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Applying the "Neurospeech Therapy" Approach to the Organization of an Adaptive-Preventive Environment for Children with Early Speech Delay

Eliana Danilavichiutie[1], Olha Arkadieva[1], Olena Doroshenko[2], Olena Nahorna[2], Liudmyla Trofymenko[1]

[1]Department of Speech Therapy, Mykola Yarmachenko Institute of Special Education and Psychology, National Academy of Educational Sciences of Ukraine, Kyiv, Ukraine
[2]Department of Special Education, Faculty of Educational Sciences and Arts, Volodymyr Vynnychenko Central Ukrainian State University, Kropyvnytskyi, Ukraine

ABSTRACT: The purpose of the study was to theoretically substantiate the adaptive-preventive environment of early support for children with speech delay based on the neurospeech therapy approach, neuro-psycho-linguistic-synergetic basis and the International Classification of Functioning, Disability and Health. The study is of a theoretical-analytical nature and is based on the analysis, systematization, comparison and theoretical modeling used to process sources, compare scientific approaches, determine the structural components of support and build the author's model. The results obtained showed that early support for children with delayed speech development should not be built around individual speech manifestations, but taking into account the individual profile of the child's functioning. It was determined that such a profile includes speech, sensory, motor, cognitive, regulatory and communicative characteristics that affect the child's activity in play, everyday life, interaction and educational situations. It was substantiated that an adaptive-preventive environment should combine early intervention, dynamic observation, family-centered support, interdisciplinary interaction, functional description of difficulties and personalized adaptations. It was shown that the neurospeech therapy approach specifies the mechanism of speech difficulties through the interrelation of neurological, psychological, linguistic, synergetic and environmental factors. The psychological component is associated with higher mental functions of various modalities, and the synergetic component is associated with the child's spontaneous adaptations to their own characteristics. The proposed model reflects the sequence of transition from the individual profile of the child to the selection of speech, sensory, visual, spatial, regime and communicative adaptations. Thus, the obtained data confirm the feasibility of using a neurospeech therapy approach for personalized design of the early support environment. The practical significance of the results lies in the possibility of their use by speech therapists, special educators, psychologists, educators of inclusive groups and support teams in preschool educational institutions for planning personalized early support for children with delayed speech development.

1. INTRODUCTION

The early childhood period (from birth to three years) is a special stage in a child's development. It is at this time that speech, communication, sensorimotor skills and other developmental indicators are formed. It is worth noting that a child's speech development depends on many factors – from biological and mental to social and environmental conditions (World Health

Organization, 2020). Delayed speech development is the result of the interaction of biological, psychological, social and environmental factors (Feng et al., 2022). Therefore, to reduce the manifestations of speech difficulties, an environment should be created for the child in which they will not experience additional obstacles in interacting with other children or adults (Lipkin et al., 2020).

Early support for children with these difficulties is increasingly being provided. One of its components is the interaction of individual specialists: speech therapists, psychologists, educators, doctors and families. This contributes to a more coordinated performance of tasks, supporting children in understanding the significance of communication and establishing relationships with other children and adults (Vermeij et al., 2023). According to the analysis, the combination of early identification of difficulties and speech therapy support causes positive changes in children's speech manifestations. However, they depend on the individual characteristics of the child's development (Heidlage et al., 2020; Fan et al., 2024; Hsieh et al., 2023). It is known that other areas of support for speech development are the interaction of children with adults in everyday situations (Gonzales et al., 2022). The use of the environmental development model provides grounds for a deeper consideration of the influence of the environment on the development of children's speech. The environment can facilitate the manifestation of difficulties or create additional obstacles for the child.

It is advisable to use not only symptoms but also functional signs of development to describe children's difficulties. To make this possible, the International Classification of Functioning, Disability and Health (ICF) should be used. This tool provides grounds for considering children's difficulties in relation to their activity, participation in activities and environmental conditions (World Health Organization, 2020). With the help of such a description, it is possible not only to identify children's difficulties, but also to understand how the environment itself helps them to perform activities or creates obstacles in their interaction with other children or adults. Depending on this, goals can be set for speech therapists to take into account not only the speech aspect of children, but also their participation in social relationships (Kwok et al., 2023; Singer et al., 2023; Cunningham et al., 2021).

Neurospeech therapy involves the analysis of the child's higher mental functions of various modalities: auditory, visual, motor, spatial, regulatory and memory. The synergetic aspect reveals the child's individual ways of self-organization, which are manifested in their speech characteristics. They indicate that the child's difficulties are individual in nature, which requires personalized support for their development. Neurospeech therapy indicates that the methodological basis for organizing an educational environment for children with special speech needs is the study of the neuro-psycho-linguistic-synergetic basis of the child's development (Danilavichiutie, 2024a). The selection of adaptations in the educational environment is associated with the individual psychophysical characteristics of the child and the idea of an inclusive educational process (Danilavichiutie, 2020), as well as with the creation of a barrier-free educational environment (Danilavichiutie, 2024b).

Although there is scientific research on the implementation of family-centered support, the use of the ICF and the organization of an inclusive educational environment, the issue of applying a neurospeech therapy approach to the organization of an educational environment for children with special speech needs is still insufficiently studied. It is necessary to establish how speech manifestations at an early age can be considered, taking into account the sensory, motor, cognitive, regulatory and communicative characteristics of the child. It is important to study the possibility of integrating the ICF into the description of the child's difficulties in terms of their functioning, activity, participation and environmental factors. Therefore, the implementation of such an approach in the design of an educational environment for children with special speech needs should be justified. Such an approach can help to identify changes that occur in children if the barriers to the formation of speech and communication skills are reduced. The aim of the study was to theoretically substantiate the neurospeech therapy approach to organizing an adaptive-preventive environment for early childhood children with delayed speech development based on the neuro-psycho-linguistic-synergetic basis and the International Classification of Functioning, Disability and Health. To achieve the specified goal, the following tasks were set: to analyze international and national experience in the field of early support for children with delayed speech development; to reveal the neurospeech therapy interpretation of speech difficulties; to determine the possibilities of using the ICF to describe the functioning of children with delayed speech development; to develop a model of the environment for early childhood children with such difficulties.

2. LITERATURE REVIEW

The problem of supporting young children with delayed speech development is studied in the scientific literature from various perspectives. Thus, the World Health Organization in its recommendations on child health notes that the early development of a child is associated with the balance of health, care, safety, learning and relationships (World Health Organization, 2020). Consideration of speech delay also applies to neuroscience. The study of the neuroplasticity of children's speech, sensitive periods of development and the influence of early experience on subsequent development gives grounds to consider the influence of environmental factors and the environment on speech development (Nelson et al., 2024).

A separate area of study in the scientific literature is the identification of speech difficulties in children and the analysis of the causes of these difficulties. The advantages and possibilities of early identification of such difficulties are also investigated. Scientists Lipkin et al. (2020) examined in detail the advantages of screening for speech difficulties in children, since early detection creates the conditions for the timely implementation of support measures. Speech delay is also studied in the context of child neurology, since the influence of other information about the child's development on speech difficulties is taken into account (Durgut & Tekin, 2024). The identification of individual characteristics of children and their impact on the effectiveness of interventions is considered in the work of Vermeij et al. (2023). The authors showed that the outcome of support depends on the individual developmental profile of the child.

One area of study is family support. Research on the effectiveness of speech interventions that involve parents shows that such interventions can influence the child's achievement of positive outcomes (Heidlage et al., 2020). Analysis of the effectiveness of speech interventions that therapists provide to children with speech delays shows that such interventions can be more effective if they are family-focused and transferred to the everyday family space (Heidlage et al., 2020; Hsieh et al., 2023). After all, it is in the family space that a child learns to understand speech signals, learn new things, talk, and interact with other people (McCarthy & Guerin, 2022).

The structuring of the essential prerequisites of speech activity is considered in scientific studies that study speech in connection with the nervous system, its regulation, perception and rhythm. Neural correlates and direct influence on the development of speech activity in children at an early age, especially with a high probability of autism spectrum disorders, are factors that establish the importance of neurobiological elements in the development of speech skills (Morrel et al., 2023). The connection of speech activity with the cognitive potential of children with neurodevelopmental disorders is also established, which emphasizes the need to study both speech and non-speech indicators (Peristeri et al., 2024). In studies of speech activity rhythms, its dependence on sequence, motor planning, auditory activity and attention is also studied (Lense et al., 2021; Ladányi et al., 2020).

The psycholinguistic approach to the study of speech activity in children with speech delay gives grounds to consider it not as the number of words used, but as the acquisition, production, understanding and disruption of speech development processes (Alduais et al., 2022). Within the framework of this topic, not only vocabulary and grammatical indicators can be studied, but also other parameters, in particular communicative intention, processing of linguistic information and understanding of addressed speech (McGregor, 2020). Analysis of studies devoted to children with developmental speech disorders indicates that such children have difficulties with recognition, which is one of the assessment factors in educational systems (McGregor, 2020; McGregor et al., 2023). The study of these children requires not only an analysis of their difficulties, but also the determination of their abilities, which corresponds to the logic of personalized support.

The possibility of using the ICF in speech therapy is due to the fact that a connection is established between speech difficulties and the characteristics of children's functioning (Borges et al., 2020). The study by Kwok et al. (2023) analyzed speech therapy support for preschool children using the ICF, where it was indicated that it is necessary to take into account indicators such as children's functioning, their activity and participation in everyday situations. Goals in speech therapy require the study of not only speech difficulties, but also children's activity. The activity of children with speech disorders depends not only on their own speech abilities, but also on the demands of the situation (Singer et al., 2023). Changes in children's activity are the result not only of speech development, but also of their ability to participate in play, interaction with other children and everyday situations (Cunningham et al., 2021).

The concept of an inclusive educational environment in recent studies is associated with the need to create conditions for active communication of children in this environment. The development of communication skills in young children in an inclusive

educational space depends on their interaction with other children in the conditions of a preschool educational institution (Turko et al., 2022). Strategies for inclusive preschool education for children with communication difficulties include adaptation of the learning environment, the use of flexible teaching methods, and cooperation of educators from different areas within the group (Yadav & Huddar, 2025). The presence of such an environment can contribute to the development of speech and communication skills of preschoolers, provided that it is purposefully organized in institutions for children with communication difficulties (Brodin & Renblad, 2020). These provisions can be considered through the analysis of speech therapy practices for working with young children with speech delays in inclusive preschool groups (Fitri et al., 2025).

The Ukrainian concept of neurospeech therapy allows combining international models and ideas of early intervention with a domestic theoretical explanation of speech difficulties. Within the framework of the idea of using the ICF in the modern inclusive educational process, which was substantiated by Danilavichiutie (2020), it is possible to describe each need of the child. The neuro-psycho-linguistic-synergetic model creates the basis for understanding the essence of the very concept of "neurospeech therapy" (Danilavichiutie, 2024a). The psychological component of the model covers the higher mental functions of the child of various modalities, and the synergetic component covers the child's own ways of self-formation and self-organization. The idea of creating a personalized environment for children with speech difficulties was proposed in works that focused on creating a barrier-free environment for children within the ICF (Danilavichiutie, 2024b). The possibility of using multisensory strategies for children with speech difficulties has also been established (Danilavichiutie, 2026).

Research also focuses on digital and assistive tools in the study of children with speech difficulties. Artificial intelligence as a tool can create personalized aids for children with neurodevelopmental disorders, but their use is considered auxiliary (Barua et al., 2022). Applications for digital study of psycholinguistic development of preschool children with speech disorders are tools for empowering children, but only in cases where they correspond to the needs and environment of the child (Utepbayeva et al., 2024). In environments that pay attention to neurodiversity-affirming type of support for children's speech, it is very important to use methods that do not stigmatize the child, but support their individual way of communication (Gaddy & Crow, 2023). Research focused on these topics confirms the general direction of development of neurospeech therapy analysis taking into account digital and assistive tools. At the same time, they do not replace specialized studies of speech difficulties.

The analysis of the research has shown that this issue is in the field of scientific attention, but the possibility of using the neurospeech therapy approach to create an adaptive-preventive environment for children with speech difficulties has not been sufficiently highlighted. It is worth investigating how the mental, linguistic, neurological and synergetic components of the neurospeech therapy approach can be combined, as well as how children's speech difficulties can be studied within the ICF in terms of the possibilities of personalizing the environment for their adaptation. Such questions justify the need to create a model of an adaptive-preventive environment for young children with delayed speech development based on the neurospeech therapy approach.

3. AIMS

The aim of the study was to provide a theoretical basis for a neurospeech therapy approach to creating an environment for young children with delayed speech development. To achieve this goal, difficulties in children's speech development were considered not as separately studied manifestations, but as manifestations of the child's individual development profile. Various research methods made it possible to link speech development with the perception of neurological, psychological, linguistic, synergetic and environmental factors.

The intermediate results of the study were attempts to study and summarize information about international and Ukrainian approaches to supporting children with delayed speech development, as well as about the content of the neurospeech foundation and the possibilities of its reflection through the ICF. In particular, an analysis of environmental adaptations was carried out, which take into account not only the identified strengths and vulnerabilities of children's development according to their profile, but also their spontaneous ways of adapting to their own peculiarities of speech development. The final result of the study was the construction of a model of the environment for early childhood children aimed at supporting their development.

4. MATERIALS AND METHODS

The study is theoretical and analytical and is aimed at studying issues related to determining the methodological principles of supporting young children with speech difficulties in an inclusive educational environment. The work pays attention to works

that studied the problems of early intervention, speech development delays, speech development mechanisms, psycholinguistic analysis, family support, inclusive educational environment, ICF and neurospeech therapy. The main method of study is the analysis of scientific texts without collecting primary data.

The search for sources was carried out in the bibliographic databases PubMed, Scopus, Web of Science and ERIC, as well as on the electronic scientific platforms ScienceDirect, SpringerLink and Wiley Online Library. Additionally, Google Scholar and ResearchGate were used to expand the search, refine bibliographic data and access full texts. The search was conducted in English and Ukrainian, since the study involved comparing international and Ukrainian experience in early support for children with speech delay. The following key queries were used to search for English-language sources: «early language delay», «speech and language delay in toddlers», «early intervention for language delay», «family-centered language intervention», «parent-implemented language intervention», «developmental language disorder», «communication disorders in inclusive preschool education», «ICF and speech-language pathology», «communicative participation in preschool children», «neurodevelopmental mechanisms of language delay», «psycholinguistic development in preschool children», «adaptive educational environment for children with speech delay», «personalized support for children with communication disorders». To narrow and combine results, logical operators AND and OR were used, in particular: «language delay» AND «early intervention», «speech delay» AND «preschool» AND «inclusive education», «ICF» AND «speech-language pathology», «developmental language disorder» AND «communicative participation», «family-centered intervention» AND «language delay», «neurodevelopmental disorders» AND «language development». The Ukrainian-language search was carried out using the following queries: «speech delay», «early support for children with speech difficulties», «speech therapy», «inclusive educational environment», «International Classification of Functioning», «barrier-free educational environment», «children with special speech needs».

The selection of sources was carried out according to the following criteria: relevance to the topic of the work, scientific relevance, relevance and theoretical relevance. The analysis included scientific articles, systematic reviews, meta-analyses, clinical recommendations, scientific works and scientific and methodological materials containing information on early speech development, its disorders, interventions, family support, neurodevelopmental and psycholinguistic aspects of speech, inclusive educational environment, ICF approach and neurospeech therapy approach. Sources that were not related to early age, speech development, educational environment or functional description of the child's difficulties were excluded. As a result of the selection, 39 scientific and scientific and methodological sources published between 2020 and May 2026 were included in the final analysis.

The theoretical basis of the study was selected from the position of the neuro-psycho-linguistic-synergetic basis of speech therapy support. The ideas of early intervention, family support, functional approaches in education according to the ICF and inclusive environment were used. The components of the neurological basis of speech therapy support were selected as a basis for explaining speech difficulties and their connection with the maturation of the child's nervous system. The components of the psychological basis were used to explain difficulties associated with higher mental functions of a person. The components of the linguistic basis were selected with a view to studying speech manifestations, the ability to understand addressed speech and its use. The components of the synergetic basis were used to study the child's individual ways of self-organization.

A set of general scientific and special methods was used in the research process. Analysis of scientific literature was applied to identify the main areas of study of the problem; synthesis - to combine the provisions of early intervention, neurospeech therapy, ICF and inclusive education; comparison - to compare international and Ukrainian approaches to supporting children with delayed speech development; generalization - to formulate common provisions on the organization of an adaptive environment; systematization - to group sources by thematic areas; classification - to isolate the neurological, psychological, linguistic, synergetic and environmental components of the analysis; interpretation - to explain the content of scientific provisions in the context of early age; abstraction - to separate theoretically significant characteristics of support from individual clinical or pedagogical cases; concretization - to transfer general provisions to the problem of an adaptive-preventive environment; logical-semantic analysis – to clarify the meaning of the concepts of «speech delay», «neurospeech therapy approach», «adaptive-preventive environment» and «personalized development support»; modeling – to build a theoretical model of the environment; critical analysis – to identify insufficiently developed aspects in previous studies.

Two methodological procedures were used specifically for this study. The first procedure used in the study was a special type of neurospeech analysis that separates information about the linguistic, neurological, psychological and synergetic properties of children's difficulties. This procedure allowed us to take into account all the properties of the child that affect their ability to

communicate. The second methodological procedure used in the study was functional mapping in the ICF interpretation. This procedure provided a combination of the child's difficulties with the concepts of functioning, activity, participation and environmental factors. Using ICF-oriented mapping, it was determined which factors affect the child's ability to interact in different situations.

5. RESULTS

5.1 Generalization of the logic of early support for children with delayed speech development

Considering the complex mechanisms of support for children with delayed speech development, it can be distinguished as a holistic system that includes such elements as the identification of difficulties, cooperation with the family, interdisciplinary interaction, experience of the natural developmental environment and description of the requirements for the child. This approach is also known in other scientific areas relevant to child development, in particular regarding health, care, safety and social relationships, defined by the World Health Organization (2020). Identification of difficulties at an early age is one of the main elements that determines the possibility of timely intervention aimed at preventing the emergence of secondary limitations (Lipkin et al., 2020). Support programs should include not only the study of the child's speech manifestations, but also the implementation of various initiatives that will facilitate interaction with them.

A summary of the sources shows that one of the main ideas of early intervention – is the support of the individual trajectory of the child's development. The dynamics of the development of children's speech abilities within the framework of specific interventions depends on the individual trajectory of the child's development (Vermeij et al., 2023). The idea of individual abilities is associated with the early period of development, when the organism is sensitive to changes in the environment (Nelson et al., 2024). Thus, the means of the environment are selected in such a way as to provide support for the development of the child's speech abilities.

A requirement for support is the presence of language experience in the family. Language interventions with the participation of parents have an impact on children's language skills when they are used daily (Heidlage et al., 2020). Impact on the family requires their inclusion in the intervention and an understanding of their potential for the child's development (McCarthy & Guerin, 2022). This factor is defined as a constant component of the environment that the child perceives as a space for language experience.

Environmental organization of support shifts the focus from influencing individual skills to creating conditions for everyday interaction experiences. Studies that focus on family influences on the development of language skills have found that the effectiveness of assistance is achieved as a result of its inclusion in the child's natural developmental situations (Fan et al., 2024). This approach has also been identified for children aged 18 to 36 months (Hsieh et al., 2023). The environment is interpreted as a set of factors that contribute to the child's interaction: organizational, speech, sensory, visual and communicative.

Functional description of difficulties requires studying the child's actions, interactions, and participation in group and routine situations. Using the ICF allows not only to describe children's difficulties, but also to understand how they act. Analysis of goals for preschool children created using the ICF indicates that they should relate to the child's actions, and not just speech manifestations (Kwok et al., 2023). The participation of children with speech disorders depends on a significant number of environmental factors (accessibility of communication, adult support, organization of group interaction, demands of the situation, and opportunities to participate in everyday activities), which determine the possible outcome of support (Singer et al., 2023; Cunningham et al., 2021).

To create effective support for children, it is necessary to coordinate the actions of specialists who develop adaptations in accordance with the individual difficulties of the child. When studying inclusive education in preschool institutions, it was found that the development of children's communicative competence occurs through flexible pedagogical methods, adaptation of the educational environment and support for children with speech difficulties (Turko et al., 2022; Yadav & Huddar, 2025). Research on speech therapy practices in inclusive preschool institutions indicates techniques, difficulties and support systems that facilitate the interaction of children with adults in the educational process (Fitri et al., 2025). Thus, adaptations that are created for individual children are a combination of early intervention, family actions, interaction between specialists and a description of the difficulties that the child has.

According to international experience, support and study of children with speech delay are focused on early intervention, family actions, studying children's activity, their participation in groups or educational situations (World Health Organization, 2020; Heidlage et al., 2020; McCarthy & Guerin, 2022; Kwok et al., 2023). Ukrainian experience in the context of neurospeech therapy focuses on the internal mechanism of the emergence of difficulties, the study of higher mental functions of children and their spontaneous ways of adapting to their characteristics (Danilavichiutie, 2020; Danilavichiutie, 2024a). Thus, international experience involves a functional, family and environmental consideration of the difficulties of children with speech delay, and the Ukrainian neurospeech therapy approach focuses on studying the internal mechanism of these difficulties. The main areas of early support for children with speech delay and their importance for the adaptive-preventive environment are presented in Table 1.

Table 1. Generalized areas of early support for children with delayed speech development

Direction of support	Content	Importance for an adaptive-preventive environment
Early intervention	Early identification of speech difficulties and planning of support during the development of functions	Helps prevent secondary difficulties and support speech, communication, regulation and participation
Dynamic observation	Tracking changes in the child's speech, activity, communication, behavioral regulation, and interaction	Supports timely clarification of the child's needs and updating of environmental adaptations
Interdisciplinary interaction	Coordination of speech therapy, psychological, pedagogical, medical and family components of support	Forms a holistic vision of the child's individual functioning profile
Family-centered support	Engaging parents in using supportive strategies in daily life, play, care, and communication	Transfers support to the natural environment and ensures repeatability of the communicative experience
Environmental organization	Selection of speech, sensory, visual, spatial and regime supports	Reduces communication barriers and creates conditions for initiative, imitation and participation
Functional description of difficulties	Analysis of speech manifestations through functioning, activity, participation and environmental factors	Focuses support on identifying challenges, facilitators, barriers, and possible adaptations
Personalized adaptations	Selection of supports according to the child's strengths and vulnerabilities, communication styles, and needs	Ensures that the environment matches the individual functioning profile
Prevention of secondary difficulties	Preventing a decline in communicative initiative, avoidance of interaction, and entrenching a passive position	Supports the child's activity and gradual expansion of their participation in educational and everyday situations

Source: Created by the authors based on sources (World Health Organization, 2020; Lipkin et al., 2020; Heidlage et al., 2020; McCarthy & Guerin, 2022; Danilavichiutie, 2020; Danilavichiutie, 2024a; Kwok et al., 2023; Yadav & Huddar, 2025)

Therefore, supporting children with speech delay within the framework of the above study includes various stages – from diagnosing the problem to trying to solve it. This approach is consistent with the scientific consideration of children's speech development. At the same time, the addition of the Ukrainian approach provides grounds to study individual problems and ways to solve them in each child.

5.2 Neurospeech therapy interpretation of a child's speech delay

Speech delay should be considered as a generalized individual profile that combines neurological, psychological, linguistic, synergetic and environmental factors. According to the Ukrainian concept of neurospeech therapy, individuals with special speech needs should not be considered in isolation through individual speech components, but holistically, based on a neuro-psycho-linguistic-synergetic basis (Danilavichiutie, 2024a). Thus, it is necessary to study not only the manifestations of speech difficulties, but also the child's ability to assimilate information, regulate their behavior, interact with others and use certain means to achieve their goal.

The neurological dimension is related to the consideration of speech difficulties in the context of the maturation of the nervous system, sensorimotor organization, regulation, perception, rhythms and temporal coordination. Research in child neurology has established that speech delay can be associated with the characteristics of the child's nervous system and organization (Durgut & Tekin, 2024). Analysis of rhythm, timing, cognitive performance of children and their neurodevelopmental mechanisms shows that speech difficulties are related to motor skills, regulation and perception (Lense et al., 2021; Ladányi et al., 2020; Peristeri et al., 2024). Therefore, in an adaptive-preventive environment, neurological analysis can be the basis for choosing the pace of interaction, the method of transmitting information, the use of sensory supports or the mode.

The psychological dimension is not limited to the emotional or volitional sphere, but is associated with the study of higher mental functions related to hearing, vision, movement, space, regulation or memory. Each of these elements can act as a strong or vulnerable side of the child's mental development. Psychological analysis is based on scientific studies that have established the relationship between speech, regulation, cognitive performance and neurodevelopmental characteristics (Mulvihill et al., 2020; Peristeri et al., 2024). Studies of children with developmental language disorders have shown that it is necessary to study not only cases of limited opportunities, but also the existing opportunities of children (McGregor et al., 2023). Therefore, psychological analysis is used to select adaptations that take into account the demands on children and are considered as possible ways of interaction.

The linguistic dimension encompasses the features of speech expression, speech comprehension, the presence of a communicative goal, ways of forming speech utterances, and children's use of verbal and nonverbal modes of interaction. Psycholinguistic studies of children's speech development include the study of the processes of assimilation, comprehension, formation, and decay of speech activity (Alduais et al., 2022). Within developmental psychology and psycholinguistics, speech is considered in connection with cognitive and communicative processes (Nurjanah et al., 2024). Difficulties in speech development in children are associated with the ability to understand speech, its use in communication, and involvement in communicative interaction, which children can carry out in various ways.

The synergetic dimension encompasses the child's ways of self-regulation and adaptation to their own speech and communication characteristics. From the point of view of neurospeech therapy, this dimension is related to the fact that the same speech manifestations can have different causes, compensatory processes, and needs in speech development (Danilavichiutie, 2024a). Children's spontaneous adaptation to difficulties is individual in nature. The ways of adaptation can differ significantly in different children: some avoid speech activity, others carry it out with gestures, echolalia responses, body movements, or actions with objects. Such forms of self-regulation and adaptation should not be eliminated, but should be studied to understand the child's ability to self-regulate and expand their communicative activity.

The environmental dimension includes an assessment of the child's neurological, psychological, linguistic and synergetic state in the conditions that are everyday for them. In works devoted to the use of the ICF to create a barrier-free educational environment, the study of the child's difficulties is carried out not only through their condition and functions, but also through their activity, participation, barriers and facilitators of the environment (Danilavichiutie, 2020; Danilavichiutie, 2024b). Defining the requirements for speech therapy goals through the ICF system indicates the need to study the child's participation in individual situations (Kwok et al., 2023). In the context of neurospeech therapy, this means that when choosing adaptation methods, attention should be paid not only to actions that the child cannot yet perform, but also to the child's ability to participate in contact, imitation, understanding instructions, choosing a way to communicate information and inclusion in joint activities. The generalization of these provisions allowed us to identify the components of neurospeech analysis, their content and significance for a young child with delayed speech development (Table 2).

Table 2. Components of neurospeech therapy analysis of speech delay

Component	Analysis content	Value for personalized support
Neurological	Maturation of the nervous system, sensorimotor organization, regulation, perceptual processing, rhythm, timing, and motor planning	Guides the selection of the pace of interaction, sensory supports, regime structures, and methods of presenting information according to the child's neurodevelopmental profile
Psychological	Higher mental functions of different modalities: auditory, visual, motor, spatial, regulatory, memory; strengths and vulnerabilities of development	Supports the creation of adaptations that build on the child's preserved capabilities and take into account attention, imitation, orientation in the situation, and self-regulation
Linguistic	Understanding of addressed speech, communicative intention, vocabulary, grammatical means, production of utterances, verbal and non-verbal ways of interaction	Guides the selection of available means of communication and the gradual expansion of the child's speech participation
Synergetic	Individual ways of self-organization and spontaneous adaptation of the child to their own speech, cognitive, sensory and communicative characteristics	Focuses support on the individual mechanism of difficulties and the selection of strategies according to the child's way of functioning
Environmental	Conditions of daily interaction, barriers, facilitators, situational demands, availability of communicative, sensory, visual and organizational supports	Links the child's analysis with adaptation of the educational environment, family involvement, and interdisciplinary support

Source: created by the authors based on sources (Danilavichiutie, 2024a; Danilavichiutie, 2024b; Alduais et al., 2022; Durgut & Tekin, 2024; McGregor et al., 2023; Kwok et al., 2023)

The summary presented in Table 2 shows that the neurospeech therapy interpretation of speech development difficulties provides a transition from the description of individual manifestations to the analysis of the individual profile of the child. In such an analysis, speech difficulties are considered in connection with the nervous organization and higher mental functions, linguistic processes, adaptations and environmental factors. The proposed adaptations are determined in accordance with the child's profile.

5.3 ICF-oriented mapping of the child's functioning and participation

Within the ICF, the description of the difficulties of a child with a language disorder encompasses the relationship between the child's functioning, their activity, participation and environmental factors. In contrast to describing only language difficulties, the ICF approach allows us to consider how language difficulties affect the child's activity or participation in different situations (Borges et al., 2020). For preschool children, it has also been determined that goals should go beyond language development and encompass the child's activity and participation (Kwok et al., 2023). In this way, the ICF approach provides a transition from describing language development to understanding the conditions in which the child performs actions and participates in everyday life.

The child's functioning within the framework of mapping, carried out in accordance with the requirements of the ICF model, is studied not only in speech aspects, but also through perception, attention, memory, motor planning, behavioral manifestations of the child, as well as the ability to perceive speech and respond to it in different situations (Danilavichiutie, 2024a). Failure to follow simple instructions does not always mean a lack of ability to understand speech. Failure to follow simple instructions or requests may be the result of unstable attention, difficulties in regulation, the inability to perform certain motor actions, as well as the result of a mismatch between the pace of fulfilling the requirements for the child and the capabilities that they have.

The ability of children to perform certain actions is one of the aspects of their study within the ICF model. Activity is the ability to perform actions related to communication, play, everyday life or education (Singer et al., 2023). Identification of the activity of children under study requires the study of play actions, perception, participation in games, following simple instructions, responding to adult appeals and participation in group activities. The study of the activity of children with speech disorders requires an analysis of the correspondence of their actions to certain situations and conditions of the environment in which they are located, since difficulties in performing certain actions may result from the inability to react in a specific situation (Singer et al., 2023). Such difficulties may relate to communicative actions, answering questions or performing appropriate actions within everyday life. The child's activity should be considered in connection with environmental conditions.

The concept of child participation in ICF-oriented mapping describes the inclusion of the child in interactions with adults and other children, play, regime moments, group activities and educational activities. Assessing the communicative participation of preschool children involves studying not only the child's communicative skills, but also the use of available communicative resources in natural interaction situations (Cunningham et al., 2021). A child may be physically present in a group of children, but demonstrate passive behavior that does not involve initiating interaction or using communicative signals. Children's participation in the study is used to assess whether the environment matches the child's individual functioning profile. Environmental adaptations should meet their needs and facilitate involvement in group, everyday, communicative and educational activities.

Other factors considered environmental in the proposed model are conditions that can affect the child and separate them from other children or from participation in the processes taking place around them. In studies devoted to the use of ICF and the creation of a barrier-free educational environment, environmental factors are considered as conditions that can facilitate or limit the child's participation in relevant activities (Danilavichiutie, 2020; Danilavichiutie, 2024b). In such situations, barriers are considered, for example, excessively fast speech of an adult, multi-component instructions, lack of choice of actions, lack of possibility of recovery of the performed action, lack of consistency between the actions of adults and children. When studying early care for children with special educational needs in the context of inclusive education, ICF environmental factors are used to determine the needs of the child (Damyanov, 2024). Analysis of barriers in each individual case is a necessary step in studying the limitations of a child's participation in interactions with other children or in relevant activities.

In an adaptive-preventive environment, facilitators are conditions that reduce barriers for the child. They can perform the following functions: slowing down the adult's speech, using short instructions, using visual elements for children, simplifying the perception of complex actions, allowing for the resumption of the completed action, using simple methods of coordination between adults and children (Damyanov, 2024). For inclusive preschool environments, such adaptation acts as a way to support the child through a change in the environment (Scifo et al., 2025; Yadav & Huddar, 2025). In this case, facilitators are considered as a mechanism that can be used to implement ICF-oriented actions. In various cases, first, those environmental factors that can separate the child from other children are identified, and then ways to overcome them are determined.

The basis for the formation of the proposed model is the study of the ICF provisions on the use of environmental factors to determine the functional difficulties of the child and the selection of adaptations. First, the difficulties of the child's speech activity are studied: the complexity of vocabulary expansion, difficulties in understanding speech, the lack of ability to formulate phrases, the lack of perception of initiatives from other children, the limited use of non-verbal means of communication. Next, the child's functioning is studied: the lack of ability to concentrate on performing actions, the lack of ability to preserve the remembered process, the lack of ability to restore the performed action. After that, the child's activity is analyzed: inactivity in actions, non-participation in cooperation, difficulties in performing individual actions. Activity in interaction is also studied: participation in communication, interaction, perception of the performed action. The last stage is the study of environmental factors, barriers and facilitators, which gives grounds for selecting appropriate adaptations for children (Figure 1).

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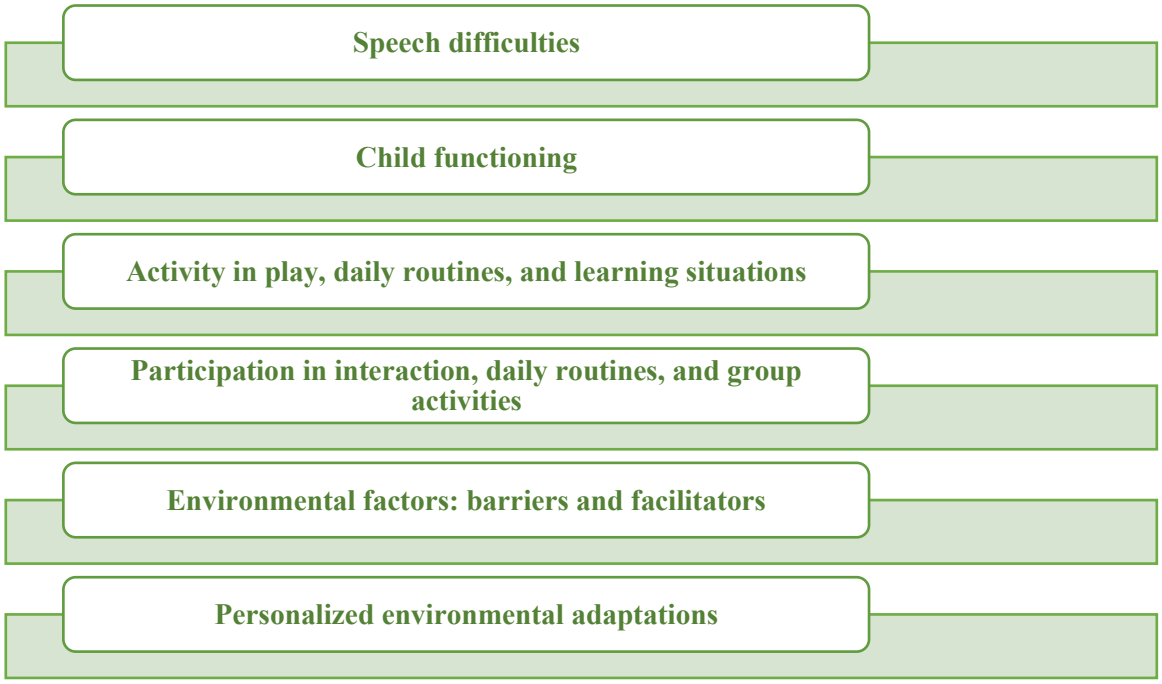

Figure 1. ICF-oriented logic for describing difficulties in an early childhood child

Source: Created by the authors based on an ICF-oriented approach to describing the functioning, activity, participation, and environmental factors of a child with speech difficulties (Danilavichiutie, 2020b; Borges et al., 2020; Kwok et al., 2023; Singer et al., 2023; Damyanov, 2024).

The presented scheme summarizes the sequence of analysis of difficulties in the child's speech development, taking into account their interaction with the world. The content of the difficulties is established through the child's perception of information, performance of actions, participation in interaction and response to the requirements of the environment. Thus, ICF-oriented analysis combines the neurospeech therapy-based description of the child with the selection of adaptations aimed at reducing barriers for children with such features. It acts as a connecting link between the characteristics of speech difficulties and changes that can be introduced into the child's environment. The use of such analysis allows you to link the child's properties with their activity, participation in the game, interaction or other manifestations under study. The value of ICF-oriented analysis is that adaptations are selected not only on the basis of the presence or absence of speech development difficulties, but in accordance with the real profile of the child's functioning.

5.4 Adaptive-preventive environment model of personalized development support

As part of the study, an adaptive-preventive environment model was developed for children with speech delay (Figure 2). The proposed model is based on the proposition that supporting a child's development should go beyond the study of speech development alone and take into account the individual profile of their functioning. This proposition is based on the ICF functional approach, according to which a child's difficulties are studied in the context of their activity, participation, and environmental factors that influence them (Borges et al., 2020; Kwok et al., 2023). The neurospeech therapy approach assumes that the organization of the environmental factor should take into account the child's speech, sensory, motor, cognitive, regulatory, and communicative capabilities, as well as their individual ways of self-organization (Danilavichiutie, 2024a).

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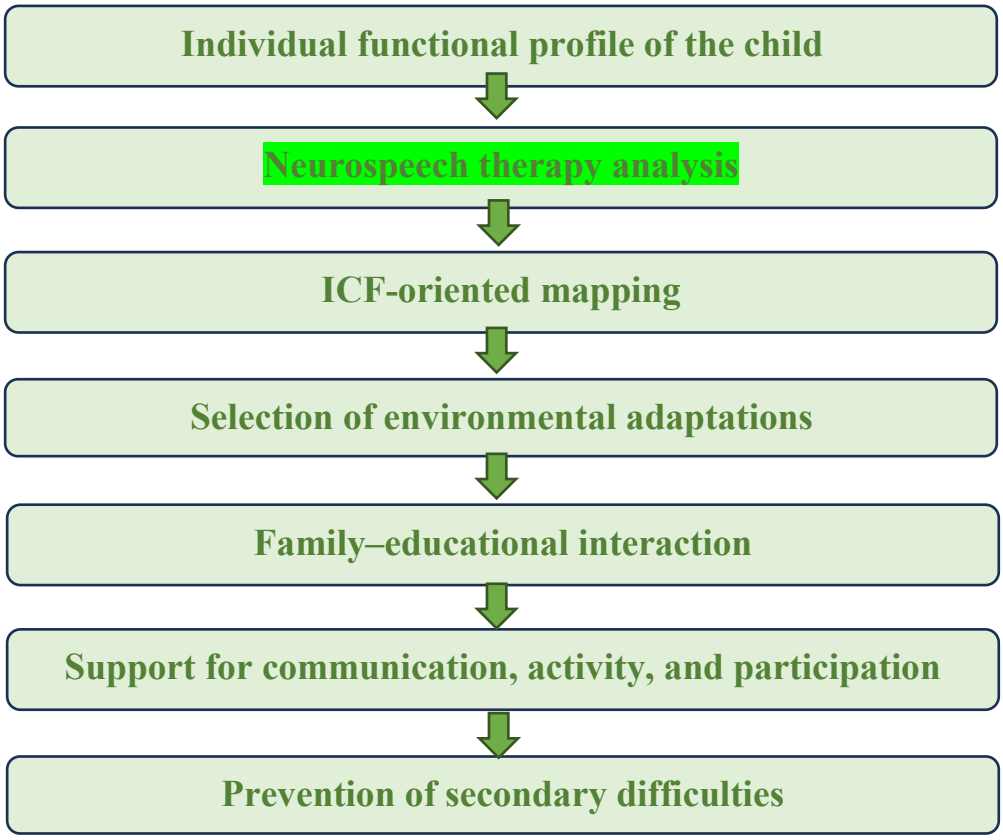

Figure 2. Adaptive and preventive environment for children with speech delay

Source: developed by the authors based on a theoretical generalization of international approaches to early intervention, family-centered support, ICF-oriented description of child functioning and the Ukrainian concept of neurospeech therapy (World Health Organization, 2020; Lipkin et al., 2020; Heidlage et al., 2020; Danilavichiutie, 2020; Danilavichiutie, 2024a; Kwok et al., 2023; Singer et al., 2023)

The model presented in Figure 2 reflects the transition from the analysis of the individual profile of the child's functioning to the creation of an educational environment that promotes their communication, activity and participation. The reflection is not linear, since at each stage the next one is determined, and it is also possible to return to the previous stages. The individual profile of functioning is the basis of the model. Performing a neurospeech analysis allows to clarify the mechanism of difficulties, using the ICF system - to determine the child's condition, and performing environmental adaptations - to reflect the effective requirements of the environment for the child. The individual profile of functioning reflects speech manifestations, perception, attention, memory, motor planning, relevant behavioral manifestations and the ability to communicate. The profile reflects the child as an individual with their strengths and vulnerabilities, which indicates that communication difficulties are not isolated from other developmental characteristics (Durgut & Tekin, 2024; Peristeri et al., 2024).

Performing a neurospeech analysis allows us to clarify the individual mechanism of difficulties. In the psychological dimension, higher mental functions of the auditory, visual, motor, spatial, regulatory and memory modalities are determined (McGregor et al., 2023; Danilavichiutie, 2024a). The synergetic dimension allows us to determine the child's adaptation to their own characteristics and the need for their adaptation (Danilavichiutie, 2024a). Thus, children who have the same speech manifestations may need different environmental conditions.

ICF-oriented mapping translates the results of neurospeech therapy analysis into the plane of functioning. As a result of mapping, speech difficulties are studied not only as speech manifestations, but also as those that affect the performance of actions, inclusion in groups, regime actions, interaction and participation in the educational process. For example, difficulties

in understanding speech may affect the performance of instructions or inclusion in group actions, and difficulties in regulation indicate a limitation in the ability to transition from one action to another (Singer et al., 2023; Cunningham et al., 2021).

Based on the neurospeech analysis and ICF mapping, the need for selecting supports for preschool children is determined. The reflection of difficulties leads to the determination of the necessary types of supports - speech, sensory, visual, spatial, regime or communicative. Depending on the identified difficulties in children, the need to use visual prompts or change the pace of action, sensory structuring of space, determining the sequence of actions or using gestures is established. The study of preschool education of children with speech difficulties indicates that adapting the environment in accordance with the needs of children is one of the mechanisms of preschool education (Yadav & Huddar, 2025; Scifo et al., 2025). Adaptation is considered one of the mechanisms of organizing the environment.

Family-educational interaction requires the coordination of efforts of professionals and the family to transfer the experience and strategies of interaction with the child into their daily communication with parents and other adults (Heidlage et al., 2020; McCarthy & Guerin, 2022). Within the framework of the model, the family plays an active role in this process. Interaction between professionals and parents should be aimed at coordinating all observations about the child and developing a strategy to support them in everyday life.

The expected outcome of the model is an increase in children's ability to communicate, be active, and participate in interaction. A child's speech development is associated with inclusion in joint activities. The more the environment corresponds to the child's individual profile, the greater the opportunities for them to enter into interaction, use available means of communication, join group activities, and perform actions together with other children and adults (Cunningham et al., 2021; Singer et al., 2023). According to the described mechanisms, the effectiveness of the model should be determined not only by the speech activity of children, but also by the growth of their ability to interact.

The preventive potential of the model allows preventing the emergence of secondary difficulties, indicating a decrease in communicative initiative, refusal to interact, promoting a passive position in the group, barriers to the manifestation of feelings and the experience of participation. Prevention is possible within the framework of the representation of the difficulty, the coincidence of adult actions and the creation of an environment that promotes the manifestation of the child's active position (World Health Organization, 2020; Lipkin et al., 2020). An adaptive-preventive environment, thus, can support the child in action, as well as prevent their difficulties that affect further development.

The developed model includes analysis of the individual profile of the child's functioning, neurospeech analysis, assessment according to ICF, identification of adaptations, organization of interaction with the family, support of the child's communication and activity, and prevention of secondary difficulties. All these elements can be subordinated to the organization of an environment in which the child receives not only support for speech development, but also conditions for active action, interaction, and participation in everyday communicative situations. The developed model allows reflecting neurospeech analysis not only at the level of individual actions of the child, but also in the structure of the educational environment adapted to their functioning.

6. DISCUSSION

The results of the study confirm the feasibility of studying speech delay not as a separate speech manifestation, but as a profile of the child's functioning, which affects their interaction with other children. It is advisable to monitor children with speech difficulties at an early age not only through the study of vocabulary, sounds and phrases, but also through the expansion of their activity, communication and participation in natural situations. This conclusion is consistent with the views of McGregor (2020) on the need to take into account the needs of children with developmental speech disorders, as well as with approaches to assessing the participation of preschool children in communication (Cunningham et al., 2021).

The overall results of the study reflect the state of the proposed environment in terms of international research data. The requirement for dynamic observation of children with speech difficulties at an early age corresponds to the recommendations for developmental observation and screening in early childhood (Lipkin et al., 2020), as well as the provisions of Nelson et al. (2024) on the impact of children's early experiences on their neurodevelopment. The proposed model contributes to the clarification of these views, focusing on creating an environment in which children act, interact and learn every day. Interventions that are integrated into everyday life, play and education are more effective.

Comparison with works on family-centered care in speech development confirms the certain importance of the family as a permanent environment of perception and participation in the support process. Heidlage et al. (2020) established the effectiveness of speech interventions performed by parents, and McCarthy and Guerin (2022) consider family-centered care as a process that requires the family to be open, agree on goals, and participate in supporting the child. Scientists Fan et al. (2024) and Hsieh et al. (2023) also showed the possibilities of children's speech development as a result of family participation in the speech support process. The results obtained expand these approaches by introducing family-educational interaction. The family is considered not only as an executor of instructions, but also as a participant in identifying difficulties, selecting facilitators, and introducing strategies to support children.

The results also coincide with studies on inclusive educational environments. Publications on inclusive preschool education emphasize the communicative competence of educators and the flexibility of the educational environment for children with communication difficulties (Turko et al., 2022; Yadav & Huddar, 2025; Scifo et al., 2025). In the study of Al Baqi et al. (2024), an inclusive educational environment is defined as a factor that creates opportunities for early childhood language development. Fitri et al. (2025) address the techniques, difficulties and support systems for children with communication difficulties in an inclusive preschool education environment. The model proposed in the study works by incorporating an adaptive-preventive environment that not only responds to children's difficulties, but also prevents them from intensifying.

An important result of the study is the introduction of the ICF model into the neurospeech therapy interpretation of speech difficulties. Correlation with other studies in the field of studying difficulties in children with special speech needs, in particular with the works of Borges et al. (2020), Kwok et al. (2023) and Damyanov (2024), shows that the ICF concept allows for a more precise identification of the child's difficulties in terms of activity, participation, barriers and facilitators of the environment in which they live. The feasibility of applying the ICF model to the study of a child's speech difficulties is also reflected in how these difficulties are considered in the neurospeech therapy approach.

The Ukrainian concept of neurospeech therapy considers speech difficulties of individuals with special speech needs on the basis of a neuro-psycho-linguistic-synergetic basis (Danilavichiutie, 2024a). The model proposed in the study confirms this aspect of neurospeech therapy analysis. Other approaches to the analysis of difficulties are mostly based on the study of neurological problems that manifest themselves in early childhood, in the family, in the process of inclusion in the educational environment and modeling the appropriate environment according to the ICF. The Ukrainian concept of neurospeech therapy expands the study of such difficulties, taking into account internal psychological, speech and adaptive manifestations through which the child builds an attitude towards their own characteristics.

The interpretation of the psychological and synergetic components requires special attention in its composition. The dimension of the psychological component includes the reflection not only of the emotional-volitional and motivational sphere, but also of other dimensions, such as auditory, visual, motor, spatial, regulatory and memory functions, which can act as both strengths and vulnerabilities of development. The specified coverage corresponds to the results of studies that studied children's self-regulation, for example, in the study by Mulvihill et al. (2020), as well as studies that studied the reproduction of speech and cognitive characteristics, in particular Peristeri et al. (2024). The synergetic component indicates the possibility of significant differences in speech as a result of the reflection of the same manifestations through different mechanisms. The spontaneous use of certain gestures can be a way for a child to reflect their own mode of functioning.

Studies investigating the mechanisms of speech, including neurodevelopmental and clinical studies, also support the rationale for interpreting speech delay. The findings of Morrel et al. (2023) on neural correlates of speech development in children at increased risk for autism spectrum disorder suggest a link between speech and neurodevelopmental features. Kasari et al. (2023) examine speech outcomes following early intervention in children with limited speech and emphasize the importance of early support for communication development. A meta-analysis by Fuller and Kaiser (2020) on the social and communicative outcomes of early intervention also supports a link between children's speech difficulties and other neurodevelopmental features. Such a link cannot be directly established for every child with these disorders, but the general agreement is seen as supporting the findings, indicating the need to examine speech in the context of a general developmental profile, especially at an early age.

The practical implications of the study can be considered to be aimed at using the model to plan personalized support for children with delayed speech development. The general form of the model allows educational professionals and educators to

solve such tasks as analyzing the child's profile, identifying barriers, planning adaptations, collaborating with the family, and determining the effectiveness of using adaptations. The proposed concept corresponds to the views of Gaddy and Crow (2023), who emphasize the need to take into account the individual ways of perception and communication of children with delayed speech development. For example, the use of digital or assistive tools to provide personalized support is considered in the works of other researchers, in particular Barua et al. (2022), Utepbayeva et al. (2024), and Haque et al. (2025). In the case of using such digital assistive tools, they should be considered as a supporting resource that contributes to the adaptation of the educational environment to the characteristics of the child.

One of the limitations of the study is related to its theoretical nature. The model was formed on the basis of scientific sources and was not empirically tested. All scientific sources differed in design, age of children, clinical characteristics and content of the educational environment. They also differed in the methods of measuring speech development. As a result, it is not possible to directly generalize the results to other groups of children with delayed speech development. In other words, empirical studies should be conducted in inclusive preschool institutions to determine the effectiveness of the proposed model.

The overall results of the study are consistent with international scientific approaches and research. In particular, the study is unique in that it links factors that affect a child with delayed speech development with environmental factors. This approach allows us to consider neurospeech therapy not only as a direction of professional support for the child, but also as a basis for creating an educational environment focused on the activity, communication, and participation of children with delayed speech development.

7. CONCLUSION

The article substantiates the adaptive-preventive environment as a way of organizing early support for children with delayed speech development based on an individual functioning profile. The results obtained showed that it is advisable to analyze speech difficulties at an early age in connection with communicative initiative, regulation, sensory and cognitive features, child participation and environmental conditions. The planned theoretical generalization was implemented through the construction of a model that combines neurospeech therapy analysis, ICF-oriented mapping, selection of adaptations and family-educational interaction. The novelty of the study lies in the presentation of a neurospeech therapy approach as a tool for designing an educational environment, which takes into account higher mental functions of various modalities, spontaneous adaptations of the child and the individual mechanism of speech difficulties. The results of the study can be used in speech therapy, special pedagogy, psychological support, the work of educators of inclusive groups and the organization of support for children during educational activities. The use of the model provides grounds for identifying barriers and facilitators for children, selecting speech, sensory, visual, spatial or communicative adaptations, as well as coordinating the actions of educational specialists and the family. The limitations of the study are related to its theoretical nature and the lack of empirical verification of the proposed model. Further research can be aimed at testing the model in preschool educational institutions, improving the criteria for selecting adaptations, as well as studying the dynamics of communication and activity of children in educational and everyday activities.

AUTHOR CONTRIBUTIONS

Eliana Danilavichiutie: Conceptualization, Validation, Writing—Original Draft, Project Administration.
Olha Arkadieva: Formal Analysis, Data Curation, Methodology, Writing—Original Draft.
Olena Doroshenko: Investigation, Supervision, Writing—Review & Editing.
Olena Nahorna: Investigation, Formal Analysis, Writing—Review & Editing.
Liudmyla Trofymenko: Visualization, Writing—Review & Editing.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ETHICS STATEMENT

This study was based exclusively on the analysis of publicly available scientific and methodological literature and did not involve human participants, animals, primary data collection, or the processing of personal or identifiable information. Therefore, ethical approval and informed consent were not required.

DATA AVAILABILITY STATEMENT

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

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