

## Neuropsychological in the Treatment of Academic Abilities of Children with Special Needs (Dysgraphia, Dyscalculia, Dyslexia, Slow learning)

Nadia Lutfi Choirunnisa<sup>1\*</sup>, Mochamad Nursalim<sup>2</sup>, Diana Rahmasari<sup>3</sup>

<sup>1,2,3</sup>Surabaya State University

<sup>1</sup>nadiachoirunnisa@unesa.ac.id, <sup>2</sup>mochamadnursalim@unesa.ac.id, <sup>3</sup>dianarahmasari@unesa.ac.id

**Abstract:** This article describes research on the application of neuropsychological approaches in improving the academic abilities of children with special needs, including dysgraphia, dyscalculia, dyslexia, and slow learners. Using descriptive qualitative methods, this study describes in detail the impact of neuropsychological interventions on participants with learning difficulties. The results of the analysis showed significant improvements in these children's writing skills, math ability, reading skills, and learning comprehension speed. This study indicates that neuropsychological approaches can provide practical support in addressing the academic challenges of children with special needs by detailing the behavioral and cognitive changes observed during the intervention. The practical implication is that these methods can be integrated into educational programs tailored to meet individual needs, improving learning efficiency and effectiveness. In conclusion, this article contributes to our understanding of the positive potential of neuropsychological approaches in supporting the academic development of children with learning difficulties, paving the way for developing more adaptive intervention strategies focused on each child's specific needs.

**Keywords:** Neuropsychology, Children with Special Needs, Academic Abilities

**Abstrak:** Artikel ini menggambarkan penelitian tentang penerapan pendekatan neuropsikologis dalam meningkatkan kemampuan akademik anak-anak berkebutuhan khusus, termasuk disgraphia, diskalkulia, disleksia, dan lambat belajar. Dengan menggunakan metode deskriptif kualitatif, studi ini menjelaskan secara rinci dampak intervensi neuropsikologis pada peserta dengan kesulitan belajar. Hasil analisis menunjukkan peningkatan signifikan dalam keterampilan menulis, kemampuan matematika, keterampilan membaca, dan kecepatan pemahaman belajar anak-anak tersebut. Studi ini menunjukkan bahwa pendekatan neuropsikologis dapat memberikan dukungan praktis dalam mengatasi tantangan akademik anak-anak berkebutuhan khusus dengan merinci perubahan perilaku dan kognitif yang diamati selama intervensi. Implikasi praktisnya adalah bahwa metode-metode ini dapat diintegrasikan ke dalam program pendidikan yang disesuaikan dengan kebutuhan individu, meningkatkan efisiensi dan efektivitas pembelajaran. Kesimpulannya, artikel ini berkontribusi pada pemahaman kita tentang potensi positif pendekatan neuropsikologis dalam mendukung perkembangan akademik anak-anak dengan kesulitan belajar, membuka jalan untuk pengembangan strategi intervensi yang lebih adaptif yang berfokus pada kebutuhan spesifik setiap anak.

**Kata kunci:** Neuropsikologi, Anak Berkebutuhan Khusus, Kemampuan Akademik

### INTRODUCTION

Academic ability is essential in child development (Peng & Kievit, 2020). The story of intellectual skills in children is significant because it plays a crucial role in forming their knowledge base. Academic ability can affect many things in a child's future, such as cognitive ability, reasoning ability, and emotional management ability. The learning process in areas such as mathematics, science, languages, and humanities provide a deep understanding and stimulates critical and analytical thinking. This ability equips children with essential problem-solving skills to face life's challenges. In addition, academic learning also involves developing communication skills, allowing children to convey their ideas and concepts clearly and effectively. The importance of academic ability is not only limited to the intellectual realm but also plays a crucial

role in understanding social and cultural ideas. Children learn about the history, culture, and values that shape their society, helping them become more knowledgeable and strong individuals. In addition, developing academic abilities contributes to daily living skills, such as time management and the ability to work independently.

Children with dyslexia are also at increased risk of learning disabilities that affect other academic skills, including those impacting reading comprehension (Christopher et al., 2012), mathematics (Landerl & Moll, 2010), and writing (Berninger et al., 2001). Academic ability is lower in children with special needs than in children without special needs (Moojen et al., 2020). Their inability to capture information, process concepts, or cope with academic tasks becomes a severe obstacle in their learning process. The neuropsychological approach is considered a relevant and in-depth framework for this challenge. Cognitive neuropsychology has been critical in improving the understanding of neurological aspects of learning disabilities in recent decades (Nazari et al., 2022).

Neuropsychological analysis is a specialized field within psychology that focuses on understanding the relationship between brain function and behavior. It involves the assessment and interpretation of cognitive, emotional, and behavioral functioning based on knowledge of brain structures and functions. A neuropsychological analysis can reveal how brain functions related to reading, spelling, or math skills are affected. For example, for a child with dyslexia, neuropsychological research can highlight areas of the brain involved in letter recognition and phonological understanding. By understanding its neurological basis, interventions can be designed to stimulate or strengthen the brain connections involved in the reading process. Grote & Novitski (2016) found that neuropsychological approaches can be used to analyze the brain-related disorders and behaviors shown more precisely, including learning disorders. Learning disorders are common neurodevelopmental conditions occurring idiopathically and in the context of other medical conditions (Colvin et al., 2022). Neuropsychological analysis can also help assess the relationship between cognitive and emotional aspects and academic ability. For example, anxiety or attention problems that may be related to special needs can affect a child's ability to focus and manage academic tasks. With this understanding, tailored teaching and intervention approaches can be designed to optimize children's potential and overcome obstacles they may face. Neuropsychological analysis can provide a solid foundation for developing personalized and effective lesson plans, maximizing the academic development of children with special needs.

This article seeks to investigate and discuss how understanding the interrelationships between children's brains, cognition, and behavior can be applied to improve their academic abilities. By detailing the distinctive patterns in the brain workings of children with special needs, this approach opens a window into understanding the neurobiological mechanisms underlying their learning difficulties. In addition, this article examines the urgency of this approach in the context of educational inclusivity. In an era where inclusive education is in the spotlight, the emphasis on personalizing education is becoming increasingly important. The neuropsychological approach allows educators and education experts to design learning strategies tailored to each child's specific needs, initiating innovative solutions to improve learning effectiveness. Neuropsychological methods are more effectively used to reduce dyslexic symptoms (Mousavi et al., 2023). The successful implementation of this approach can also positively impact the level of confidence and motivation of children with special needs in pursuing academic achievement. We hope to foster a supportive learning environment and close educational gaps by embracing a thorough grasp of each individual's distinct neurobiological qualities. Thus, the purpose of this article is to provide a thorough examination of how neuropsychology's human-centered approach might serve as a solid foundation for improving the academic performance of children with exceptional needs. Our goal is to provide a complete strategy that incorporates insights into brain function with innovative educational methods, embracing every child's journey towards learning and achievement.

This article describes research on the application of neuropsychological approaches in improving the academic abilities of children with special needs, including dysgraphia, dyscalculia, dyslexia, and slow learners. Dysgraphia is a learning disorder that affects a person's ability to write coherently and legibly. Individuals with dysgraphia may struggle with forming letters, spacing words appropriately, and organizing their thoughts on paper. Dyscalculia is a specific learning disability that affects a person's ability to understand and manipulate numbers and mathematical concepts. Dyslexia is a common learning disorder characterized by difficulties with reading, spelling, and decoding words. It affects the way the brain processes written language. Slow learning, also known as slow processing speed, refers to a difficulty in quickly and efficiently processing information.

## **METHOD**

This study used a qualitative descriptive approach. The qualitative descriptive research method is a research approach that aims to provide an in-depth and detailed picture of the observed phenomenon. In this method, researchers focus on understanding an event's context, meaning, and complexity, namely the treatment carried out by therapists and teachers in schools inclusive of children with special needs (dysgraphia, dyscalculia, dyslexia, and slow learning).

Data collection used interviews with 14 resource persons who were a combination of therapists and inclusive teachers or teachers of Special Schools in the Surabaya area. The instrument used is an interview sheet with open-ended questions asking about treatment of children with special needs. This limited study discusses the four disorders most affecting children's academic ability. Two experts in the field of psychology and are lecturers at the Faculty of Education UNESA have validated the interview instrument. Through interviews with accompanying teachers and therapists of children with special needs, neuropsychological approaches can be evaluated in the context of their personal experiences. Neuropsychological approaches can be evaluated in the context of their personal experiences.

Analysis of qualitative data from these interviews helps reveal the nuances and feelings of children related to the approach, allowing the identification of effectiveness and challenges that may arise. The stages of data analysis through interviews in research involve a series of systematic steps to detail, classify, and understand the information obtained from participants. First, the audio recording or text transcript is reviewed after the interview to gain a general understanding of the topic covered. The next step involves data segmentation, where parts of the discussion relating to the theme or research question are identified and isolated. This process helps focus attention on critical aspects relevant to the research objectives.

Furthermore, data categorization is was carried out, grouping these segments into thematic or conceptual categories representing specific patterns or trends. The further analysis involves looking for relationships and ways among those categories. This include identifying differences or similarities in views, experiences, or attitudes between participants. Coding can be applied to improve the reliability of the analysis by assigning labels or codes to data units with similar or interrelated meanings to enhance the reliability of the research. Finally, interpretation of the results of the analysis is carried out. It involves synthesizing qualitative findings into key findings and crafting a narrative explaining the results' meaning or implications. This process provides context and an in-depth understanding of the phenomenon under investigation while ensuring the interpretation is relevant to the research question. The entire process of analyzing interview data helps detail and open perspectives to the diversity and complexity of answers from participants, making a significant contribution in understanding the context involved in the research.

## **RESULT AND DISCUSSION**

This study presents data from several cases of children with special needs who undergo treatment to improve their academic abilities. The study's results will be elaborated with a neuropsychological approach. The results showed that neuropsychological interventions positively affected the intellectual skills of children with special needs, including dysgraphia, dyscalculia, dyslexia, and slow learners. The application of neuropsychological interventions to children with dysgraphia resulted in a significant improvement in their writing skills. There were marked changes in writing strategies, motor coordination, and idea expression. In children with dyscalculia, this intervention successfully improved their math skills, especially in understanding mathematical concepts, using symbols, and problem-solving. A positive influence was also seen in dyslexic children after going through neuropsychological interventions, where their reading ability experienced marked improvement. Changes include improved reading speed, text comprehension, and word pattern recognition. Meanwhile, in the slow learner group, this intervention succeeded in increasing the rate of learning comprehension, facilitating their learning process more efficiently.

### Dysgraphia Disorder

Dysgraphia is a learning disorder that affects a person's ability to express themselves in writing. Individuals with dysgraphia tend to face difficulties with paper, including problems with layout, sentence structure, and spelling of words. Despite having average or even above-average intellectual abilities, they may encounter problems in transferring their ideas to paper in an organized and understandable manner. Dysgraphia can be chronic and affect a person's academic development, especially in subjects that require strong writing skills. In dealing with dysgraphia, therapeutic approaches involving specific support, such as handwriting therapy or assistive technology, can help individuals overcome obstacles in their writing process. It is essential to recognize that dysgraphia is not a reflection of a lack of intelligence or effort but rather a neurological challenge that requires exceptional understanding and support to help individuals reach their potential in writing skills. Neuropsychology in dysgraphia can be seen in distinguishing "b" and "d" or the sound the letter.

**Table 1. Results of Interviews with Therapists Treating Children with Dysgraphia Disorders**

<b>Annoyance</b>	<b>Treatment</b>
Dysgraphia	In some cases, children were found to have difficulty distinguishing the letters B and D. The treatment carried out on children is to use repetition of writing refracted. Children are familiarized with handwriting on paper to train motor and letter recognition. In addition, it also presents picture cards of various colors that clearly show the letters B and D. Consistent treatment can improve a child's dysgraphia disability.

In the case presented by the interviewee in Table 1 shows that the therapist performs visual letter recognition and handwriting to distinguish the letters B and D. Some things that can be done for dysgraphia in the neuropsychology approach are writing in lowercase and uppercase prints, spellout loud, in writing, and type; the introduction of numbers and symbols; the introduction of visual letters and imagery (Ingles et al., 2014). The neuropsychological approach makes an important contribution in managing and treating dysgraphia, a learning disorder that affects a person's writing ability. By understanding the neurological basis of dysgraphia, neuropsychology professionals can design appropriate and personalized interventions.

This therapy often focuses on understanding how brain function affects writing skills, taking into account motor, cognitive, and sensorimotor aspects. Handwriting therapy, for example, can help improve motor coordination and control of hand movements necessary in the writing process. In addition, the neuropsychological approach also includes the use of assistive technologies, such as software or applications specifically designed to support individuals with dysgraphia.

Treatment with children's writing will help children recognize letters and train motor muscle skills. Handwriting is a complex perceptual-motor task involving attention, perceptual, linguistic and fine motor skills (McCutchen, 2011) and opens up opportunities for dysgraphic children to recognize letters better (Gargot et.al., 2020). Each cortex lobe in both hemispheres can affect the production of written language, albeit in different ways (Hillis, 2004) and the treatment of dysgraphia is the first step to preventing neuroscience diseases such as stroke and Alzheimer's (Rapcsak & Beeson, 2002). Neuropsychological therapy becomes the foundation for understanding and responding holistically to the complex needs of individuals with dysgraphia, creating positive changes in their writing skills and strengthening self-confidence and motivation in an academic environment.

Neuropsychological analyses in children with dysgraphia shed light on the involvement of brain function in their writing skills. Dysgraphia, a disorder affecting handwriting skills and written expression, can be understood through a neuropsychological lens to identify potential specific neurological barriers. Through the use of neuroimaging techniques and neuropsychological assessment, the analysis can highlight areas of the brain involved in fine motor coordination, writing pattern recognition, and visual-motor integration required in writing. Neuroimaging allows the mapping of brain processes for cognitive performance (Levitan et al., 2016). For example, there can be misalignment between brain areas involved in planning fine motor movements and the execution of handwritten actions in children with dysgraphia. The problems in this study raise questions that underlie the exploration of the application of neuropsychological approaches in improving the academic abilities of children with special needs, including dysgraphia, dyscalculia, dyslexia, and slow learners.

Based on that, the findings of this study are that to cope with children with dysgraphia, suitable treatments are repetition and refraction of writing. This can simultaneously train motor and letter recognition periodically. In addition, the treatment that can be done is to add pictures to help children distinguish and recognize letters.

### **Dyscalculia Disorder**

Dyscalculia is a learning disorder that affects a person's ability to understand and use mathematical concepts. Developmental Dyscalculia (DD) is a learning disability and neurodevelopmental disorder resulting from central nervous system dysfunction (Lima et al., 2011). It is a learning disorder characterized by significant difficulty in learning academic skills related to mathematics or arithmetic (McCaskey et al., 2020). Individuals with dyscalculia may have trouble understanding numbers, recognizing mathematical patterns, and performing basic calculation operations. Despite having average or even above-average levels of intelligence, they can face significant challenges in completing everyday math tasks. Dyscalculia is not simply the result of a lack of effort or indifference to mathematics but rather a neurological disorder that requires a unique approach to education and care. In treating dyscalculia, individualized and tailored therapeutic and educative approaches are often needed, involving a variety of mathematics teaching strategies, visual aids, and professional support. A deep understanding of the neurological aspects of the disorder is key to designing effective interventions to help individuals with dyscalculia overcome barriers and build the mathematical skills needed in everyday life.

**Table 2. Results of Interviews with Therapists Treating Children with Dyscalculia Disorders**

<b>Annoyance</b>	<b>Treatment</b>
Dyscalculia	In the cases found, children have difficulty recognizing subtraction signs (-) and addition (+) and other symbols in mathematics. This delay in introducing dyscalculia makes it difficult for children to follow other children's academic achievements. Another mistake is that children are taught the same numbers as other children in class. The treatment is to repeat the introduction of numbers and mathematical symbols from the beginning. Repetition is done consistently and continuously. In addition, numbers and symbols are recognized using the abacus method, rod sticks, and number cards.

The neuropsychological approach provides a solid foundation for the management and treatment of dyscalculia, a learning disorder that affects a person's ability to understand and use mathematical concepts. By understanding the neurological basis of dyscalculia, neuropsychology professionals can design specific and effective intervention strategies. This therapy often thoroughly assesses brain functions associated with mathematical processing, such as number recognition, counting skills, and understanding mathematical patterns. Mathematical work in children arises from core regions known to be associated with number processing, such as the parietal and frontal areas, but also originates from previously unrecognized parts in mental-arithmetic networks, such as the insula, claustrum, and cingulate gyrus (Arsalidou et al., 2018). This importance of observation of brain function allows the preparation of therapeutic programs tailored to individual needs. Neuroscience studies show functional and structural differences in children with dyscalculia compared to typically developing children. Structural and functional differences were particularly evident in the frontal and parietal cortex (McCaskey et al., 2020).

Cognitive therapy and special exercises can help build neural connections that support math skills. In addition, assistive technology, such as specially designed applications or software, can be integral to neuropsychological interventions. This approach focuses not only on overcoming concrete mathematical difficulties experienced by individuals with dyscalculia but also on developing alternative compensatory and teaching strategies that suit their needs. Through a neuropsychological approach, individuals with dyscalculia can get better support to develop their math skills, build confidence in the academic environment, and overcome obstacles that may arise while learning mathematics.

### **Dyslexia Disorder**

Dyslexia is a neurological disorder in reading, spelling, and understanding words and can cause problems in processing written language (Vellutino et al., 2004). Dyslexia is caused by several genetic and environmental risk factors and their interactions (Peterson & Pennington, 2015). Individuals with dyslexia can have difficulty recognizing letters, associating sounds with letter symbols, and understanding word sequences. Although their intelligence may be normal or above average, difficulties in processing phonological information, i.e. the relationship between sounds and letters, can be a major obstacle to reading and spelling skills. Dyslexia is not the result of a lack of intelligence or learning effort, but rather a specific disorder requiring an appropriate pedagogical approach. Interventions for dyslexia often involve specific learning strategies that focus on developing reading and spelling skills, the use of multi-sensory teaching methods, and specific support from education professionals. Early recognition and intervention in dyslexia can help individuals overcome their reading and spelling difficulties, open the door to more positive academic development, and strengthen their confidence in learning.

**Table 3. Results of Interviews with Therapists Treating Children with Dyslexia**

No	Annoyance	Treatment
1	Dyslexia	In the next case is dyslexia. The treatment in this case is to introduce children to basic letters and train them basic reading (B-A = BA, C-A = CA). Treatment is done continuously by adding three, four, and so on. In addition, the method of playing with audiovisual media will help speed up the child's abilities.
2	Dyslexia	In other cases, treatment is done with an emotional approach so that children are comfortable learning. The handling in this case is to accept and realize that there is a problem in the temporal lobe so that the child has obstacles in receiving commands. So that the treatment carried out is to repeat commands or instructions when learning.
3	Dyslexia	In other cases, the treatment is done with handwriting therapy to practice focusing the child. Handwriting therapy carried out by the resource person is also carried out with the aim of coordinating the fine motor skills of the child, allowing the child to control pen pressure and improve the shape of the letters that have been written by the child. In addition, in this case, cognitive behavioral therapy is also done to make the child able to process information, memory and attention to form a child writing well.
4	Dyslexia	In the next case, treatment is done by increasing the child's concentration, labeling items with the name of the object so that the child memorizes letters from objects around him.

Based on the results of interviews conducted, there are interesting findings that treatment in dyslexia is repeated and consistent. Previous research also revealed that one of the ways used in people with dyslexia is to provide repeated learning (Ramus & Ahissar, 2012; Park & Lombardino, 2013). Neuropsychological approaches play a key role in managing and treating dyslexia, a learning disorder that affects the ability to read, spell, and understand words. Through a deep understanding of the neurological basis of dyslexia, neuropsychology professionals can design intervention strategies that are specific and tailored to individual needs. This therapy often involves an assessment of brain functions related to language processing and phonological understanding (Azorín et al., 2018).

This approach allows the preparation of intervention programs involving exercises and activities designed to strengthen the brain connections involved in reading. This therapy may also include the use of multi-sensory learning methods, which integrate the senses of sight, hearing, and physical movement to improve reading comprehension and skills. Technological support, such as computer programs or applications designed specifically for dyslexia, can also be used to facilitate the learning process. In addition, neuropsychological approaches focus on developing compensatory strategies that help individuals overcome reading difficulties. This involves learning certain techniques and the use of tools that facilitate text comprehension. Through this approach, individuals with dyslexia can gain better reading skills, increase their self-confidence, and successfully overcome challenges in an educational environment. By providing focused support on neurological aspects, the neuropsychological approach significantly contributes to helping individuals with dyslexia develop their full potential in reading and spelling skills.

### **Slow Learner Disorder**

Slow learner is a term used to describe individuals who experience delays in understanding and processing information compared to their peers. Another term refers to slow learners as Borderline Intellectual Disability (BID). This is not a medical diagnosis or a mental health disorder, but rather a description of a slower level of cognitive development in an educational context. Slow learner individuals may need extra time or different teaching approaches to understand academic concepts (Van Duijvenbode & VanDerNagel, 2019). Although they usually

have normal or near average intellectual potential, they may face challenges in pursuing the usual classroom curriculum. Special education interventions, additional support from teachers, and teaching methods that focus on their needs can help facilitate understanding and learning. It is important to remember that the term "slow learner" is more descriptive and does not reflect the extent of one's potential. With the right support, individual slow learners can achieve adequate academic achievement and develop their overall potential.

**Table 4. Results of Interviews with Therapists Treating Children with Slow Learner Disorders**

Annoyance	Treatment
Slow Learner	The treatment consists of taking an emotional approach to the child so that the child feels comfortable, then providing motivation. The second is to give the child time to think, until the child cannot answer. If he can't, then the teacher can give clues. The third is repeating the material that has been delivered because these young learners tend to have short memory, so it is easy to forget the material that has previously been taught. So when today we get material about addition, the next day before we are given new material, we must first repeat the material on the previous day, which is addition.

Neuropsychological approaches have an important role in helping manage and care for individuals referred to as "slow learners." By understanding the neurological basis of this slower pace of learning, neuropsychology professionals can design intervention strategies tailored to the specific needs of each individual. Neuropsychological therapy for slow learners often involves a thorough evaluation of brain functions related to information processing and learning. Through a deep understanding of brain structure and function, this approach enables the design of intervention programs that integrate a variety of learning techniques. This could include a more visual approach to teaching, the use of assistive devices, or learning methods that focus on practical experience. Sumiati & Gumiandri (2022) neuroscience-based learning strategies, including movement methods, art therapy, games, and fun learning are effective in generating motivation and learning achievement of slow learner students.

Neuropsychological therapy may also include training in cognitive skills and learning strategies designed to reinforce certain aspects of learning. Previous research proves that neuropsychology can reduce the symptoms of BID (Van Duijvenbode, 2017). In addition, this approach can help identify and handle specific problems that may be obstacles to the speed of learning. By focusing on individual needs, neuropsychological approaches help create learning environments that support the development of academic abilities and life skills required by slow learners. The importance of the neuropsychological approach lies in its ability to integrate an understanding of brain function with effective educational strategies, providing specialized and tailored support to promote individual progress. Through this approach, slow learners can achieve success in learning and reach their full potential in their academic development.

## CONCLUSION AND SUGGESTIONS

Neuropsychology has an important role in analyzing disorders in children and helping to handle them appropriately. Key findings from the study highlight the important role of neuropsychological interventions in designing educational programs tailored to individual needs. Neuropsychological approaches can improve writing skills (dysgraphia), math skills (dyscalculia), reading skills (dyslexia), and speed of learning comprehension (slow learner) in children with special needs. The conclusions of this study make an important contribution to our understanding of how neuropsychological approaches can be tailored to the needs of children with learning difficulties. The practical implication is that the application of these methods in



educational settings can provide more effective support for the academic development of children with special needs. In addition, this article stimulates further consideration in developing individually adaptable intervention strategies, increasing attention to neurocognitive differences in children with special needs.

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