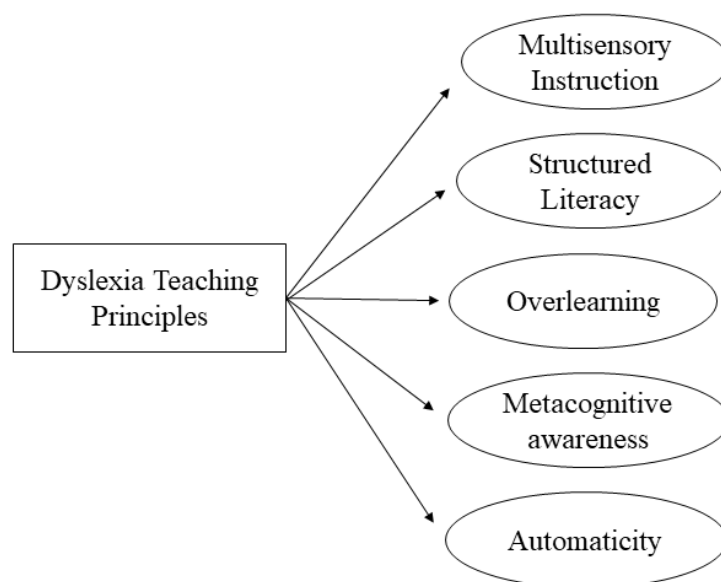

Figure 1. Teaching principles of dyslexia

Multi-sensory instruction is an approach to teaching language and literacy skills that utilizes all the senses concurrently. Incorporating auditory, visual, kinaesthetic, and tactile elements is highly crucial as dyslexic learners have difficulty in receiving and processing information/ input through various modalities. A variety of methods adopting the principles of this approach were developed and found successful in teaching language and literacy skills for children with dyslexia. For instance, Joshi, Dahlgren, & Boulware-Gooden (2002) showed statistically significant gains in phonological awareness, decoding, and reading comprehension among the learners using the Alphabetic phonic method - an Orton-Gillingham-based multi-sensory approach - when compared to another literacy program that did not incorporate the same.

The structured literacy approach is one of the most effective approaches towards teaching dyslexic learners (Moats, 2019). It provides support in decoding, spelling, and

phonological skills because of the difficulties dyslexic learners encounter with language processing skills. It is an explicit, systematic, and sequential approach taking different levels into account like the phoneme, grapheme, morpheme, phoneme-grapheme correspondences, orthography, syntax, and semantic. It also includes methods that incorporate hands-on learning activities that are actively engaging and multimodal in nature, demanding a high degree of interaction between the teacher and the student. Moreover, the teacher constantly monitors the progress to measure the amount of retention, offers immediate feedback for correctness, and demonstrates skills for guided practice. Examples of structured instructions that are effective with a substantial body of evidence include Wilson Reading System (Wilson, 1988), Lindamood Phoneme Sequencing Program (Lindamood & Lindamood, 1998), Direct instruction (Carnine, Silbert, Kameenui, & Tarver, 2009), etc. Although certain structured literacy methods are more effective than the others, all structured literacy methods have a marked effect on the learning curves of dyslexic learners than any other general instruction (Moats, 2017).

Overlearning is a pedagogical concept that refers to the systematic practicing of newly acquired skills or study materials beyond a level of mastery to achieve automaticity and memory consolidation. This helps in the retention of required skills and can be readily applied in securing or processing new information. Dyslexic learners need extensive practice to acquire a skill and it is important to practice the same skill in different contexts. Teachers make deliberate connections for the learners to process the information they acquired and ensure that they comprehend the same. This helps in transferring information from working memory to long-term memory. For instance, (Shaywitz, 2020) suggests overlearning for dyslexic children to achieve successful reading by rereading the same passage aloud at least four times. Combley (2000) and Miles (1993) contended that overlearning through repetition is key in teaching the first language for dyslexic learners.

Methods that impart automaticity have significant effects on the learning process of dyslexic learners (Hook & Jones, 2002; Jamshidifarsani, Garbaya, Lim, & Blazevic, 2021; Wolf, Miller, & Donnelly, 2000). Automaticity is essentially the quick, precise, and effortless identification and processing of information to provide an apt output. Poor identification and processing of information among dyslexic learners are tackled with approaches that accommodate automaticity. Particularly in reading, which involves higher-order cognitive processing, achieving automaticity can be quite difficult. LaBerge and Samuels (1974) suggested that automaticity through repetition and accuracy helps in the involvement of episodic memory for the processing of information and delivering an output. Thus, overlearning/repetition becomes an important aspect in achieving automaticity in reading for dyslexic learners.

Another feature to consider is the metacognitive aspects of learning. Although there is a contradictory body of evidence about incorporating metacognitive experience to enrich the reading achievement of dyslexic learners, they nevertheless find the experience itself extremely challenging or futile (Furnes & Norman, 2015; Reid, 2001). However, when they become autonomous learners, metacognitive awareness plays a huge role in the identification of learning style, use of learning strategies, techniques, and self-efficacy (Leather, Hogh, Seiss, & Everatt, 2011). Most of the strategies and methods are accommodative of this feature irrespective of the inconclusive results on the gains of metacognitive experiences in successful learning (Camahalan, 2006; Tops, Callens, Desoete, Stevens, & Brysbaert, 2014).

4. Strategies to support learning

Extensive research on the employment of strategies for successful learning indicates that it is important for learners, especially dyslexic, to be familiar with and employ the same to overcome difficulties in learning. Dyslexic learners benefit substantially from the use of learning strategies for a successful learning outcome (Graham, Harris, Macarthur, & Schwartz, 1991; Kirby, Silvestri, Allingham, Parrila, & La Fave, 2008; Nelson & Hourigan, 2016). However, some reports indicate the knowledge gap of dyslexics on the use of learning strategies (Olofsson, Ahl, & Taube, 2012). To overcome the gap and to tackle the long-standing difficulty, the teachers must inculcate a wide range of learning strategies in dyslexics during the teaching-learning activities. Examples of successful learning strategies include Reciprocal teaching, scaffolding, paired thinking, using multiple intelligences, skills transfer, etc.

Dyslexic learners benefit from a wide range of learning strategies. Reciprocal teaching sets a teacher to monitor and support the learners' progress of comprehension by asking questions, clarifying doubts, summarizing discussion, and assisting an outcome (Palinscar & Brown, 1984). When teachers asking questions, they indirectly enable the learners to generate and ask new questions and get their doubts clarified. Raising appropriate questions and participating in the discussions leads to refinement of learners' involvement and thereby achieve greater gains in learning and comprehension (Efstratia, 2017). While reciprocal teaching aids in generating new questions, scaffolding generates appropriate responses. Scaffolding is a similar strategy aimed at increasing the interaction between teachers and learners through a series of support so that learners develop an increased comprehension of a text (Cudd & Roberts, 1993). The volume of support gradually decreases as the learners gain a proximal level of comprehension. This strategy is highly effective especially when there is a great degree of interaction through the series of support a teacher provides (Cumming-Potvin, 2007; Rodgers, 2004). Interaction with both the teacher and the peers allows dyslexic learners to reflect on the learning process. This facilitates a possible transfer of skills for effective learning. All these strategies involve metacognitive aspects that allow learners to become self-adequate. To become self-adequate, dyslexic learners need to be aware of their learning process i.e., metacognitively aware. It is achieved through self-assessing, self-monitoring, and self-directing. Employing this strategy is effective in learning and comprehension, and with adequate practice learners gradually become autonomous (Camahalan, 2006; Furnes & Norman, 2015). When learners are metacognitively aware, they can make use of their preferred learning style for successful learning achievement. For instance, Exley (2003) reported the improvement of learning achievements among dyslexic learners using their preferred learning style. It is crucial to identify their ideal style of learning and their strengths. It is believed that their strengths are the compensation of deficits and the difficulties they display. Strengths like visuospatial abilities, artistic talents, creativity, etc resonating with multiple intelligences are significantly associated with dyslexia (Von Károlyi, Winner, Gray, & Sherman, 2003; Wolff & Lundberg, 2002). Learning strategies that accommodate their strengths substantially help in closing their learning gaps (Andreou, Vlachos, & Panagiota, 2013).

5. Educational interventions

While treating dyslexia solely with medical support is far-fetched, it can be surmounted by special educational interventions (Figure 2). Fitting educational interventions along with a favorable learning atmosphere can eventually capacitate dyslexic learners with consummate

achievements, both linguistic and social. A wide range of educational interventions premised on the previously discussed principles, approaches, and strategies remarkably benefit dyslexic learners. Personalized educational plans based on strengths and learning styles improve their learning achievements (Cornett-DeVito & Worley, 2005; Hughes, Herrington, McDonald, & Rhodes, 2011; Ozernov-Palchik & Gabrieli, 2018). Although this type of intervention is time-consuming, it caters to the needs of the individuals. Details of the individual's difficulty, targeted teaching-learning methods, targeted materials, adopting preferred strategies, continuous monitoring, and standard assessment are the key factors in designing personalized educational plans. A common dyslexia-educational plan does not benefit all dyslexic learners. There is variation in their response towards a common intervention and it often renders substandard outcomes (Bowyer-Crane, Snowling, Duff, & Hulme, 2011; Torgesen, 2000). The level of intelligence, type of difficulty, socioeconomic status, etc contributes to the outcome (Al Otaiba & Fuchs, 2002; Lam & McMaster, 2014). Therefore, it is critical to cater to the needs of the individuals and utilize personalized educational intervention for a successful learning outcome.
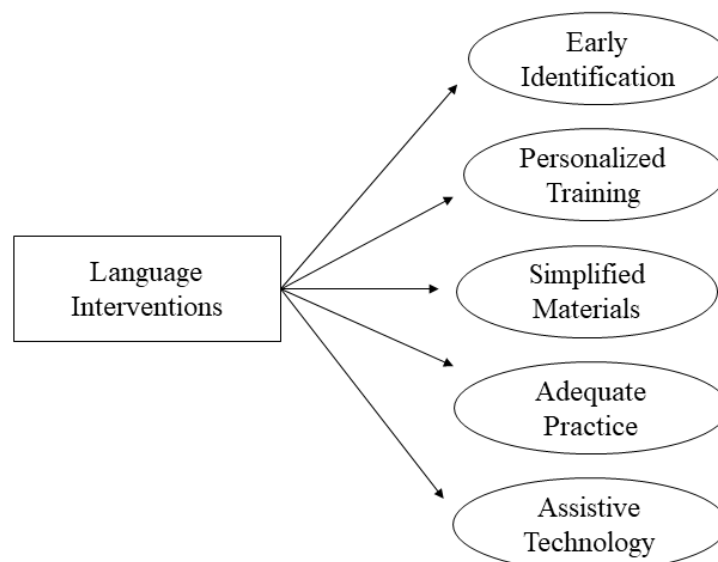

Figure 2. Educational and language interventions

Early identification and intervention for dyslexia are crucial to close the achievement gap (Ferrer *et al.*, 2015; Snowling, 2013). A substantial body of evidence has established that it is possible to identify the difficulty as early as the preschool years (Ferrer *et al.*, 2015; Gallagher, Frith, & Snowling, 2000; Lyytinen *et al.*, 2006). Early identification and treatment of dyslexia return successful academic achievement during the treatment period and the beneficial effects persist over time. For instance, Elbro and Petersen (2004) found that the dyslexic children who were intervened in their kindergarten outperformed the children who were not intervened in the phonological awareness and letter knowledge tasks. The results were similar in the follow-up tests that were conducted in their higher grades. Van Der Leij (2013) states the importance of early intervention of dyslexia by providing a detailed summary of studies carried out under the Dutch Dyslexia Program and argues that early intervention works best in tackling the difficulty along with personalized treatment. When interventions are not started early, dyslexic

learners miss out on the practice required for learning. Consequently, they do not keep pace with the expected learning progress and fail severely (Schatschneider & Torgesen, 2004). Whereas, when the intervention starts early, especially even before they start developing the foundation for learning, successful learning gains are promising.

The use of technology-assisted interventions helps in augmenting successful learning outcomes for dyslexic learners (Kalyvioti & Mikropoulos, 2014; Madeira, Silva, Marcelino, & Ferreira, 2015; Rooms, 2000). A wealth of research and resources are dedicated to the effective use of assistive technologies in dyslexia education and intervention (Rooms, 2000). For instance, Torgesen, Wagner, Rashotte, Herron, and Lindamood (2010) investigated the efficacy of two computer-assisted instructional programs for students at risk for reading difficulties and found significant changes in their reading skills that include phonemic awareness, phonemic decoding, rapid naming, reading accuracy, and reading comprehension. Assistive technology is not only beneficial in addressing the reading difficulties of students with dyslexia but also contributes positively to their affective factors (Svensson *et al.*, 2021). Therefore, accommodating technological aids in the educational interventions of dyslexia is incredibly beneficial.

6. Conclusion

Meeting the needs of children with dyslexia is a challenging task. Specialist schools and trainers play a crucial role in the successful outcome of dyslexic learners. However, with informed knowledge of the educational needs, teaching principles, and preferred learning strategies, and strengths of dyslexic learners, a dyslexia-inclusive environment can be achieved. It is important to acknowledge the individual differences in learning and not to dictate a universal pedagogical approach. It is also important to recognize the strengths of dyslexic learners and implement strategies like multiple intelligences to overcome barriers to learning. While inclusion is desirable, it is also prudent to understand the challenges it brings to the table. Arduous reconciliation of the approaches and pedagogy, flexible assessment, and essential practices are the main challenges in an inclusive educational front. There is a pressing need for research into accommodating dyslexia in the mainstream educational setting, reconciliation of pedagogies that cater to the needs of both dyslexic and healthy learners, providing holistic training to dyslexic learners in a conventional classroom, etc. It is highly significant to understand the differences not only as teachers but also as parents and society at large so that they feel less isolated and more included. Alongside educational support, emotional support is appreciated for pleasurable learning experiences. Hence, being informed about suitable teaching principles and approaches coupled with beneficial learning strategies enables dyslexic learners with consummate learning achievement.

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