

Development of Phonemic Awareness in Speech and Reading Literacy of Pupils with Specific Learning Disorder

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ABSTRACT:

Music-based concept focused on the development of auditory processing in Reading Literacy of pupils with specific learning disorders at the primary school level. The use of colour notation contributed to improvements in auditory discrimination, which was reflected in enhanced pronunciation quality and in the frequency accuracy of phonemes with similar articulatory features. Significant progress was also observed in graphomotor activities, supported by the implementation of rhythmic–movement exercises. In addition, positive effects were noted from the application of the dichotic stimulation method, which assesses the degree of lateralization of auditory functions. This methodology enables the identification of the hemisphere that is dominant in the processing of speech and music. Despite these findings, certain challenges were also identified, particularly the diversity of the research sample in the areas psychomotor abilities. Based on the research findings, the innovative music therapy program represents an effective intervention for improving speech abilities, reading literacy in the first year pupils with specific learning disorders.

Keywords: Specific Learning Disorders, Music Concept, Phonemic Awareness, Reading Literacy

INTRODUCTION

The Music Concept focuses on auditory processing and cognitive functions of pupils with specific learning disorders at the primary school level. It comprises the phonemic awareness method, dichotic stimulation, music for children, colour notation and melodic-intonation method, which are further specified in relation to the development of reading literacy.

Mikulajová (2018) systematically clarifies the connection between phonemic awareness and the development of reading literacy in her studies. She highlights developmental principles concerning the

awareness of the sound structure of words, as well as the ability to manipulate phonemic analysis and synthesis, which are important for language acquisition and fluent reading. Within this method, pupils first acquire phonemes, followed by graphemes. The primary objective of the phonemic awareness method is to cultivate the mental representation of a word as a meaningful linguistic unit. The method particularly relies on prosodic aspects of speech—rhythm and melody—which play a significant role in acquiring the syllabic structure of words. In contrast, phoneme-level spelling is a more demanding process due to the high degree of abstraction involved (Mikulajová,

2023). Although pupils recognize letters as graphic symbols, they do not yet understand their phonemic (sound) equivalents. Facilitating the transition from syllabic to phonemic structures, requires consistent professional intervention and systematic support in auditory perception.

The research also incorporated a theoretical reflection and experimental validation of the dichotic stimulation methodology, which determines the degree of lateralization of auditory functions (i.e., the methodology can identify the hemisphere dominant in processing speech, sounds, and music) (Goswami et al., 2013). Musical interventions including dichotic stimulation can significantly contribute to the development of phonemic awareness by enhancing specific auditory processing skills and cognitive functions related to phonological awareness (Gordon, 2007; Vannson et al., 2015, 2017).

Music-movement interventions inspired by the method of Music for Children are focused on developing the ability to differentiate speech sounds and their temporal duration along with the capacity to perceive accents that segment connected speech. Simultaneously, these interventions stimulated auditory perception skills to detect timbre and dynamic aspects of speech, and also the ability to anticipate the placement of stress within words (Jarvis et al., 2019; Thaut, 2015).

The concept also included the use of Colour Notation, which substitutes traditional musical notation with coloured and shaped symbols, making it visually more comprehensible and easier to memorize for pupils with specific learning disorders (Moser, E. et al., 2018). Colour Notation graphically represents rhythmic and metric values and pitch frequency ((Kivijärvi, 2019; Lee & Hsiao-Fang, 2020, Ruokonen & Ruismäki, 2012). It provides a clear musical representation of pitch, melody, and the musical phrase that it is expected to play on the piano and sing. Phonological differentiation refers to the ability to distinguish and recognize individual speech sounds (phonemes) and their differences within a language (Agawu, 2016; Blum, 2017). In conjunction with the melodic-intonation concept, this leads to the development of auditory discrimination of sound differences—manifested as

improved perception and analysis of subtle changes in pitch (Yang et al., 2014; Simha, 2018). Improvements in auditory discrimination can be applied to the pronunciation of phonemes with similar articulation, as well as to syllables, words, and sentences (Jarvis, 2019; Carter-Ényì, 2020; Lagasse, 2016).

The primary aim of the research was to develop a concept based on understanding of the challenges faced by pupils with specific learning disorders in the area of reading literacy. This concept is intended to support the development of reading skills from the perspectives of development of phonemic awareness - learning proper breathing technique, articulation, visual and auditory differentiation, and other cognitive skills, while simultaneously enhancing the quality of life for pupils (also characterized by impaired communication abilities and deficits in specific skills).

This objective is closely related to the research questions addressed during the study. The formulation of the research questions was based on two thematic areas:

1. Comparison of development in the observed domains — reading expression, speech abilities, and written expression following the application of the innovative music concept.
2. Additional effects beyond the observed domains of reading literacy, speech, and writing following the implementation of the Music Concept.

These thematic areas are expressed in two research questions:

- RQ1: In which of the observed domains — reading expression, speech, and writing — did

the greatest development occur, and in which was the development the least?

- RQ2: What additional effects beyond the areas of reading literacy, speech, and writing can

be observed following the application of the innovative music concept in the first

year pupils with specific learning disorders at the primary school level?

The types of tasks were derived from the individual music-educational methods of the innovative music concept as well as from the requirements of the „National Curriculum for Pupils with Specific Learning Disorders“ (2024), according to which pupils with learning disorder are educated with a focus on the development of the phonetic-phonological level of language. This level consists of the following components of phonemic awareness training based on Mikulajova's method:

- Differentiating between syllable lengths, hard and soft syllables, consonant voicing, and sibilants of both categories, along with other phonological distinctions;
- Rhythmization of words, word combinations, rhymed texts using body percussion;
- Dividing words into syllables, composing words from syllables, determining the order and position of syllables in a word, syllabic analysis and synthesis of words;
- Isolating the first and last phoneme in a word, spelling three-, four-, and multisyllabic words, connecting isolated phonemes into words, determining the position of phonemes in words (phonemic analysis and synthesis of words).

METHODS

Study Design

A qualitative research was undertaken in which we implemented activities designed by us in the form of music therapy modules aimed at reducing or eliminating reading difficulties of first-grade pupils with learning disorder in primary school. To assess reading literacy before and after (pre-test and post-test) the application of the modules, we used two subtests of reading literacy test (Mikulajová, 2012). Changes were monitored through observation supplemented by interviews with teachers. The results in six observed areas—phonemic awareness, correct breathing, articulation, visual and auditory differentiation, and other cognitive functions—were evaluated based on the achieved scores and percentages before and after the intervention.

The main evaluative measures applied were the Letter Reading subtest, the Phonemic Awareness subtest, and a teacher questionnaire for assessing students' literacy. The content of these tests, aimed at recording changes in participant performance before and after the implementation of the modules, was compared and evaluated. The obtained scores and percentages are analyzed in the concluding section of the study, alongside the assessment of pre-test and post-test outcomes. During the application of the Innovative Music Concept, data collection was conducted through direct observation of the participants. Additionally, after each session, detailed records were created documenting the session's progression and noting observed changes.

Participants

The study was conducted during the educational process in the first grade of primary school. Participant selection was based on predefined criteria, prioritizing those with a closer affinity and relationship to music. All participants shared communication difficulties and deficits in reading literacy. The study involved three first-grade students aged six to seven years with specific learning disorder who attended regular therapeutic sessions over six months. Each session lasted 45 minutes and involved the application of innovative music modules focused on music-perceptual activities, vocal training, colour notation, music-drama activities, and play songs. The therapeutic activities were based on the methods of the Innovative Music Concept, aiming to develop reading literacy skills.

The first participant was a 6-year-old boy attending the first grade of primary school. He comes from a complete family that provides adequate conditions for his upbringing and education. Based on previous diagnostics, he was identified with a nonspecific communication disorder. Significant deficits were observed across all language domains. In spontaneous communication, dysgrammatism, a limited vocabulary, and simple stylistic sentence structures are present. The boy exhibits marked difficulties with attention concentration, which negatively impacts his performance in school tasks as well as his participation in group work. These

difficulties primarily affect his level of reading literacy. Due to his language and cognitive disorder, he required an individualized approach and targeted support, especially in the areas of communication and perceptual-cognitive function development.

The second participant was a 6-year-old boy attending the first grade of primary school. He was raised in a stimulating family environment. The family actively collaborates with the school and supports the child's educational process. The boy was diagnosed with Attention Deficit Hyperactivity Disorder (ADHD). Deficits in phonemic awareness were identified, which represent a significant barrier to acquiring the fundamentals of reading and writing. These difficulties were particularly evident in phoneme identification, distinguishing the first and last sounds in words, as well as phonemic analysis and synthesis.

The third participant was a six-year-old boy from Ukraine currently residing in Slovakia. He attended kindergarten in Ukraine and entered the first grade of primary school in Slovakia without a prior adaptation period. This circumstance poses a challenge, particularly in terms of acquiring Slovak as the language of education and communication. The participant exhibited difficulties with articulation and pronunciation, as well as a limited vocabulary in Slovak. Despite these linguistic barriers, he was highly motivated, attentive during lessons, and actively engaged in the educational process. The boy required targeted support in developing prosodic aspects of speech, especially in pronunciation and articulation, as well as educational assistance.

Research Implementation

The study was conducted in three phases. *In the first phase*, participants completed an initial assessment, during which interviews with teachers and analyses of reading performance were simultaneously conducted. *The second phase* took place over four months, involving 20 sessions. During this phase, therapeutic exercises were implemented through 10 modules based on the Innovative Music Concept aimed at developing reading literacy. The therapeutic activities were adapted to the individual needs of each pupil and their level of reading literacy in the Slovak language. Music-oriented methods

were delivered through various music activities. *In the third phase*, the same test as in the first phase was administered to evaluate the progress in reading performance of students with specific learning disorder in the first grade of primary school.

Pre-Intervention Assessment

Prior to the implementation of therapeutic exercises grounded in the Innovative Music Concept within reading instruction, participants' baseline reading literacy levels were systematically assessed. This assessment employed a teacher-administered questionnaire specifically designed to evaluate various dimensions of students' reading literacy, supplemented by two subtests derived from the Literacy Predictors Test. Identical assessment instruments were re-administered post-intervention to rigorously evaluate the efficacy of the therapeutic program. Furthermore, longitudinal monitoring of participants' reading behaviors was conducted to monitor developmental changes during the intervention period. From a methodological perspective, the study utilized a qualitative research design implemented across twenty structured sessions. The research concentrated on implementing therapeutic exercises designed to foster the development of analytical-synthetic thinking, psychomotor skills, and both visual and auditory analysis—core competencies critical to the advancement of reading literacy.

The content analysis involved summarizing the findings derived from direct observations conducted during each participant session. Detailed notes were systematically recorded throughout the study to document individual progress and to capture factors influencing the intervention process. Subsequently, comparative evaluations of session outcomes across participants were performed to identify trends and variations. The session records, combined with content interpretation, were instrumental in evaluating the relevant data and, together with graphical documentation, constituted the foundation for the study's conclusions. The results supported the hypothesis concerning the efficacy of the music-oriented concept in enhancing reading literacy among first-grade pupils with specific learning disorders at the primary school level. Beyond improvements in reading

performance, changes in communicative interaction were also monitored, allowing for an assessment of these students' potential for successful inclusion in mainstream educational settings.

First Observation

This section presents the processing of information in the form of a description of the first observation,

conducted prior to the implementation of therapeutic exercises. The findings outlined here were captured through observation of the students during the exercises and through interviews with the classroom teacher. Below, we provide a table summarizing the tasks and monitored areas during the first-grade reading lesson.

Table 1. Overview of tasks and monitored areas in the reading lesson in the first grade

Tasks	Assigned tasks	Monitored areas
1.	Listening to the reading of the text	Attention
2.	Conversation about the text	Ability to capture information from the read text, conduct a conversation, answer in coherent sentences.
3.	Searching for a new phenomenon	Correct understanding of instructions, memorization of what is heard, application of new knowledge in practice, ability to distinguish letter shapes, phonemic awareness.
4.	Reading one at a time	Correct articulation, combining letters into a word, orientation in the text, maintaining attention, visual and auditory perception, distinguishing the shapes of letters, sound aspect of pronunciation.
5.	Conversation about the content of the text	Ability to actively participate in the conversation, understand the discussed topic.
6.	Feedback, communication, singing together	Engage in conversation, active participation, connection of sentences, concentration When singing: development of rhythmic feeling, intonation skills, correct articulation, memory skills (text and melody of the song), imagination (creating associations of the song with the previously read text).

Participant 1 – based on the comprehensive analysis of data obtained from the initial observation, it can be concluded that he exhibited significant deficits across multiple linguistic domains. The most difficulties were identified in grammatical sentence construction, limited lexical repertoire, difficulties with text orientation, and impaired retention of content from the reading material. In spontaneous verbal communication, manifestations of dysgrammatism, restricted vocabulary, and simple sentence structures were observed. Furthermore, the participant had attentional difficulties, which negatively affected his performance in school tasks.

Participant 2 – the initial observation identified pronounced difficulties primarily within the morphological-syntactic and phonetic-phonological domains. Notably, the participant demonstrated impaired phonemic awareness, deficits in reading and writing competencies. These problems were most apparent in tasks involving phoneme identification, discrimination of initial and final phonemes within words, and phonemic analysis and synthesis. Additionally, the participant exhibited a restricted vocabulary and articulatory challenges. Participant had been also diagnosed with Attention Deficit Hyperactivity Disorder.

Participant 3, a native of Ukraine, demonstrated significant difficulties with articulatory agility, pronunciation, and Slovak vocabulary acquisition. Throughout conversational activities, he was encouraged to actively participate. The participant faced challenges across all linguistic domains and was unable to use the global reading strategy effectively. Despite multiple repetitions, his comprehension and orientation within the content of the discussed topic remained limited. However, in comparison to other participants, he demonstrated a relatively greater capacity for sustained attention during task performance.

Verification of the level of reading literacy

Questionnaire for teachers to assess the literacy of pupils in grades 1-4

When verifying the level of pupils' reading literacy, we used a questionnaire for teachers to assess the literacy of pupils in the 1st- 4th grade of elementary school, and two subtests from the test of literacy predictors at the beginning and end of the research. The authors of the questionnaire, Mikulajová and Váryová (2012), were based on the determined performance and content standards, and knowledge about the development of language skills of pupils with learning disorder in primary school. They compiled four separate questionnaires for the first to fourth graders, in which the teacher evaluated three areas of the pupils' abilities and competencies: speaking, reading and writing. The three basic areas of skills and abilities can be evaluated together (total score) and separately. This allowed us to see the profile of the students' results and compare individual results among pupils. This questionnaire is compiled in such a way that the content of the individual items aligns closely with that of the teacher's, does not take much time, and its evaluation and administration do not require any training. The questionnaire reflects the student's typical performance, which meaning is not tied to their current behavior. The teacher's task is to fill in all the items by marking the answer that best describes the given pupils. Subsequently, the points from the individual items of the three areas are counted and written in the marked boxes. The sum of the points makes up the total score. The qualitative analysis of the profile consists of

comparing three areas: spoken language, reading and writing, which creates a more detailed profile of the student's abilities (Mikulajová, 2012).

In the research, due to the delayed development of pupils with learning disorder, we used a questionnaire intended for the first year of elementary school. When evaluating the questionnaire, we proceeded in the following way: first, we evaluated the pupils' score in speaking, reading and writing, as well as the overall score from the questionnaire. Concurrently, we determined in which areas they were showing delayed progress and to what extent. Absolute values and values in percentages were then compared between areas and pupils. Finally, we compared the results of the questionnaires before applying the methods and after their application.

The evaluation of the three participants' questionnaires and their comparison is presented in the research results section.

Letter reading test and phonemic awareness test

In addition to the questionnaire, we verified the level of reading literacy at the beginning and end of the research, through the letter reading subtest and the phonemic awareness subtest, both part of the literacy predictors test. Mikulajová (2012) created this test in order to assess the level of development of language preliterate skills. It is primarily intended for the diagnosis of children of preschool age and for pupils in the 1st year of elementary school. The aim of the test is to identify children who are at risk of having difficulties in acquiring reading literacy. Due to the nature of their intellectual disability, this test is an ideal tool for determining the current level of literacy of students with specific learning disorder, as well as for predicting possible future success in this area.

1. Reading letters

The subtest determines whether the student knows the letters of the Slovak alphabet and can read simple words. The test consists of two parts: reading large print letters and words aloud from a template. The chosen words are short and commonly used. We chose this subtest because the knowledge of letters is an important predictor of reading quality

and helps to point out a possible problem related to the instillation and memorization of individual letters (Mikulajová, 2012).

2. Phonemic awareness

The awareness of the phonetic structure together with the knowledge of letters forms the basic mechanism of decoding symbols - the Alphabetic languages (Mikulajová, 2012). The test consists of three types of tasks of varying difficulty: dividing words into syllables, isolating the first phoneme in words, and synthesizing words from phonemes. Phonemic awareness is one of the key predictors of reading technique. From the knowledge presented in the theoretical part of this thesis, it follows that the ability to distinguish the phonemes of the language has a fundamental influence on the reading literacy of pupils with specific learning disorder. Individual types of tasks point to different difficulties related to distinguishing phonetic structure. Through the records resulting from the scores in the observed areas, during the initial verification of the reading literacy level, we can set and prepare the concept so that it deliberately affects the weakened areas. This subsequently increases the probability of its resulting effectiveness. During the administration of the two subtests, we used recording sheets to record the results. For the first letter reading test, we needed a paper pattern of letters with words. Before each exercise, we first completed a short practice session to ensure understanding of the assigned task. We wrote down the number of correctly completed tasks in the marked boxes on the sheet. The resulting score is the sum of the accumulated points, which we compare with the table of the percentile standard determined for the given grade. We present the evaluation of the tests and the comparison of the results in the research results subsection.

Modules

Ten innovative musical modules were implemented within twenty sessions, focusing on improving speech,

reading, and writing skills. Each module included activities designed to develop proper *breathing techniques, articulation, visual and auditory perception, phonemic awareness, as well as other cognitive functions such as attention, analytic-synthetic thinking, and memory*. The intervention was based on humanistically oriented therapeutic methods, particularly creative music therapy. This approach is based on guided musical improvisation that fosters emotional attunement, imitation, and dialogic vocalization.

Phase 1: This phase concentrated on enhancing attention, auditory perception, and rhythmic awareness through targeted exercises, including *the identification of sound source, type, and duration*. Following this, *vocal training and rhythm-based activities* were implemented to facilitate the differentiation and segmentation of phonemes, syllables, words, and articulation.

Phase 2: This phase employed the *colour notation* method as a pedagogical tool designed to enhance cognitive and motor skills. Specifically, it targeted the development of visual and auditory analytical skills, as well as the strengthening of memory functions. Additionally, emphasis was placed on improving visuomotor coordination and psychomotor abilities. This creative process was integrated with phonemic awareness and reading.

Phase 3: This phase focused on the synthesis and application of skills cultivated in earlier phases through *music-dramatic activities*. It incorporated targeted intonation and articulation exercises alongside *play songs* designed to enhance the semantic and pragmatic aspects of speech. The approach aimed to promote the development of meaningful communicative interaction and the expressive content of language within a dynamic, interactive context.

Table 2 provides a clear overview of the modules structure, including its objectives and main activities, documenting the observed outcomes throughout the overall therapeutic process.

Table 2. Structure, Objectives, and Observed Outcomes of the therapeutic sessions

Moduls	Session	Main Activites	Objectives	Observed Outcomes
1. Cognitive functions influencing reading	1.	Movement representation of musical-expressive means (tempo, rhythm, melody, harmony colours, agogics, dynamics) of the listened musical excerpt. Sound of different instrument identification and their locations in the classroom.	Develop auditory attention and instrument sound discriminat. Adaptive motor responses to changes in tempo, rhythm, and dynamics.	All participants accurately identified three different instruments by sound. Some participants modified movement appropriately in response to tempo or dynamic changes, others required constant support.
1. Cognitive functions influencing reading	2.	Musical mosaic - creative improvisation with sounds of musical instruments based on graphic signs corresponding to certain sounds (knocking, water, bell-like, rustling). Sound - colour associations; graphic-based improvisation.	Deepen creative auditory thinking. Link visual and auditory perception.	One participant successfully produced a short sound improvisation based on a visual cue. Two struggled.
2. Differentiat. of Language Signs and Phenomena	3.	Breathing exercises; soft voice onset (using the imagery of stroking soft fur, incorporating hand movement into tone production; vocal phonation of sounds of surrounding and vowels).	Activate appropriate respiratory support. Develop controlled tone initiation.	All participants actively engaged their respiratory function to regulate phonation and began practicing rhythmic imitation of sounds and vowels. Vocal expression was further developed by incorporating speech prosodic elements.
2. Differentiat. of Language Signs and Phenomena	4.	Vocal range extension: imitation of environmental sounds by producing head tones. Articulation: rhythmisation based on rhythmic patterns; rhythmic and vocal imitation of phonemes, syllables, words, sentences, and nursery rhymes accompanied by body percussion and rhythmic instruments.	Extend the vocal range. Improve rhythmic accuracy and reproduction	All participants struggled with rhythmic accuracy and tempo but succeed to reproduce a rhythmic pattern with correct dynamics. One participant sang a simple melodic motif within an extended range successfully. Others struggled. Rhythmic patterns and exercises helped them to improve the perception of tempo and rhythmic differences in speech.

3. Commun. Interactions	5.	Emotional attunement: contact songs; play songs; reciprocal interaction based on mutual listening. Movement and dramatic expression of emotions. movement and dramatic expression of emotions; Expressing ideas about the musical piece through creative writing of haiku and rondel.	Foster social interaction through music. Encourage verbal creativity in response to musical stimuli.	Two participants maintains eye contact during musical play. They began connecting movement and expression of emotions. Not all participants showed interest in expressing ideas about the musical piece through creative writing of haiku. One participant struggled.
3. Commun. Interactions	6.	Mirroring; chain games; dialogic vocalization and songs: thematic focus on acquiring communication rules; songs with learning concepts.	Reinforce auditory and kinesthetic imitation skills. Consolidate turn- taking in musical dialogue.	Participants improved in precise reproduction of a rhythmic and melody pattern presented by a peer. They engaged actively in creating an original musical response in a question- answer format.
4. Multisens. Engagemen t in Activity	7.	Dance songs with repetitive, simple text, prominent accompaniment; canons; polyphonic structures <i>influenced by the diversity of the instrumental accompaniment</i> and different instrumental groups.	Maintain intonational stability across polyphonic structures, diversity of instrumental accompaniment; dynamic levels.	During the articulation of declaimed text, three distinct loudness levels were utilized in instrumental accompaniment to ensure clear pronanciation. All participants showed interest in keeping accurate intonation in both soft and loud dynamics.
4. Multisens. Engagemen t in Activity	8.	Group improvisations: complex rhythmic and melodic patterns and sequences with rich sonic texture in the overall musical expression; contrametric accents; voice shadowing by acoustic occlusion; talking drums.	Enhance coordination in ensemble settings. Develop perception and production of rhythmic accents.	All participants better responded accurately to rhythmic patterns. In talking drum activity they tried to produce a simple speech-like rhythm on a drum, using musical- expressive means to convey programmatic intent.
5. Pronunciat. and Perception of Phonemes in Words	9.	Initial phoneme identification by using vocal vibrato. Rhythmic decamation of object names beginning with sibilants and vowels (A, Ž, C, Š, F) in various tempos, dynamics, and expressions.	Increase precision of articulation and reaction speed.	All participants understood the link to identify the initial phoneme of a word and to reproduce it rhythmically. They improved in integrating rhythm of text with

				corresponding movement, articulatory agility.
5. Pronunciat. and Perception of Phonemes in Words	10.	Articulatory agility: based on rhythmic patterns a rhythmic and vocal imitation of phonemes, syllables, words, nursery rhymes accompanied by body percussion, movements. Final phoneme identification: rhythmic decalamation of final phoneme in objects by using vocal vibrato.	Strengthen auditory discriminat. of final phonemes. Develop sustained vocal vibrato.	Two participants learnt to identify and reproduces the final phoneme rhythmically. They produced a simple sustained vibrato. Other participant required constant support.
6. Auditory Differentiat.	11.	Visualization of the rhyme text; rhythmic arrangement of the rhyme text; solmization of the rhyme text; play the piano and sing via colour notation.	Acquire intonation skills using model patterns.	All participants clearly sang the intonation patterns by following colour notation. Intonation was guided through hand signs. Relative solmization was employed simultaneously with colour notation.
6. Auditory Differentiat.	12.	Vocal range development; colour notation with instrumental and vocal imitation of chants in different intonation patterns; gradual transposition of songs into higher keys.	Practise intonation in an expanded range. Stimulate creative melodic improvisat.	Two participants reproduced all four melodic patterns accurately. Other participant struggled. But all participants created a short melody with simple text based on instrumental cues. After they successfully transfered the chant sequences into the processes of phonemic awareness and reading.
7. Phonemic Awareness	13.	Music–movement songs; thematic project “Water” - Listening to three examples of classical music with the theme of water; movement interpretation; assignment of illustrations, colours; graphic visualization; creation of a narrative or poetic text.	Integrate music, movement and visual imagery. Develop motor memory.	Increased group participation; two participants created new movements and sounds on the theme of water.
7. Phonemic Awareness	14.	Play Songs: - Music-movement activities combining singing with movement, gestures, rhythmic accompaniment, and dramatization.	Coordinate speech and movement in synchrony.	All participants engaged actively; rhythmically recited text while walking or dancing.

8. Auditory and Visual Perception	15.	Colour notation, learning rhythmic values; object rhythmisation	Reinforce rhythmic reading from colour notation.	All participants struggled to correctly differentiate short and long notes while performing them on the piano from colour score.
8. Auditory and Visual Perception	16.	Songs from colour score; Using metronome for tempo and rhythm control.	Refine rhythmic precision and intonation.	All participants successfully sang the songs in the set tempo of metronome without omissions.
9. Differentiat. letters with similar shapes	17.	In visualizing the rhyme text using pictures, we followed the system of Alternative and Augmentative Communication (AAC), in which individual words in the text were replaced with symbols. It is important that the same symbol is always used for the same word. Differentiation of hard/soft, voiced/voiceless consonants; syllabification.	Improve phonemic differentiat. skills.	Two participants clearly understood the link. Greater initiative observed in other case.
9. Differentiat. Letters with similar shapes	18.	Syllable Synthesis. Effective reading is characterized by a sequential progression of visual fixations, each transitioning smoothly to the next. This process mirrors the slow and stable motor programs governed by the motor cortex–basal ganglia circuitry. In oral reading, a deliberately moderated pace establishes the temporal framework within which coordinated visuomotor and articulatory movements emerge, integrating slow, stabilizing motor control with precise execution.	Enhance fluency in reading transitions.	One participant read fluently while maintaining accurate pronunciation. Others showed gradual progress.
10. Developing Fluent Reading of Words and Spoken Phrases	19.	Phoneme identification; rhythmic allocation of phonemes - form the next step in this process. The foundation of this method is rhythm, as auditory perception of rhythm facilitates motor system activation and triggers predictable neurological responses. By utilizing the connection between auditory stimuli and motor activities,	Develop accuracy in phonemic analysis.	Two participants assigned correct rhythmic values to identified phonemes. Other focused on enjoying the process.

		rhythmic cues can activate fine motor speech patterns, thereby creating stable conditions for the temporal organization of motor speech responses related to intelligibility, with an emphasis on the first syllable of a word.		
10. Developing Fluent Reading of Words and Spoken Phrases	20.	Fluent reading of words and phrases: The greatest temporal duration is necessary for eliciting the initial letter or phoneme within a syllable or word. One whole note corresponds to a single letter/phoneme, while two half notes correspond to two sequential letters/phonemes. Within the temporal duration of a whole note, the first letter or phoneme is elicited; correspondingly, two letters or phonemes are elicited over the duration of two half notes and so on.	Integrate rhythm and intonation for clear articulation.	All participants read phrases fluently with precise rhythm and intonation.

(Source: own processing)

RESEARCH RESULTS

The results of research were processed and summarized in two distinct subsections. The first part focused on the interpretation of direct observation outcomes of individual participants during the implementation of various modules. Our analysis was based on systematically recorded notes taken continuously throughout the research process. The second part of the results focused on the evaluation of questionnaire data and two subtests selected from the Literacy Predictors Test according to Mikulajová (2012). These data were organized into structured tables and charts, enabling a detailed analysis of changes in participants' reading literacy levels before and after the application of Innovative music conception.

Content Analysis of Direct Observation

In the content analysis based on direct observation of participants during the interventions, we focused on main areas related to the development of phonemic awareness and reading literacy. These activities were primarily designed to develop proper breathing techniques, articulation, visual and

auditory perception, phonemic awareness, as well as other cognitive functions such as attention, analytic-synthetic thinking, and memory. Our approach was based on humanistically oriented therapeutic methods, particularly creative music therapy, which is based on the principle of *guided musical improvisation through emotional attunement, imitation, and dialogical vocalization*.

In the first phase, within the framework of *emotional attunement and shared attention*, the intervention focuses on interactive attention, which can stimulate imitation and spontaneous speech (Whalen et al., 2006). In Nordoff-Robbins music therapy, interactive attention may arise from the sensitive, musical responses of the therapist to changes in the student's attention.

The second phase involves *musical imitation*. This includes the implicit ability to mutually "mirror" each other's expressions, which is associated with the mirror neuron system—neurological mechanisms responsible for mirroring gestures, language, and emotions (Trevathan, 2005). A characteristic activity in this phase is the rhythmic

declamation of words, phrases, sentences, and rhymed texts derived from children's folk literature, as well as echo games, chain games, musical dialogues, rhythmization of spoken rhymes, and similar activities.

In the subsequent phase of speech and reading literacy development, dialogic vocalizations were employed alongside movement and instrumental play to facilitate the expression of narrative content, emotional tone, extramusical meanings, and literary material (Majzlánová, 2018). The use of dialogic vocalizations primarily encompassed rhythmized or declaimed texts, sound painting, the incorporation of environmental objects and props, movement improvisation within dramatic scenes or narratives, and playful songs. Reading, in particular, engages multiple sensory modalities, representing an integrative approach to phonemic awareness, word decoding, and comprehension of spoken language.

Case Study of Participant 1

Based on research data, Participant 1 initially exhibited difficulties with active engagement, which may be attributed to challenges in comprehending instructions and a tendency to observe peers before initiating tasks. Limited knowledge of alphabetic letters further hindered their ability to navigate the reading text. Compared with other participants, Participant 1 demonstrated a restricted vocabulary and experienced expressive challenges, frequently requiring assistance in articulating thoughts. Nevertheless, progressive exposure to the activities led to increased confidence and more active participation, despite occasional errors persisting throughout the intervention.

Breathing Technique Training: The initial activity proved to be the most engaging for Participant 1. The participant actively endeavored to perform deep inhalation and exhalation correctly, with observable improvement noted in the controlled, gradual release of air from the diaphragm.

Development of Proper Articulation: Participant 1 exhibited notable difficulties in pronouncing sibilant sounds. Throughout the training, frequent prompts and corrective feedback were necessary, as the participant initially lacked the auditory

discrimination to recognize problems in pronunciation. Engagement in play songs, dance-movement activities, and targeted vocal exercises gradually enhanced their articulatory awareness. Despite these improvements, Participant 1 continued to require individualized speech therapy and therapeutic interventions.

Visual and Auditory Differentiation: The majority of activities targeted enhancement of auditory perception, supplemented by corresponding visual stimuli. Task complexity was systematically increased through the integration of colour notation to engage multiple sensory modalities. Participant 1 demonstrated modest but observable progress in this domain.

Phonemic Awareness: At the beginning, Participant 1 was unable to segment his/her/their name into syllables, did not distinguish between long and short syllables, and had difficulties with word analysis and synthesis. Over time, however, these skills improved, and the participant repeatedly showed interest in singing Play songs, which contributed to a mild improvement in this area.

Other Cognitive Functions: Participant 1 initially exhibited considerable difficulties in acquiring rhymes and memorizing text through auditory perception. However, following the intervention period, gradual improvements were noted in their comprehension of text meaning and instructions, alongside a reduction of deficits across all monitored domains. The participant acquired foundational knowledge of letters and the ability to read simple words. An individualized approach proved essential in supporting this progress. Despite enhanced text comprehension, independent reproduction of the auditory material remained a continuing challenge.

Case Study of Participant 2

During the initial session, Participant 2 demonstrated restlessness and frequent lapses in attention toward assigned tasks. His speech was characterized by rapid tempo, unclear articulation, and difficulties with the correct pronunciation of sibilant sounds and word endings. Throughout the sessions, the participant frequently disrupted activities, sought excessive attention, and often

attempted to respond first, interrupting conversations without prompt.

Breathing Technique Training: During vocal exercises incorporating breathing techniques, Participant 2 initially demonstrated interest and engagement. However, with repeated practice, his motivation gradually waned, and his behavior began to disrupt the intervention process for other participants. As a result, it became necessary to diversify the vocal exercises by integrating musical dramatization activities, including the imitation of environmental sounds, fairy tale storytelling, and role-playing of various characters.

Development of Proper Articulation: The participant initially exhibited difficulties with articulation; however, through individualized intervention and enhanced motivation, he demonstrated progress in correctly pronouncing more complex words and phonemes. The corrective approach emphasized jaw relaxation and activation of the articulatory organs, which also contributed to improved respiratory function, as speech production was practiced on controlled breath-hold. A significant motivational factor was the participant's willingness to demonstrate model exercises before peers, which positively influenced his performance. Tasks that successfully engaged his interest were consistently executed with accuracy.

Visual and Auditory Differentiation: The participant generally demonstrated engagement in activities targeting visual and auditory differentiation, especially in sound-based games presented in a quiz format, including auditory memory matching (sound-based pairs), identification of sounds of instruments, and imitation of environmental noises. Despite this engagement, his performance was inconsistent, with frequent distractions and disruptive behaviors observed during the activities.

Phonemic Awareness: Within the domain of phonemic awareness, the participant exhibited the capacity to distinguish phonemes within words and to rhythmically articulate syllables, words, and phrases. Notably, his performance was significantly stronger during creative play activities, whereas routine tasks frequently revealed errors or incomplete responses.

Other Cognitive Functions: Participant 2 faced the greatest challenge in sustaining attention. His memory capacity was relatively intact, and he demonstrated no significant difficulties in integrating multisensory information. However, his task performance was often influenced by fluctuations in mood. Post-intervention assessments indicated improvements across all targeted areas, especially in reading skills and phonemic awareness.

Case Study of Participant 3

At the initial assessment, the participant's speech was characterized by a noticeable Ukrainian accent and a restricted vocabulary. As a native Ukrainian speaker, he demonstrated challenges in understanding Slovak. He relied on lip-reading and closely attended to verbal instructions. Deficits were evident across all linguistic domains. Despite these challenges, the participant actively engaged in interactive tasks and communicated verbally throughout the sessions.

Breathing Technique Training: The participant showed active engagement during breathing and vocal exercises, demonstrating efforts to execute them correctly with notable capacity for self-correction. Positive reinforcement through praise and encouragement functioned as significant motivational stimuli throughout the training.

Development of Proper Articulation: Activities targeting articulation skills presented notable challenges for the participant, partly attributable to his linguistic background, as the Ukrainian accent was prominent in his oral expression. Throughout pronunciation exercises, he consistently exerted effort to achieve accurate articulation, engaging in repeated practice of individual words until correct production was attained. Although occasional articulation inaccuracies occurred during spontaneous speech, the participant demonstrated the ability to self-correct in certain tasks. He actively engaged in music and movement activities, including vocal exercises and instrumental play, showing a marked preference for paired work where he exhibited both interest and cooperative behavior.

Visual and Auditory Differentiation: Participant 3 exhibited a significantly higher proficiency in visual differentiation relative to auditory differentiation. Within the auditory domain, stronger performance was noted in the identification of familiar environmental sounds (auditory memory matching tasks), while persistent challenges were evident in word discrimination, especially within phonemic awareness. Systematic repetition of targeted interventions combined with multisensory stimulation positively impacted the development of auditory discrimination. This repeated practice facilitated gradual improvements in speech production and pronunciation, highlighting the participant’s potential for continued progress through consistent, structured support.

Phonemic Awareness: Difficulties in phonemic awareness persisted throughout the duration of the program, with the most pronounced deficit observed in the synthesis of phonemes into words. This impairment is largely attributable to a limited vocabulary and a low level of contextual understanding of linguistic material. Through a reduced pace of work and targeted support involving explanations of word meanings, gradual improvements in speech production were noted. Despite this progress, the participant has not yet attained a level of independent performance and continues to require individualized support during intervention sessions.

Other Cognitive Functions: The participant exhibited slower memorization of new poems and songs containing longer sequences. Nonetheless, he demonstrated willingness and enjoyment in rehearsing previously learned texts and songs, reflecting intrinsic motivation and a positive disposition toward the activities. His attention was consistently maintained at a high level throughout

the sessions, and he engaged with notable concentration and perseverance. The participant demonstrated active engagement in group work and exhibited confidence in social interactions, frequently adopting a model role by setting an example for peers. The final evaluation indicates overall improvement across all assessed domains. Based on observed outcomes, continued development is expected, particularly in the area of speech content comprehension.

Graphic evaluation

*Teacher Questionnaire for valuating Students’ Reading Literacy*To improve the clarity and accessibility of the collected data, graphical methods were utilized. Results from individual respondents in the questionnaire survey were systematically organized into tables. Performance on specific test tasks was subsequently visualized through graphs, which were supplemented by expert commentary providing qualitative interpretation and contextual analysis of the data. As part of the evaluation of questionnaire data evaluating students’ reading literacy levels, an overview of individual participants’ scores is presented in summary tables. The questionnaire was structured to evaluate three main domains: spoken language, reading, and writing, together with an overall score. Teachers completed the questionnaires both prior to the intervention program (October 2023) and following its conclusion (March 2024), enabling the measurement of progress across the targeted literacy domains. Normative data corresponding to the first-grade elementary school level were assigned to each raw score according to the applicable conversion tables. This standardization process facilitates a comparative analysis of each participant’s performance against the expected benchmarks established by normative criteria.

Table 3 Questionnaire for teachers to assess the reading literacy of Participant 1
(domain evaluation)

October 2023 (Score, percentages, percentiles)		February 2024 (Score, percentages, percentiles)	
Spoken language score: 15/28/ 53.57%	Percentile: <5	Spoken language score: 20/28/ 71.43% + 17.86%	Percentile: 6-10
Reading score: 12/44/ 27.27%	Percentile: <5	Reading score: 24/44/ 54.55% + 27.28%	Percentile: <5

Writing score: 7/28/ 25.00%	Percentile: <5	Writing score: 19/28/ 67.86% + 42.86%	Percentile: 6-10
Total score: 34/100/ 34.00%	Percentile: <5	Total score: 63/100/ 63.00% +29.00%	Percentile: <5

(Source: own processing)

Based on the data presented in Table 3, it can be concluded that Participant 1 demonstrated measurable progress across all monitored domains, with the most pronounced improvement evident in reading skills. These results indicate that the applied interventions were effective in supporting the participant's literacy development.

Upon completion of the interventions, a gradual improvement in the participant's comprehension of text and instructions was observed, accompanied by a reduction of deficits across all targeted domains and the acquisition of fundamental knowledge of letters and the ability to read simple words. The implementation of an individualized approach proved essential in facilitating this progress.

Table 4 Questionnaire for teachers to assess the reading literacy of Participant 2
(domain evaluation)

October 2023 (Score, percentages, percentiles)		February 2024 (Score, percentages, percentiles)	
Spoken language score: 20/28/ 71.4%	Percentile: 6-10	Spoken language score: 20/28/ 71.4% +0%	Percentile: 6-10
Reading score: 11/44/ 25.0%	Percentile: <5	Reading score: 31/44/ 70.5% +45.5%	Percentile: 6-10
Writing score: 5/28/ 17.9%	Percentile: <5	Writing score: 19/28/ 67.9% +50.0%	Percentile: 6-10
Total score: 36/100/ 36.0%	Percentile: <5	Total score: 70/100/70.0% +34.0%	Percentile: 6-10

(Source: own processing)

Based on the data presented in the table 4, it can be concluded that Participant 2 demonstrated noticeable progress primarily in the areas of reading and writing. The participant's overall score increased by one percentile rank following the intervention. Following the intervention,

improvements were noted across all monitored domains, with particular gains in reading and phonemic awareness. However, despite these advances, persistent deficits remained in text reproduction, articulation, and sustained attention.

Table 5 Questionnaire for teachers to assess the reading literacy of Participant 3
(domain evaluation)

October 2023 (Score, percentages, percentiles)		February 2024 (Score, percentages, percentiles)	
Spoken language score: 12/28/ 42.9%	Percentile: <5	Spoken language score: 15/28/ 53.6% +10.7%	Percentile: <5
Reading score:	Percentile: <5	Reading score:	Percentile: <5

8/44/ 18.2%		28/44/ 63.6% +45.4%	
Writing score: 7/28/ 25.0%	Percentile: <5	Writing score: 15/28/ 53.6% +28.6%	Percentile: <5
Total score: 27/100/ 27.0%	Percentile: <5	Total score: 58/100/58.0% +31.0%	Percentile: <5

(Source: own processing)

Based on the data presented in the table 5, it can be concluded that Participant 3 demonstrated the most substantial progress in reading, accompanied by notable improvement in writing. A slight advancement was recorded in spoken language. In evaluating this participant's performance, it is important to emphasize that his native language is Ukrainian, which he exclusively uses for communication within his home environment. This linguistic context significantly influences the pace and quality of his Slovak language acquisition, which is directly reflected in his performance across the monitored domains of reading literacy. The overall post-intervention score remains below average. Although improvements were noted across all assessed domains, the participant has continued to face challenges in reading, writing, and spoken language.

Letter Reading Test and Phonemic Awareness Test

Two subtests targeting key literacy predictors—letter reading and phonemic awareness—were

administered to collect quantitative data for each participant. These assessments took place at two intervals: before intervention implementation (October 2023) and after its completion (February 2024). Raw scores were subsequently converted into percentile ranks using standardized conversion tables, allowing for comparative analysis of participant progress.

The following graphs illustrate the results of the Letter Reading Test and the Phonemic Awareness Test for each participant, displaying their respective raw scores. The Letter Reading Test has a maximum possible score of 20 points. The Phonemic Awareness Test consists of three tasks, each scored up to 5 points, resulting in a maximum total score of 15 points.

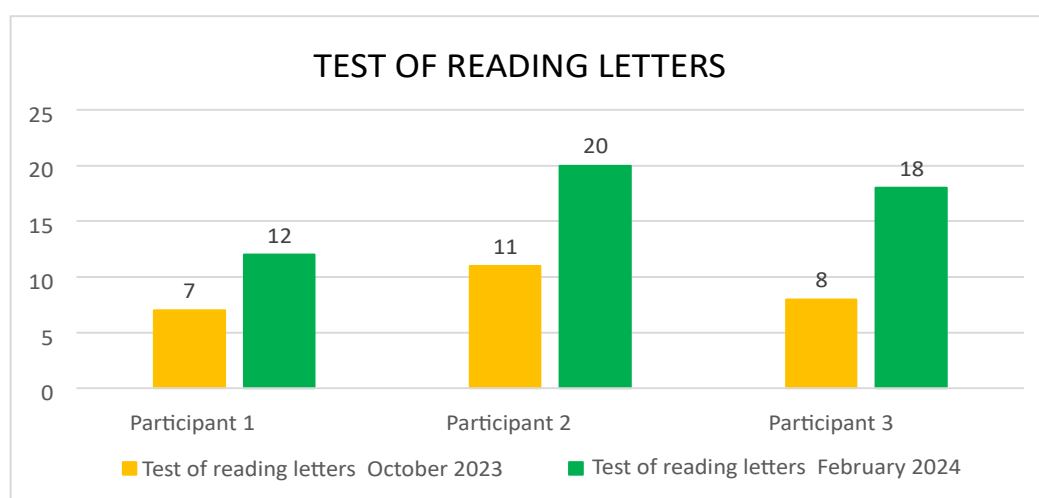


Figure 1 Comparison of participants in the letter reading subtest (pre-test, post-test)

The figure 1 clearly demonstrates improvement in Letter Reading Test scores for all three participants. In the letter reading subtest, we noted a 40% improvement in participant 2; 25% improvement in

Participant 1; and 40% in Participant 3. Participant 3 exhibited the most substantial progress, followed by Participant 2, with Participant 1 showing the smallest increase in obtained scores.

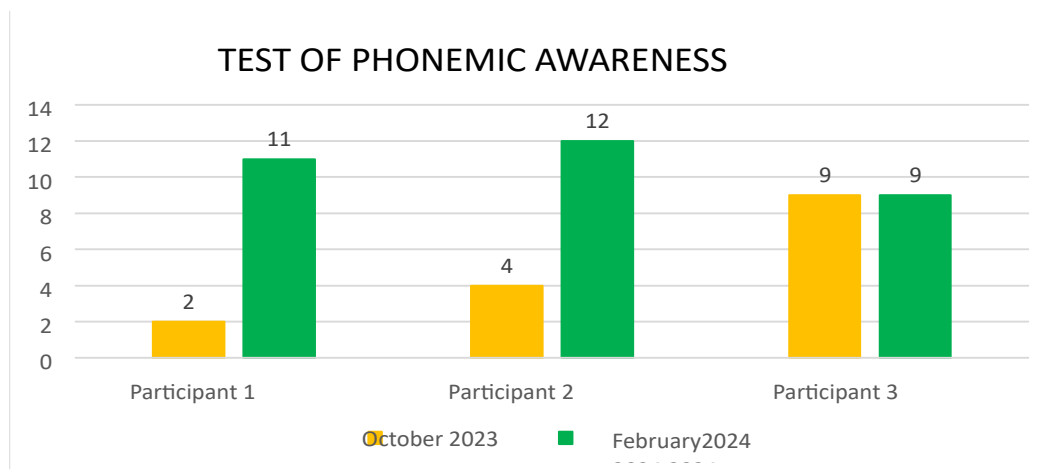


Figure 2 Comparison of participants in the phonemic awareness subtest (pre-test, post-test)

The figure 2 indicates, that in the test of phonemic awareness, between October 2023 and February 2024, the most pronounced increase in scores of 60% was observed in Participant 1. Participant 2 recorded an increase of 53.3%; and the smallest increase was recorded in Participant 3 - 0%. Participant 3 showed no significant change between the pre-test and post-test scores, a result likely attributable to language barriers, particularly difficulties with phoneme-to-word synthesis, as the participant often struggled with understanding the meanings of the words involved in the tasks. In the case of the content analysis of the participatory observatory and in the case of the Letter Reading Subtest and the Phonemic Awareness Subtest, we note progress in all monitored areas for participants, the extent of which is individual for each of them.

DISCUSSION

The present study investigated the effectiveness of an innovative musical intervention program, primarily comprising music-movement activities and colour notation techniques, implemented as therapeutic methods for pupils with specific learning disorders at the primary school level. This approach is based in the hypothesis that engagement in music creative processes can facilitate the enhancement of speech abilities, reading literacy, and writing skills among pupils with

learning disorders. The importance of incorporating artistic methods within therapeutic interventions is supported by research studies such as Dehler et al. (2016), who underscore the importance of creative arts-based approaches to promote development in specific domains such as breathing techniques, articulation, visual and auditory perception, phonemic awareness, as well as other cognitive functions. The results of our study demonstrate that both music-movement interventions and the colour notation method had a positive influence on the targeted domains.

Participant 1 exhibited notable progress in multiple aspects of reading literacy, including enhanced letter recognition and an improved ability to blend syllables into words. Nevertheless, their reading technique remains predominantly syllabic, with frequent instances of repetitive or double reading. *Participant 2* demonstrated improvements across all assessed domains. Although they continue to rely on syllabication during reading, challenges persist with longer words, often requiring assistance; at times, they produce approximations or altered versions of words. Difficulties with reading comprehension persist for *Participant 3*. At the onset of the intervention, the participant was unable to recognize all letters; however, he can now correctly identify nearly all phonemes. Participant 3 reads at a

slower pace, decoding text syllable by syllable. Overall, Participant 1 demonstrated the most significant progress in phonemic awareness and reading, accompanied by moderate improvements in writing. Participant 2 showed advancements in phonemic awareness, reading, and writing, along with slight improvements in spoken language. Participant 3 exhibited minor gains in phonemic awareness but achieved substantial progress in reading and writing, accompanied by gradual development in spoken language. The colour notation as an effective tool is based on its visual and auditory features, which support both the memorization process and the clear conceptualization of pitch and melody that the pupils are expected to play on the piano and sing (Fennell, 2021). Phonological differentiation refers to the ability to distinguish and recognize individual speech sounds (phonemes) and their contrasts within a language, offering an accessible approach for pupils with specific learning difficulties (Flaugnacco, 2015). In conjunction with the melodic-intonation approach, effective development of auditory discrimination was observed, as evidenced by improved detection and analysis of subtle pitch variations. *This enhancement in auditory discrimination facilitated more accurate pronunciation of phonemes with similar frequency patterns, extending to syllables, words, and sentences* (Besson et al., 2011).

In the development of graphomotor skills, techniques promoting a global effect of afferent stimulation were employed, significantly influencing psychomotor development. This non-invasive movement therapy comprises a series of specialized exercises, positions, and postures designed to stimulate neural structures within the brain (Osvaldová, 2024). The program included rhythmic-movement and dance activities, as well as Play songs based on a multisensory approach, which substantially contributed to improving visuomotor coordination. Participants were able to retain letters in visual memory and subsequently associate these mental images with hand and finger movements. Research indicates that visuomotor coordination development can be positively influenced by motor coordination within rhythmic-movement interpretation combined with vocal declamation

(Bishop et al., 2018). It is essential to select movement interventions that ensure precise metric-rhythmic synchronization between singing (vocal articulation), instrumental performance, and movement (Cannon & Patel, 2021).

In addition to improvements in speech, reading literacy, and writing, the stimulation methods demonstrated beneficial effects on other cognitive domains, including auditory perception, attention, memory, and sensorimotor skills. Fabiani et al. (2011) suggest that rhythmic instrumental music and dance positively contribute to the development of more precise temporal and spatial perception in the brain. Synchronization of metric pulsation and rhythmic accuracy across sounds, movements, and gestures is a fundamental requirement during dance, singing, and musical instrument performance (Hande, 2021). Instrumental music and dance serve as a natural laboratory for studying dichotic stimulation, which reveals the degree of lateralization of auditory functions. This methodology can identify the hemisphere dominant in processing speech, sounds, and music (Hall & Plack, 2009). Music interventions involving dichotic stimulation have the potential to significantly enhance phonemic awareness by strengthening specific auditory processing skills and cognitive functions related to phonological awareness (Yoo & Bidelman, 2021).

The development of students' personalities should be holistic, encompassing both cognitive and emotional dimensions. In this context, positive outcomes were observed, as students exhibited strong interest in musical interventions, particularly in playing on ethnic musical instruments, which frequently represented new experiences for them. Creativity and originality were evident in the diversity of musical techniques employed and the individualization of the creative processes, allowing for rich and varied artistic self-expression. These creative musical activities significantly enhanced pupils' interest in acquiring new knowledge, increased their engagement, and supported the cultivation of self-regulatory capacities. The implementation of modern musical interventions in the special education process has contributed to improving the quality of inclusive education for

pupils with specific learning disorders, primarily due to their positive impact on the success of the socialization process. The common foundation of the intervention consisted of inclusive educational and artistic approaches aimed at supporting pupils' development across multiple domains. This conclusion aligns with Anwar and Yasin (2024), who highlight the effectiveness of expressive therapies in enhancing communicative interactions and fostering creative abilities. Musical art, by engaging all sensory modalities—auditory, visual, motor, and kinesthetic—holds substantial capability to influence the whole person and his experience (Waluga, 2010). The process of music education provides opportunities for self-exploration and connection with others, guiding the student toward internal reflection and interpersonal engagement. Through the perception, emotional experience, and creative activity, they are able to overcome pathologically one-sided modes of perception and interpretation. Music education poses the challenge of guiding pupils to engage with dominant cultural and media productions in an approach that respects developmental principles and core anthropological constants (Gordon, 2001, 2007). It involves working with perception, expression and reflection, thereby contributing to the holistic integration of educational content. Consequently, music education offers opportunities to engage individuals with disabilities at their current developmental stage, enabling them to appropriately interpret cultural values and, according to their abilities, actively participate in creating values within the cultural context (Granero, 2021).

CONCLUSION

The primary aim of this research was to evaluate the effectiveness of an innovative music-based intervention, combining music-movement activities and colour notation, in enhancing speech abilities, reading literacy, writing skills, and emotional development among pupils with specific learning disorders at the primary school level. The results revealed significant improvements across multiple domains.

The results from the application of *colour notation* indicate that this method is an effective tool for musical interpretation, as well as for the

development of memory skills and phonemic awareness. In conjunction with the *melodic-intonation approach*, notable improvements were observed in *auditory discrimination of sound differences, evidenced by enhanced perception and analysis of subtle pitch changes*. Additionally, intonation exercises contributed to *more precise articulation of phonemes with similar pronunciation, alongside improved production of syllables, words, and sentences*.

Over the course of the 20-week therapeutic intervention, all participants demonstrated improvements in *graphomotor skills*, despite individual variability in these abilities. Within the framework of psychomotor development, *rhythmic-movement and dance activities* grounded in the principles of the innovative musical concept proved to be effective. These methods significantly enhanced visuomotor coordination by enabling pupils to more effectively integrate visual perception with hand and finger movements during writing. This improvement was further supported by metric-rhythmic synchronization of singing, movement, and instrumental performance, which reinforced motor coordination and writing proficiency. However, challenges were identified during the implementation of music-movement activities, including coordination of fine and gross motor skills, response agility, and mirror movements, which initially posed difficulties at the beginning of the therapy.

Records from the sessions confirmed the effectiveness of music therapy interventions in enhancing *communicative interaction*. The activities fostered a positive mood, facilitated tension release, and encouraged authentic self-expression through music and movement. Musical improvisations and music-movement games stimulated participants' creativity, reflected in original musical expressions. Creativity and originality were evident in the diversity of musical techniques employed and in the individualization of the creative processes, which enabled rich and varied artistic self-expression. The initially lower engagement of students was attributed to the need for adaptation to new conditions within the educational process; however, over the course of several sessions, a stable and safe

environment was established that supported inclusion, motivation, and active participation.

Based on the previously discussed findings, it can be concluded that innovative music-movement activities, alongside colour notation, constitute effective interventions for enhancing speech abilities, reading literacy, writing skills, and communicative interaction in pupils with learning difficulties profiles. Their implementation is particularly beneficial in early primary education and in special educational counseling centers. Alternating musical activities involving rhythm, singing, and instrumental activities create a supportive educational environment that minimizes performance-related stress. The research indicates that appropriately selected stimulation methods can positively impact development, even among pupils with diverse native languages or special needs, when implemented effectively within an inclusive setting.

LIMITATIONS

The present study has several limitations that should be acknowledged when interpreting the results and designing future research. The heterogeneity of the sample, characterized by varying manifestations and deficits in psychomotor abilities, may impact the objectivity and generalizability of the findings. The natural heterogeneity present in inclusive

classrooms highlights the necessity of an individualized approach. An important factor influencing the objectivity of the research results is also the professional expertise of the therapists and educators implementing the music therapy interventions. Their experience and proficiency in adapting music therapy techniques to the specific needs of the pupils with learning disorders represent a significant determinant for achieving effective outcomes following the program implementation. These limitations should be taken into account when evaluating the study's results and when designing future research.

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DECLARATION OF INTEREST STATEMENT

The author reported no potential conflict of interest

ETHICS DECLARATION

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the Comenius University, in 2024.

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