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Neuro-Motor Development Disorder as an Indicator of Learning Difficulties in Primary School Children

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Abstract

This article examines the impact of neuromotor development on the academic performance of primary school children. The role of primitive reflexes and their influence on cognitive functions is considered. During the study, an assessment of the neuromotor maturity level was conducted on 30 children with learning difficulties, including testing of gross motor skills, primitive reflex activity, oculomotor functions, and visual-auditory perception. The obtained results indicate a significant relationship between neuromotor immaturity and academic underachievement. Based on the identified data, a learning program was developed aimed at improving motor and cognitive development in children with learning difficulties.

Keywords: *Neuromotor Development, Primitive Reflexes, Cognitive Functions, Academic Underachievement, Correctional Programs, Assessment, Primary School Children.*

INTRODUCTION

Human neuromotor activity is a process formed as a result of the activation of the central and peripheral nervous systems. It involves the body's systems responsible for movement, which continuously develop as the child grows. These structures function through the musculoskeletal system via numerous signals from internal and external environments.

Neuromotor immaturity is indicated by a mismatch between movement control patterns and age-related characteristics. It is often caused by a group of primitive reflexes that remain active, although they should normally be inhibited after six months. Their state serves as an indicator of the maturity of central nervous system (CNS) functioning. Primitive reflexes are a group of reflexes that develop in utero and should be fully formed by birth (40 weeks). They are the earliest markers of nervous system development available for study. As the CNS matures, these reflexes gradually fade and transform into more advanced movement patterns (Redkina, T. A.; 2020)

Neuromotor immaturity may manifest as a functional delay or a delay in the development of neural pathways. In cases of damage to higher brain centers in early developmental stages or severe pathologies—such as strokes, trauma, or degenerative CNS diseases—primitive reflexes may remain active even at a later age.

Studies show a direct correlation between motor skill immaturity and academic underachievement. For example, delays in the development of gross and fine motor skills during the first year of a child's life can affect cognitive development and behavioral adaptation by the age of five. Currently, almost all parents begin preparing their children for school at the age of 5-6, but this "preparation" primarily focuses on cognitive skills and, to some extent, behavioral adaptation—adjustment to rules and social interaction. However, this is not sufficient, as successful schooling requires many additional skills, which are governed by the body's physiological and neuropsychological structures. (Goddard Blythe, S.; 2020)

Under current approaches to educational and developmental work with children, priority is given to cognitive development. However, the variety of manifestations of neuromotor development delay, combined with the immaturity of emotional-volitional regulation and the underdevelopment of cognitive activity, as well as delays in physical development, necessitate a new method of educational and developmental work with children.

The aim of the study was to examine the impact of neuromotor immaturity on successful school learning, as well as to justify the necessity of timely diagnosis and intervention for neuromotor immaturity to prevent potential learning difficulties in school.

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LITERATURE REVIEW

Prior research has established a connection between motor development and cognitive abilities. Studies by Ayres (2005) and Gallahue and Ozmun (2011) highlight that motor coordination deficits are often linked to learning difficulties. Goddard Blythe (2020) demonstrated that primitive reflexes such as the Asymmetrical Tonic Neck Reflex (ATNR) negatively influence reading and writing skills. Neuromotor immaturity is also associated with deficits in oculomotor control (Kolb and Gibb 2011). Research suggests that early intervention programs focusing on motor and sensory integration improve academic performance and behavioral adaptation in children with learning difficulties (Reed 2019).

METHODOLOGY

Participants

The study involved 30 primary school students (20 girls and 10 boys). All participants selected for the study demonstrated a consistent lag in mastering educational content compared to the expected learning program and educational standards due to neuromotor development impairments.

Procedure

This study is presented as a series of sequential stages

- Initial diagnostics and analysis of the results of comprehensive diagnostics;
- A system of corrective and developmental activities aimed at overcoming learning difficulties using neuropsychological methods (conducted over 8 months, were conducted twice a week, with each session lasting 30 minutes;
- Follow-up/concluding diagnostics.

To diagnose the level of neuromotor immaturity, the following methods were used:

Tests for assessing gross motor coordination and balance

- Tandem walking
- Walking on the outer edges of the feet (Fog test)

Testing the activity of primitive reflexes

- Asymmetrical Tonic Neck Reflex (ATNR): four-point support test (Ayres), standing test (adapted Hoff-Schilder test)

Test for assessing oculomotor function

- Test for visual tracking and control of saccadic eye movements (Valett)

Testing visual-auditory speech perception

- Individual sounds
- Sound combinations
- Syllables
- Synthesis

Tests for visual perception and visual-motor integration (VMI)

- Standard Tensley figures

All tests were evaluated using a **5-point scale**

0 points – no impairments detected

1 point – 25% functional impairment

2 points – 50% functional impairment

3 points – 75% functional impairment

4 points – 100% functional impairment

Intervention Program

The results of the conducted diagnostics formed the basis for structuring the educational process. This program is presented as a sequential set of activities aimed at developing school readiness in primary school children with neuromotor development impairments.

DESCRIPTION OF EXERCISES CONDUCTED

Oculomotor Exercises

Oculomotor exercises enhance cognitive activity and directly influence the learning process of children. Eye and tongue movements improve interhemispheric interaction and increase brain energy. Through the use of three-dimensional space, constantly moving eyes gather essential information and construct complex image patterns necessary for learning. Currently, lessons in educational institutions are mostly lecture-based, leaving the eyes in a static state. Reading books, tables, and writing in notebooks occurs only within a two-dimensional plane. Oculomotor exercises train the eye muscles, activate blood circulation, relieve mental strain, improve eye coordination, and enhance the ability to focus.

Articulation Development Exercises

Articulation exercises stimulate the parts of the brain responsible for controlling higher mental functions—speech, thinking, and behavior. Through these exercises, children gradually develop precise coordination of movements in the articulatory apparatus, and the movements of the tongue and lips become more accurate.

Exercises to Develop Interhemispheric Interaction

These involve performing various cross-body movements. Regular practice contributes to the development of higher mental functions. For example, clenching one hand into a fist while the other remains relaxed (palm pressed to the surface of the table), followed by simultaneous switching of movements. Another example is drawing a figure eight with one hand while drawing a circle with the other.

Breathing Exercises

Breathing exercises improve rhythm and enhance the brain's energy supply, reduce somatic disorders, calm the individual, and relieve stress. These exercises restore overall tone and relieve physical and emotional tension. The ability to voluntarily control breathing develops self-regulation over behavior and emotions. Such exercises are particularly effective for correcting hyperactivity and inattentiveness in children.

Motor Exercises for Stretching and Contracting Body Muscles

These exercises normalize hypertonic and hypotonic muscle states. Any negative changes in optimal muscle tone negatively affect overall development, mental and physical activity. This series of exercises is often a favorite among children in correctional programs. They are widely used in therapeutic physical education practices.

Relaxation

Relaxation is conducted at the beginning of a session to prepare for the activity and at the end to integrate the experience gained. Typically, this involves lying in a relaxed state (preferably on the back, arms and legs open without crossing) under calming music. The instructor provides visual imagery, such as: "Imagine you are lying on a beach, the sun is warm but not hot, the sound of waves soothes you, and there is silence all around—just you and the sea." Sometimes visualization is replaced with body awareness: "Your eyelids grow heavy and close, you take a deep breath, and another. Your arms and legs grow heavier, and you feel your entire body beginning to relax," etc.

Development of Fine Motor Skills

Fine motor exercises stimulate the left hemisphere, particularly the frontal lobe, which is responsible for the development of many complex mental functions and learning skills. Finger movement exercises help compensate for left-hemisphere deficits and activate interhemispheric interaction, contributing to children's stress resistance in school learning.

Development of Productivity and Sustained Attention

Tasks are aimed at developing sustained attention, memory, and thinking skills, including drawing graphic dictations and working with matrices of numbers and symbols.

Spatial Representation Exercises

Drawing with both hands was conducted according to a planned sequence along specified directions:

- **Row 1:** First with the left hand, then with the right hand.
- **Row 2:** First with the right hand, then with the left hand.
- **Row 3:** Both hands simultaneously from left to right.
- **Row 4:** Both hands simultaneously from right to left.
- **Row 5:** Both hands simultaneously moving outward from the center.
- **Row 6:** Both hands simultaneously moving inward toward the center.

The System of Developmental Activities for School Readiness Using Neuropsychological Methods in Extracurricular Activities

Lesson Structure

- ✔ Psychological Preparation
- ✔ Warm-up
- ✔ Main Block (development of cognitive skills, emotional and personal growth)
- ✔ Psychological Relaxation
- ✔ Lesson Reflection (games or activities aimed at developing psychophysical functions and personal qualities)

Required Materials

- ✔ Su-Jok massage balls
- ✔ Red ribbon
- ✔ Developmental games
- ✔ Correction test forms (blanks)

Lessons were conducted with a red ribbon (hair tie or bracelet) on the left hand, which served as a marker for the student to determine their right and left hands. The ribbon was specifically placed on the left hand because in school, the child does everything from left to right—writing, reading, etc.

Oculomotor exercises helped reduce strain, expand visual perception, and indirectly improve speech, attention, and memory.

Key Focus of the Program

The primary focus of the program was on techniques that improve the functionality of the upper limbs. In order for a child to successfully socialize, they need to learn.

One of the most effective aspects of this program was the integration of neurokinesiotherapy techniques with speech therapy.

According to scientific literature, the main trigger for flexion and adduction contractures of the upper limb girdle and the upper limbs themselves is the tension of the pectoralis major muscle. Increased tone of the pectoral muscles and contractures (which inevitably form over time) of the respiratory muscles prevent normal breathing for months and even years.

For years, a child may be unable to take a full breath and exhale. Functional limitations in motor activity hinder oxygenation of the body. In this condition, any speech therapy efforts focusing only on the oral cavity and articulatory muscles, without preparing the respiratory muscles for speech breathing, would be an ineffective use of time and effort.

At the same time, the kinematics of certain exercises performed within closed kinetic chain (CKC) techniques are structured in such a way that they stimulate diaphragmatic movement. Some of these exercises position the attachment points of the respiratory muscles into extreme positions involuntarily (or rather, intentionally—imagine an accordion). As a result, the child is able to take a full breath and exhale. Regular practice of these exercises significantly enhances the effectiveness of speech therapy while also allowing the child to experience the joy of unrestricted breathing.

Thus, neurokinesiotherapy techniques are designed to effectively address critical issues by:

- Creating a biomechanical foundation necessary for the proper functioning of articulatory muscles
- Preparing the respiratory system for speech breathing

The aforementioned techniques and methods have been proven highly effective in overcoming learning difficulties, achieving positive outcomes, increasing stress resilience, improving cognitive function, and synchronizing interhemispheric activity.

The structure of a session and examples of exercises are presented in Table 3.

Table 3

Session 1

Plan	Exercise
1	2
Psychological Preparation	Hello, my dear ones! I am happy to see your faces and smiles, and I believe that today will bring you joy and meaningful interaction with one another. Sit comfortably, close your eyes, listen to me, and repeat after me: “I am at school; I am in class. I am happy to be here. My attention is growing. Like an explorer, I will notice everything. My memory is strong. My mind is clear. I want to learn. I am ready to work. I am working.” Open your eyes. Let’s begin.
Warm-up	Exercise “Magic Eights” Draw an 8 (figure-eight) on the board or a large poster. If practicing with children, show them the drawing. First, practice drawing imaginary eights in the air yourself. Then, invite the children to trace the figure-eight in the air using their hands.
Main Block (Development of Cognitive and Emotional-Personal Skills)	Attention and Voluntary Focus: Copying complex shapes from the board using a grid-based approach. Spatial Orientation: Using the “House” technique to develop spatial awareness. Self-Control Exercise: “One Minute” Sit with eyes closed for one minute, focusing on internal sensations and estimating the passage of time. Creative Exercise: Compose drawings using geometric shapes to enhance perception and fine motor coordination.
Psychological Relaxation	Exercise: “Weather Vane” Stand up straight with your back aligned. Place your hands behind your head. Perform free rotations to the left and right, twisting your spine as much as possible. Variations: A) The head turns in the same direction as the body. B) The head turns in the opposite direction of the body, while the tongue turns in the same direction as the body.

Session 2

Plan	Exercise
1	2
Psychological Preparation	Hello, kids! I'm so happy to see you again! Let's get ready for a wonderful day that will bring us joy and new discoveries. Sit comfortably, close your eyes, and repeat after me: "I am at school, I am ready to learn. My attention is strong. My memory is clear. My mind is full of ideas. I want to learn and become better every day!" Open your eyes. Let's begin! Open your eyes. Let's begin.
Warm-up	Exercise "Sunshine" Imagine you are drawing a big sunshine in the air. Start by extending your arms forward and touching your fingertips together. Slowly begin to draw circular movements in the air with your hands, expanding the "sun rays." Then, add head movements: as your hands move left or right, turn your head in the same direction. Finally, try "drawing" the sunshine with only one hand, then switch to the other.
Main Block (Development of Cognitive and Emotional-Personal Skills)	Attention Development: Exercise "Colorful Dots": Children receive a sheet with dots of various colors. The task is to connect the dots of the same color to create a pattern. Spatial Thinking: Exercise "Maze": Each child gets a simple maze on paper and must navigate through it with a pencil without crossing the lines. Self-Control: Exercise "Deep Breath": Children sit down, place one hand on their stomach and the other on their chest, and practice taking slow breaths, noticing how their stomach rises and falls. Creative Activity: Exercise "Magic Shapes": Using a set of wooden or paper shapes, children create a drawing (e.g., a tree, house, or animal).
Psychological Relaxation	Exercise "Butterfly" Sit comfortably and cross your arms in front of your chest, placing your hands on your shoulders. Close your eyes and gently tap your shoulders alternately – first with your right hand, then with your left. Breathe calmly and imagine a butterfly flapping its wings. Continue the exercise for 1-2 minutes.
Lesson Reflection (*Games or activities aimed at developing psychophysical functions and personal qualities*)	Expressing emotional and cognitive state – Selecting a pictogram that best represents one's emotional and meaningful state at the end of the session. Game-based reflection activities (by choice): "Lotto" "Complete the Proverb" "Readium" Other interactive educational games

All tasks are performed by children with the direct participation of a specialist and in group settings to foster cooperation, create conditions for peer review, and provide necessary assistance.

The exercises conducted included the following areas:

- Oculomotor exercises
- Articulation development exercises
- Interhemispheric interaction exercises
- Breathing exercises
- Motor exercises
- Relaxation techniques
- Fine motor skill development
- Development of productivity and sustained attention
- Spatial representation exercises

The above methods and approaches have been proven highly effective in overcoming learning difficulties and achieving positive educational outcomes. They also enhance stress resilience, improve cognitive functioning, and synchronize hemispheric activity, which serves as a key indicator of task performance effectiveness at or above the average level.

RESULTS

At the first stage, an assessment of gross motor coordination and balance was conducted.

The results of the study are presented in Table 1.

Table 1. Results of Gross Motor Coordination and Balance Assessment

Test	Results				
	0	1	2	3	4
Tandem walking	20%	43%	17%	20%	-
Walking on the outer edges of the feet (Fog test)	17%	47%	23%	13%	-

Let the obtained results be presented in Figure 1.

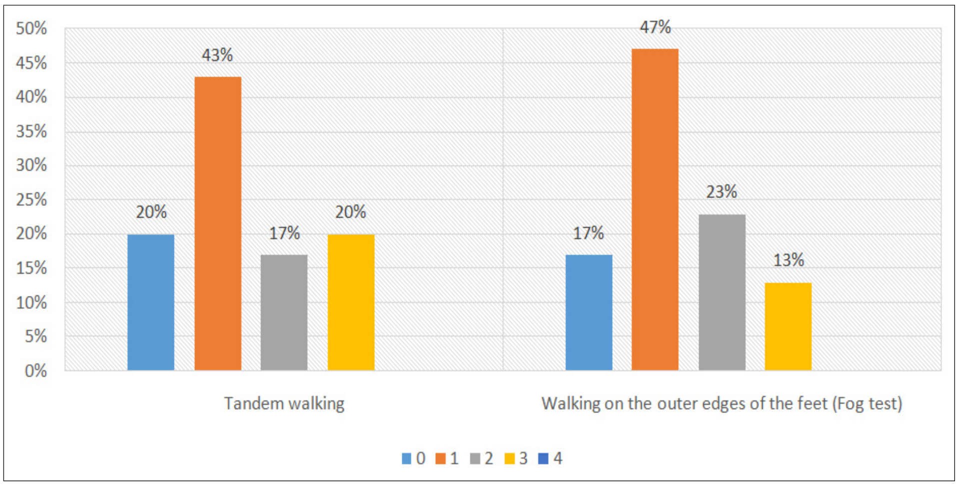

Fig. 1.

The Assessment of Gross Motor Coordination and Balance Showed the following Results

Tandem walking

✔ 20% of children had no detected impairments. They showed minor difficulties with balance and foot positioning.

✔ 43% of children had 25% functional impairment. These children demonstrated slight difficulties, such as visual fixation on a single point and minimal facial activity. They often looked down while performing the task, and minor hand or wrist movements were observed.

✔ 17% of children had 50% functional impairment. More serious difficulties were noted, including the use of a "primary balance posture" and struggles in maintaining balance along the midline.

- ✔ 20% of children had 75% functional impairment. These children exhibited an almost complete loss of balance, with outstretched arms, body swaying, and incorrect foot positioning.
- ✔ No 100% functional impairment was detected.

Walking on the outer edges of the feet (Fog test)

- ✔ 17% of children had no detected impairments.
- ✔ 47% of children had 25% functional impairment, showing slight postural changes while walking on the outer edges of their feet.
- ✔ 23% of children had 50% functional impairment, experiencing greater difficulties in maintaining balance, postural changes, and coordination issues.
- ✔ 13% of children had 75% functional impairment, struggling significantly with walking on the outer edges of their feet, with noticeable postural changes and impaired coordination.
- ✔ No 100% functional impairment was detected.

The results of the study on primitive reflex activity are presented in Table 2.

Table 2. Results of the Study on Primitive Reflex Activity

Test	Results				
	0	1	2	3	4
Four-Point Support Test (Ayres)	10%	23%	30%	30%	7%
Standing Test (Adapted Hoff-Schilder Test)	13%	27%	33%	20%	7%

Let the obtained results be presented in Figure 2.

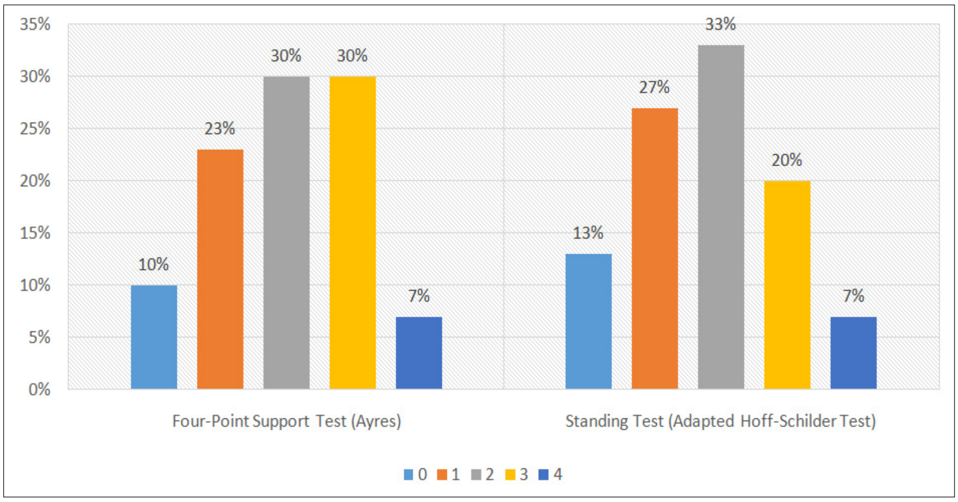

Fig. 2.

Let us examine the results of the study for the Four-Point Support Test (Ayres)

- ✔ 10% of children showed no impairments. No movements of the hand, shoulder, or hip were detected, indicating that the reflex was inactive.
- ✔ 23% of children demonstrated slight flexion of the opposite arm at a 30° angle, indicating that the reflex was active at 25%.
- ✔ 30% of children exhibited more significant flexion of the opposite arm, indicating that the reflex was active at 50%.
- ✔ 30% of children showed pronounced flexion of the opposite arm, as well as movements in the shoulder joint, indicating that the reflex was active at 75%.
- ✔ 7% of children showed a complete collapse of the opposite arm upon turning their head.

Standing Test (Adapted Hoff-Schilder Test)

- ✔ 13% of children showed no impairments.

- ✔ 27% of children made minor movements with their arms in the same direction as their head turns.
- ✔ 33% of children moved their arms and head simultaneously at a 45° angle.
- ✔ 20% of children moved their arms at a 60° angle.
- ✔ 7% of children demonstrated arm movements at a 90° angle and loss of balance as a result of head turns.

To assess oculomotor function, the Visual Tracking and Saccadic Eye Movement Control Test (Valett) was used. The results are presented in Table 3.

Table 3. Results of the Assessment of Oculomotor Function, Visual-Auditory Speech Recognition, Visual Perception, and Visual-Motor Integration (VMI)

Test	Results				
	0	1	2	3	4
Visual Tracking and Saccadic Eye Movement Control Test (Valett)	27%	23%	23%	17%	10%
Visual-Auditory Speech Recognition Testing	20%	50%	17%	10%	10%
Standard Tensley Figures	30%	17%	27%	20%	7%

Let the obtained results be presented in Figure 3.

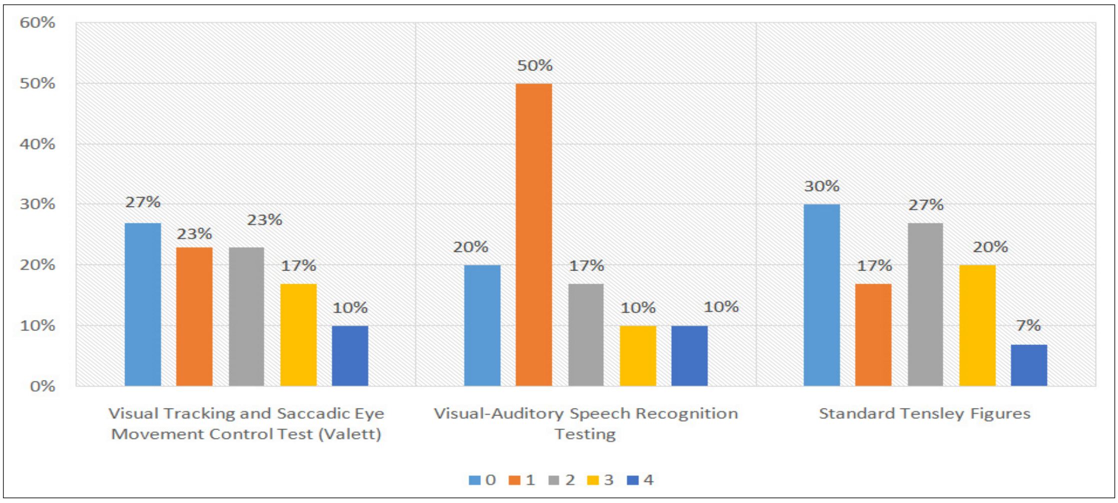

Fig. 3.

Results of the Study on Visual Tracking and Saccadic Eye Movement Control (Valett)

- ✔ 10% of children showed no impairments. They correctly named every second symbol without errors and did not use their finger to follow the text.
- ✔ 23% of children had minor impairments (25%). These children made small errors.
- ✔ 23% of children followed the text with their finger and made errors in naming symbols.
- ✔ 17% of children had a large number of errors in naming symbols, followed the text with their finger, read hesitantly, and lost their place in the text.
- ✔ 10% of children were unable to correctly and sequentially name every second symbol.

Results of Visual-Auditory Speech Recognition Testing

- ✔ 20% of children properly matched letters (25% functional impairment).
- ✔ 50% of children had 25% functional impairment. They made minor errors when matching letters and sounds in lists of consonants and sound combinations.
- ✔ 17% of children (50% functional impairment) correctly matched letters only in the consonant list.
- ✔ 10% of children (75% functional impairment) correctly matched letters and sounds only after repeating the task after the examiner.
- ✔ 10% of children (100% functional impairment) were unable to match letters and sounds, neither when reading symbols from the sheet nor when repeating them aloud.

Standard Tensley Figures

✔ 30% of children (no functional impairment) correctly copied all figures from the sample.

✔ 17% of children (25% functional impairment) struggled to cross the midline with diagonal lines in the British flag figure.

✔ 27% of children (50% functional impairment) made many errors in crossing the midline with horizontal lines in the British flag figure.

✔ 20% of children (75% functional impairment) showed slight distortions in drawing the diamond or inverted square shapes.

✔ 7% of children (100% functional impairment) significantly distorted more than two figures.

Thus, the study of the neuromotor development level of primary school children revealed that most children demonstrate a low level of neuromotor development, which determines their insufficient readiness for school education.

At the conclusion of the formative stage of the study, a control assessment was conducted. To examine the dynamics of neuromotor development, the same battery of diagnostic methods was used as in the initial (baseline) stage of the study.

Table 4. Results of Gross Motor Coordination and Balance Assessment at the Control Stage

Test	Results				
	0	1	2	3	4
Tandem Walking	47%	30%	20%	3%	-
Walking on the Outer Edges of the Feet (Fog Test)	37%	33%	23%	7%	-

Let the obtained results be presented in Figure 4.

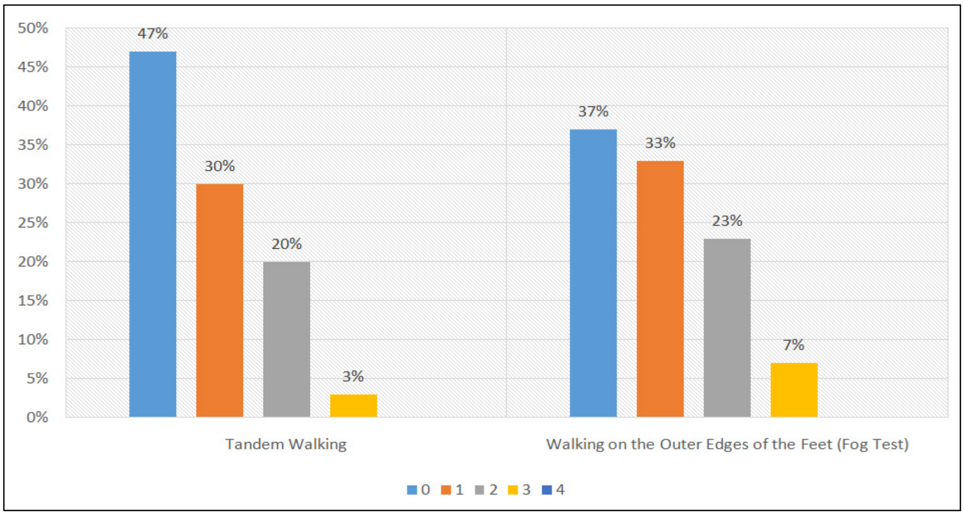

Fig. 4.

Gross Motor Coordination and Balance Assessment Results:

Tandem Walking:

✔ 47% of children showed no impairments. They displayed minor difficulties with balance and foot positioning.

✔ 30% of children demonstrated 25% functional impairments, including slight difficulties such as visual fixation on a single point and minor facial activity. These children often looked down while performing the task and showed small hand or wrist movements.

✔ 20% of children demonstrated 50% functional impairments. These children exhibited more significant difficulties, adopting a “primary balance” posture and experiencing challenges in maintaining balance along the midline.

✔ 3% of children demonstrated 75% functional impairments, marked by near-total loss of balance. They extended their arms, swayed their bodies, and had improper foot positioning.

✔ No children showed 100% functional impairments.

Walking on the Outer Edges of the Feet (Fog Test)

- ✔ 37% of children showed no impairments.
- ✔ 33% of children demonstrated 25% functional impairments, including slight changes in posture when walking on the outer edges of their feet.
- ✔ 23% of children demonstrated 50% functional impairments, experiencing more significant difficulties. These children showed changes in posture and coordination while walking on the outer edges of their feet.
- ✔ 7% of children demonstrated 75% functional impairments, finding it difficult to walk on the outer edges of their feet, with noticeable severe posture changes and impaired movement coordination.
- ✔ No children showed 100% functional impairments.

The results of the study on primitive reflex activity are presented in Table 5.

Table 5. Results of the Study on Primitive Reflex Activity

Test	Results				
	0	1	2	3	4
Four-Point Support Test (Ayres)	40%	23%	30%	7%	-
Standing Test (Adapted Hoff-Schilder Test)	33%	27%	27%	13%	-

Let the obtained results be presented in Figure 5.

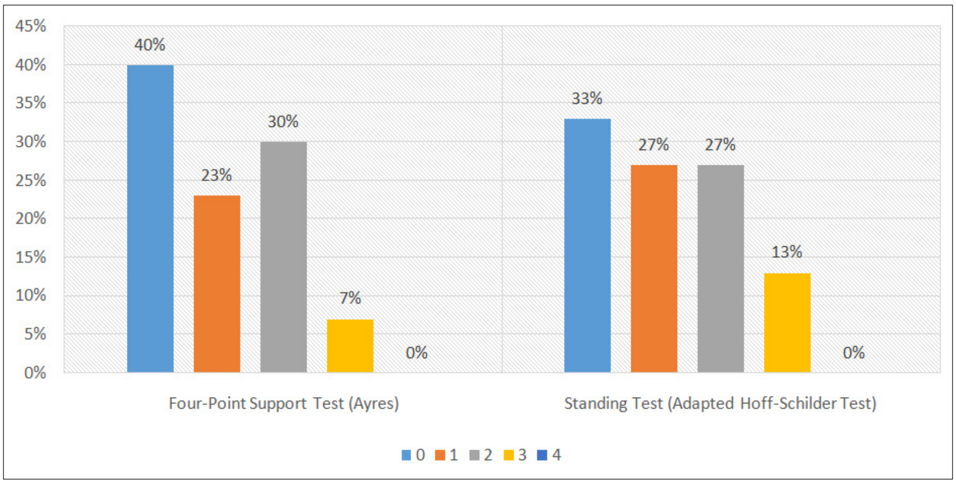

Fig. 5.

Results of the Study on the Four-Point Support Test (Ayres)

- ✔ 40% of children showed no impairments. No movements of the hand, shoulder, or hip were detected, indicating the reflex is inactive.
- ✔ 23% of children displayed slight bending of the opposite hand at 30°, meaning the reflex is active at 25%.
- ✔ 30% of children showed more significant bending of the opposite hand, indicating the reflex is active at 50%.
- ✔ 7% of children exhibited pronounced bending of the opposite hand and shoulder joint movements, meaning the reflex is active at 75%.
- ✔ No children showed 100% functional impairments.

Results of the Standing Test (Adapted Hoff-Schilder Test)

- ✔ 33% of children showed no impairments.
- ✔ 27% of children made slight hand movements in the same direction as their head turn.
- ✔ 27% of children simultaneously moved their hands and head at 45°.
- ✔ 13% of children moved their hands to 60°.
- ✔ No children showed 100% functional impairments.

To assess oculomotor function, the Visual Tracking and Saccadic Eye Movement Control Test (Valett) was used. The results are presented in Table 6.

Table 6. Results of the Assessment of Oculomotor Function, Visual-Auditory Speech Recognition, Visual Perception, and VMI

Test	Results				
	0	1	2	3	4
Visual Tracking and Saccadic Eye Movement Control Test (Valett)	47%	33%	10%	10%	-
Visual-Auditory Speech Recognition	40%	43%	10%	7%	-
Standard Tensley	56%	17%	17%	10%	-

Let the obtained results be presented in Figure 6.

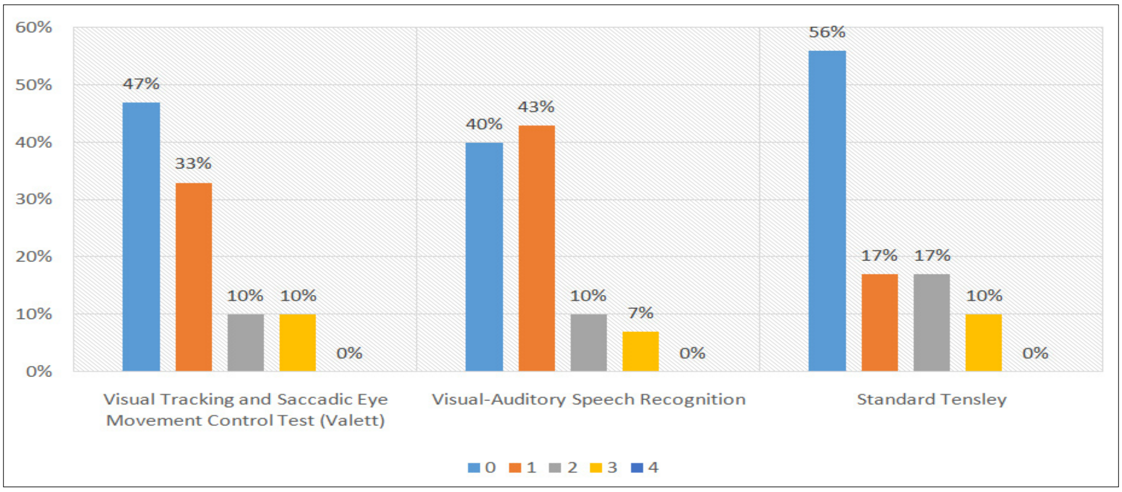

Fig. 6.

Results of the Study on Visual Tracking and Saccadic Eye Movement Control (Valett)

- ✔ 47% of children showed no impairments. They correctly named every second symbol without errors and without using their finger to follow the text.
- ✔ 33% of children displayed 25% impairments, making minor errors.
- ✔ 10% of children followed the text with their finger and made errors when naming symbols.
- ✔ 10% of children had a significant number of errors, used their finger to follow the text, read hesitantly, and lost their place in the text.
- ✔ No children showed 100% functional impairments.

Results of Testing Visual-Auditory Speech Recognition

- ✔ 40% of children correctly matched letters (no impairments).
- ✔ 43% of children displayed 25% impairments, making minor errors when matching letters and sounds in lists of consonants and sound combinations.
- ✔ 10% of children (50% impairments) correctly matched letters only in the consonant list.
- ✔ 7% of children (75% impairments) correctly matched letters and sounds only after repeating them after the tester.
- ✔ No children showed 100% functional impairments.

Results of the Standard Tensley Figures Test

- ✔ 56% of children displayed no impairments, correctly copying all figures from the example.
- ✔ 17% of children (25% impairments) struggled to cross the midline with diagonal lines in the British flag.
- ✔ 17% of children (50% impairments) made many errors when crossing the midline with horizontal lines in the British flag.
- ✔ 10% of children (75% impairments) produced slight distortions when drawing a diamond or inverted square.
- ✔ No children showed 100% functional impairments.

The study of the neuromotor development levels of primary school children at the control stage of the research demonstrated an improvement in their neuromotor development, highlighting the effectiveness of the corrective intervention.

DISCUSSION AND FINDINGS

The results of this study demonstrate a strong relationship between neuromotor immaturity and learning difficulties in primary school children. The data indicate that children with persistent primitive reflexes, poor gross motor coordination, and weak visual-auditory integration are more likely to experience academic underachievement. These findings are consistent with previous research suggesting that neuromotor maturity is a prerequisite for effective learning (Goddard Blythe 2020; Doidge 2015).

Children who scored lower on motor coordination tests, such as the Tandem Walking Test and Fog Test, also exhibited difficulties in maintaining posture, balancing, and orienting themselves in space. These motor challenges can interfere with tasks such as sitting still, focusing on the board, and controlling hand movements during writing activities (Ayres 2005; Gallahue and Ozmun 2011). In addition, the presence of active primitive reflexes suggests a delay in central nervous system maturation. The Four-Point Support Test and Standing Test results indicate that children with strong reflex responses tend to struggle with attention, impulse control, and fine motor tasks, which are essential for reading and writing.

A significant finding of this study is the impact of visual tracking and saccadic eye movement control on academic skills. Children with reduced oculomotor control often experienced difficulties in reading, as they lost their place in a text or had trouble shifting focus between different points on a page. This aligns with previous studies demonstrating that oculomotor function plays a key role in reading fluency and comprehension (Kolb and Gibb 2011; Kuhl 2010). Similarly, deficits in visual-auditory integration hinder phonemic awareness and the ability to recognize letter-sound correspondences, which are fundamental for literacy acquisition.

The intervention program implemented in this study, which focused on improving neuromotor functions through targeted exercises, showed positive outcomes. Over the course of eight months, participating children demonstrated improvements in motor coordination, oculomotor control, and fine motor skills. These improvements translated into better academic engagement, as children found it easier to concentrate, follow classroom instructions, and perform writing tasks. These findings reinforce the growing body of evidence that movement-based interventions can enhance cognitive development and learning outcomes (Reed 2019; Smolyaninov 2011).

Despite these promising results, this study has some limitations. First, the sample size was relatively small, limiting the generalizability of the findings. Future studies should consider larger populations to validate these results. Additionally, while the intervention program showed effectiveness, long-term follow-up is needed to assess whether the benefits persist over time. Lastly, while neuromotor assessments provide valuable insights, further research is needed to explore the underlying neurological mechanisms linking motor development and academic achievement.

Overall, the findings emphasize the importance of early screening for neuromotor immaturity and the integration of movement-based interventions in early education settings. Teachers and specialists should consider incorporating motor coordination activities and sensory integration techniques into classroom practices to support children with learning difficulties. The evidence suggests that a multisensory approach to education, which includes physical movement, visual tracking, and auditory processing exercises, can significantly enhance children's learning potential.

By recognizing the role of neuromotor development in academic success, educators and policymakers can work towards implementing strategies that support children at risk of learning difficulties. Further research should focus on developing standardized neuromotor assessment tools for early identification and exploring the most effective intervention models for different types of learning challenges.

CONCLUSION

This study provides compelling evidence that neuromotor immaturity significantly impacts the learning process in primary school children. The findings confirm that children with persistent primitive reflexes, poor motor coordination, and weak visual-auditory integration are at a higher risk of experiencing academic difficulties. These impairments affect their ability to sit still, focus, track visual information, and perform fine motor tasks such as writing, which are essential for academic success.

The results highlight the necessity of early screening for neuromotor immaturity to identify children at risk of learning challenges before they enter formal education. Traditional educational approaches primarily focus on cognitive development while overlooking the importance of motor function and sensory integration. However, this research supports the integration of movement-based interventions in early education as a means to improve learning outcomes.

By recognizing the profound link between neuromotor development and academic performance, we can create a more inclusive and effective educational system that supports children with learning difficulties. Ensuring that neuromotor interventions become a standard component of early education may help bridge the gap between developmental delays and academic achievement, ultimately leading to better learning experiences and long-term success for all children.

Data Availability Statement

The data supporting this study were not retained due to ethical considerations and the lack of parental consent for data storage. All data were analyzed in an aggregated form and deleted after the completion of the study.

REFERENCES

1. Ayres, A. Jean. 2005. *Sensory Integration and the Child: 25th Anniversary Edition*. Western Psychological Services.
2. Berninger, Virginia W., and Todd L. Richards. 2002. *Brain Literacy for Educators and Psychologists*. Academic Press.
3. Doidge, Norman. 2015. *The Brain's Way of Healing: Remarkable Discoveries and Recoveries from the Frontiers of Neuroplasticity*. Viking.
4. Dorofeeva, S. V. 2017. "Linguistic Aspects of Dyslexia and Dysgraphia Correction: Experience of Successful Application of a Comprehensive Approach." *Questions of Psycholinguistics* 3 (33): 184–211.
5. Gallahue, David L., and John C. Ozmun. 2011. *Understanding Motor Development: Infants, Children, Adolescents, Adults*. 7th ed. McGraw-Hill Education.
6. Goddard Blythe, Sally. 2020. *Assessment of Neuromotor Readiness for Learning: INPP Developmental Screening Test and School Correction Program*. Linka-Press.
7. Kolb, Bryan, and Robbin Gibb. 2011. "Brain Plasticity and Behavior." *Annual Review of Psychology* 62 (1): 235–260.
8. Kuhl, Patricia K. 2010. "Early Language Learning and Literacy: Neuroscience Implications for Education." *Mind, Brain, and Education* 4 (3): 128–142.
9. Luria, Alexander R. 1973. *The Working Brain: An Introduction to Neuropsychology*. Basic Books.
10. Redkina, T. A. 2020. *Neuromotor Readiness of Children for School Learning*.
11. Reed, Paul. 2019. *Developing Sensorimotor Skills in Early Childhood: A Guide for Educators and Therapists*. Routledge.
12. Shonkoff, Jack P., and Deborah A. Phillips, eds. 2000. *From Neurons to Neighborhoods: The Science of Early Childhood Development*. National Academy Press.
13. Smolyaninov, Alexander G. 2011. *Neurokinesiotherapy. Hand-Brain: A Practical Guide*. Press-KIT.
14. Vygotsky, Lev S. 2011. *Pedagogical Psychology*.