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THINKING OUTSIDE THE BOX WHEN MUSIC EDUCATION INTERSECTS WITH CREATIVE PROCESSES IN THE CONTEXT OF SPECIFIC LEARNING DISORDERS

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Abstract:
This research explores how students with Specific Learning Disorders (SLD), such as dyslexia, engage in creative processes. It aims to change the common perception of dyslexia as primarily a limitation, highlighting instead the unique strengths and perspectives these students bring to their creativity. By showing their innovative capabilities, we provide a more balanced view that recognizes their potential beyond the challenges they face. The study aims to (i) elucidate the distinctive creative behaviors and innovative problem-solving abilities exhibited by neurodivergent musicians; (ii) underscore that students with dyslexia possess a notable capacity to synthesize ideas in unconventional ways, accompanied by profound emotional engagement and authenticity in their artistic expression; (iii) recognize the difficulties faced by students with SLD in managing complex musical scores and motor coordination. Ultimately, this empirical review critically assesses the effectiveness of interactive, self-directed teaching methodologies and advocates for personalized, multisensory instructional strategies.

Keywords: creativity, cognitive adaptation, music learning, specific learning disorders

1. Introduction

This research explores how students with Specific Learning Disorders in music and other artistic fields can develop creativity, which encompasses both innate imaginative expression and measurable skills that allow individuals to transform their potential into appreciated works of art. Consequently, in line with most contemporary theories of creativity, training approaches deliberately focus on specific, distinct aspects of this complex and often debated phenomenon (Huovinen, 2021). Indicators of creativity in music can be assessed through the cohesive interplay of compositional elements, which collectively contribute to a sense of unity. Enhancing emotional intensity—a process that

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intertwines both intrinsic and extrinsic complexity—activates a multifaceted network of perceptual and cognitive relationships (Schiavio et al., 2017).

Furthermore, the aspect of originality, characterized by novelty and differentiation, conveys authenticity to listeners. This authenticity, in turn, helps the audience feel appreciated for their focus on genuine expression, evoking sincere emotional responses that resonate with their past experiences (Umar Rauf et al., 2023). Such dynamics underscore the intricate relationship between musical creativity and the listener's emotional engagement, establishing a profound connection through shared human experiences.

This study adopts a research approach that moves away from traditional subjective and procedural views of creativity, focusing instead on its measurable aspects because it emphasizes quantifiable features. A creative idea is characterized by novelty, a key trait driven by efforts to produce results that are both innovative and beneficial. This viewpoint connects the personal experience of creative processes with the objective evaluation of the outcomes, leading to a deeper understanding of the relationship between individual creativity and assessment criteria.

2. Purpose of Study: Creativity as Cognitive Adaptation

There are established areas of research validating the effectiveness and stability of using music as an integrative and supportive practice in treating children with specific reading learning disorders. While fully understanding the neurocognitive rationale behind these approaches is essential, we believe it is equally important to devote time and energy to understanding the specific learning challenges that students with SLD face daily in musical contexts.

The primary focus of this study is the creative processes of students with dyslexia and, more broadly, SLD. The research objectives encompass several significant aspects: creative responses as cognitive adaptation; cognitive transcoding functions; creative dynamics involving the interplay between flexibility and persistence; contexts of divergent thinking; embodied musical cognition; and musical creativity as a form of cognitive restructuring and self-actualization.

The literature review was necessarily extensive, though it was not systematized—nor did it yield analytical classification criteria—as these were not the primary goals of the work. Our main aim was to highlight the theoretical models and methodological perspectives implicit in the research examined.

Consequently, the study reveals, on the one hand, a wide range of models that can be translated into educational initiatives and teaching tools. On the other hand, a clear bottleneck is evident regarding methods, teaching technology, and the definition of inclusive, specialized teaching practices.

The creative process in specific learning disorders responds to *the need to redefine and cultivate a new internal mental space*, fostering new cognitive connections and opening up alternative pathways for intellectual and personal growth. Highlighting this process can help instill confidence and motivation in neurocognitive adaptation and resilience.

Seen from this perspective, the "creative process" in specific learning disorders is, in fact, a functional adaptation to learning difficulties. Therefore, in terms of neuroplasticity, functional creative adaptations encourage the brain to expand and specialize its neural network with new connections to compensate for specific deficits. Furthermore, simulating alternative realities or potential solutions enhances the ability to think ahead (Khalil et al., 2019).

The conceptual framework proposed by Schiavio & Benedek (2020) offers a transformative perspective on creative cognition, framing it as an ongoing process of skillful adaptation between organism and their environment. Not casually, individuals with dyslexia perceive creative expression as a continuous, dynamic process of adaptation to contextual challenges, rather than an episodic occurrence of "enlightenment." This suggests that the original modes of information processing facilitate innovative avenues for emotional expression and problem-solving.

3. Literature Review: Theoretical Background

Creativity is often viewed as stemming from individual inspiration, sparked by brainstorming or sudden insights, leading to tangible results. However, its true significance emerges within social, cultural, or historical contexts (Lage-Gómez et al., 2024). This perspective highlights the social, functional, and systemic aspects of creativity. While personal exploration is essential, the outcomes are always rooted in a social foundation (Elisondo, 2016).

Second, creativity, which is sometimes perceived as an instantaneous or progressive elaborative process, is in fact marked by temporal and energetic fluctuations. From a neurocognitive standpoint, this promotes activation and facilitates the development of formal, sensory, perceptual, and cognitive qualities, foundational for recognition and memory, emphasizing the dynamic interplay between physiological states and cognitive activities in the production of creative thought. This viewpoint situates creative and cognitive faculties within an embodied and enactive framework.

Creativity can be conceptualized as a *recursive and continuous flow* that extends beyond isolated instances of intuitive insight. This perspective necessitates a continual reevaluation and refinement of one's cognitive frameworks and conceptual models. Consequently, action emerges as an integral component of the creative process, particularly in adapting to environmental dynamics (Cseh, 2016).

Third, creativity inherently draws upon a shared linguistic and lexical heritage, featuring sonic and gestural qualities that can elicit shared emotional and rational responses, as well as symbolic and figurative triggers.

As in verbal language, musical creativity extends beyond the text, working on intonation and rhythmic variability. These formal, structural, and functional elements, which, in a certain way, correspond to prosody, suggest expressive sonic actions, akin to the richness of nonverbal gestures, thereby enriching and adding meaning (Fabiani et al., 2010).

3.1 Transcoding Function of Creativity

Creativity's holographic essence establishes a continuous feedback loop between specific actions and the overarching system. By allowing the whole to be perceived within its localized parts, this perspective unifies individual personal growth (*Bildung*) with the parallel development of a cohesive structure (*Gestalt*).

The creative transcoding function, previously underscored across psychological, neural, social, emotional, and cognitive domains, is now being emphasized once more. This function is inherently multisensory, featuring multimodal neural representations linked through interconnected activity patterns that build upon existing neural structures (Thagard & Stewart, 2011).

The interactive process of creativity flourishes and evolves through a dynamic interaction that links personal actions with environmental constraints and resources, integrating both structural and processual elements into a single embodied experience.

This is what is called action-centered interaction. This aligns perfectly with the idea that the mind does not reside solely in the brain, but is extended, integrated, and enacted to form a whole system, describing a dynamic process in which thought and action occur simultaneously. In other words, creativity arises from thinking in action, in situations where bodily movement, perception, and cognition merge (e.g., music, dance, martial arts, painting, sculpture, etc.). The learning environment and scenario presented here reflect the dynamics of a co-evolutionary system. This implies that creative work is a collaborative endeavor that forms through the interaction of individuals and their surroundings, not just an intellectual and inward process (Malinin, 2016; Schiavio & Kimmel, 2021; Shimizu & Okada, 2022).

3.2 Flexibility and Persistence

Any supportive integration between creative tactics and strategies in music learning claims continuous cognitive updating. This process breaks down mental rigidity, enabling musicians to overcome learning plateaus. This cognitive flexibility allows students to adapt to complex, simultaneous demands, such as auditory processing, motor control, and emotional regulation, thereby improving overall execution and interpretative problems. (Hao et al., 2023; Gkintoni et al., 2026).

Creative thinking can manifest when the endeavor to generate ideas and solutions is rooted in a methodical and comprehensive examination of a finite set of categories, a process characterized by persistence. This exploration allows for the coexistence of seemingly contradictory approaches, enabling diverse methodologies to interact and enrich each other. By leveraging both paradigms, the creative process seeks to maximize the potential of each approach, thereby facilitating more innovative outcomes (Nijstad et al., 2010; Lucas & Nordgren, 2015; Lu et al., 2017).

While a flexible dynamic of cognitive approaches is valuable because it allows for the intersection of seemingly unrelated ideas, a thorough and ongoing exploration, focused on specific categories, allows for detailed analysis and can reveal details and practical applications that would otherwise remain obscure.

The playful, creative, and exploratory application of divergent thinking in individuals with SLD encourages the development of specific cognitive strategies, emphasizing the generation of multiple and unexpected solutions. This approach fosters neurocognitive reorganization that is advantageous for spatial reasoning and imaginative mental processes, and typically involves atypical information handling.

On the other hand, the *interaction of multiple cognitive processes* and highly integrated yet seemingly opposing brain functions—such as spontaneous mind-wandering (Default Mode Network) and deliberate, rule-based concentration (Executive Control Network)—is the feature and hallmark of creative thinking, characterizing it in all its intrinsic complexity.

Therefore, it cannot be reduced to a simple sequential mapping of neural networks; rather, it involves complex nonlinear interactions among cognitive processes and requires a thorough understanding of cognitive dynamics (Barnett & Vasiu, 2026). In fact, during particularly engaging musical activities, people often experience a state of total immersion in the flow of expression. This manifests as an altered perception of time and heightened self-awareness, while maintaining full control over the gestural, temporal, and rhythmic dynamics of the performance.

This experience also requires a balance between the difficulty of the activity and the individual's skill level.

The creative flow presents itself as a unitary experience that includes a high level of concentration, in which musical thought does not distinguish between the physical body that acts (Körper) and the body acted and experienced (Leib), a state in which awareness and sense of control coincide without placing limits on the activity itself. This deep unity between mind and music directly challenges traditional dualistic perspectives, instead grounding creativity in embodied cognition (Abraham, 2014).

3.3 Multiple Ways to Solve a Single Problem

Throughout the musical creative process, characteristics of both divergent and convergent thinking emerge. The production of original ideas is often rapid and meaningful when mediated by contextual norms and practices. At the same time, creative thinking shows persistence when committed to expressive, performative, and interpretative objectives and attributes (Doyle, 2017). These approaches allow individuals to leverage their strengths, fostering new ways of acquiring knowledge.

Indeed, divergent thinking is an essential tool for cognitive adaptation for people with specific learning disorders (SLD) or neurodivergent traits. It enables overcoming the obstacles of linear learning by generating multiple, personalized solutions to various problems.

The focus shifts to processes that suspend the search for an immediate executive outcome, allowing time and cognitive space for exploration and ideation, thus offering the opportunity to generate multiple potential responses rather than a single "correct" response.

Music learning contexts in which divergent thinking helps develop cognitive adaptation tactics and strategies that bypass rigid symbol-based coding methods, relying on sensory integration, associative processing, and creative problem-solving, thus transforming cognitive difficulties into strengths in artistic expression.

The functioning of the nervous system is intricately linked to the interplay of auditory, proprioceptive, and visual feedback mechanisms. This integration is essential for harnessing associative connectivity within working memory, which helps maintain instructions and information. Such cognitive processes facilitate the exploration of alternative solutions and the generation of innovative musical concepts. Moreover, this dynamic interaction demands cognitive flexibility, enabling individuals to adapt their thought processes and approaches. Concurrently, it necessitates inhibitory control, which is crucial for transcending established patterns and habits. By regulating attention and automatic responses, individuals can cultivate opportunities for creative change in their musical practice (Gilhooly, 2007; Benedek et al., 2014; Vaisarova & Carlson, 2021).

3.4 Musical Thought and Its Embodiment in Phonological Forms

The relationship between musical thought and its embodiment in phonological forms is a complex and multifaceted area of study. This interplay can be understood through the lens of how individuals engage with and experience music on both cognitive and sensory levels. Phonological embodiment refers to the way in which sound patterns and structures manifest in our understanding and perception of music (López & Anta, 2023). This encompasses the rhythmic, melodic, and harmonic elements that form the basis of musical compositions, as well as how listeners perceive and internalize them. The cognitive processes involved in music cognition are influenced by both the physical properties of sound and the neural mechanisms that process these sounds (Collins et al., 2014). Experienced processing focuses on how individuals interact with music in real time, drawing on their personal histories, emotional responses, and contextual frameworks.

This aspect emphasizes the subjective nature of musical experience, in which listeners may interpret and engage with music differently depending on their backgrounds, emotional states, and cultural contexts. By examining the dynamics between phonological embodiment and experienced processing, researchers can gain insights into the cognitive mechanisms underlying musical understanding and appreciation.

This exploration can also shed light on broader questions related to creativity, expression, and the role of music in human culture. Investigating the balance between the abstract elements of musical thought and the tangible experiences they evoke offers rich potential for enriching our understanding of music as a vital aspect of human experience.

Musical thinking in individuals with dyslexia seeks to avoid the rigid challenges of phonological processing of written language by favoring holistic, visuospatial, and auditory representations of information. Musical engagement improves associative processing, working memory, and even the communicative and symbolic meaning of musical action, thereby facilitating the rapid recombination of ideas in real time (Pino et al., 2024; Peng, 2025).

Furthermore, promoting an *internal sense of rhythm and metrics* offers an alternative, highly personalized path for temporal and motor expression, with concrete possibilities for overcoming motor-temporal conflicts in executive tasks that require instantaneous rhythmic replication or continuous synchronization (Carboni, 2025).

Consequently, this approach shifts the focus from academic shortcomings to creative strengths (Runco & Acar, 2012; Bellemare-Pepin & Jerbi, 2025). It also allows for flexible information manipulation, which is extremely effective in addressing the difficulties arising from any educational challenge.

Creative approaches to solving various types of problems benefit from using tools such as patterns, diagrams, models, and mind maps. These techniques not only support learning but also stabilize cognitive processes, thereby improving understanding and retention of information. Ultimately, they enhance executive awareness by promoting a more structured thinking approach. Engaging in diverse tasks continuously fosters neurocognitive restructuring, altering how information is processed. As a result, attention can shift from phonological or sequential modalities to more visuospatial, motor, and proprioceptive modes (Carboni, 2026).

3.5 Creative Learning and Self-Realization

Two primary hypotheses encapsulate the understanding of creative strengths in individuals with Specific Learning Disorders. First, there are strategic nonverbal behaviors that serve as adaptive responses. Second, there is a neurobiological overcompensation that leads to heightened activity in brain regions associated with creativity. Regarding cognitive profiles, individuals with dyslexia typically exhibit a global information-processing style, often associated with creative thinking. This allows them to forge connections between seemingly unrelated elements, often through unconventional methods. Furthermore, they tend to exhibit enhanced visuospatial reasoning and display significant figurative creativity, typically reflected in higher performance on tests measuring specific dimensions of creative thinking (Cancer et al., 2016).

The study of compensatory neural mechanisms in dyslexia has generated many intriguing hypotheses, but researchers often do not fully agree on these ideas. When considering creativity as a broad concept, no significant differences are observed between individuals with dyslexia and those without (Erbeli et al., 2021; Majeed et al., 2021). However, when examining specific types of divergent thinking, notable differences do emerge. Significant results are found in areas such as fluidity, originality, abstraction, elaboration, and flexibility. These advantages in creativity tests may be attributed to specific processes or outcomes related to originality and fluency (Cancer & Antonietti, 2019) or to an enhanced overall capacity for visuospatial processing (von Karolyi et al., 2003).

Cognitive compensation in specific learning disorders (such as dyslexia) is viewed as a form of neuroplasticity in which the brain reorganizes itself to overcome deficits in key processing areas.

This process involves shifting from specialized, underactive networks to more generalized alternative systems to bypass these deficits. Compensatory mechanisms are believed to develop over time. For instance, hyperactivation in both the left and right inferior frontal gyrus in individuals with dyslexia is age-related (Shaywitz et al., 2003; Hancock et al., 2017).

The *dyslexic advantage* often noted in creative, holistic, and visuospatial tasks is typically linked to the right parietal cortex. This area is crucial for spatial perception, visuomotor control, and directing attention. It is not surprising, then, that this neural region plays a fundamental role in the neurocognitive processing of music, particularly in tasks such as conscious recall, melody recognition, rhythm discrimination, and higher-order auditory spatial orientation (Schaal et al., 2015).

Musical processing fosters a distinctive neurocognitive profile. It balances hemispheric processing and enhances interhemispheric connectivity through the posterior corpus callosum. This leads to atypical lateralization, allowing hyperactive language processing to be distributed across frontal networks while also stimulating subcortical regions, such as the basal ganglia. As a result, this enhances creative problem-solving skills (Villar-Rodríguez et al., 2024).

The relationship between musical processing and neurocognitive development presents a fascinating area of exploration for understanding the brain's organization and functionality. By facilitating balanced hemispheric processing, musical engagement supports cognitive functions, particularly in language and creativity.

Indeed, the observed enhancement of interhemispheric connectivity via the posterior corpus callosum indicates that musical training may foster integrative cognitive processes, leading to a more holistic approach to problem-solving. (Steele et al., 2013) The activation of subcortical regions, such as the basal ganglia, further supports the notion that musical training engages a broad neural network, potentially enhancing executive functions and adaptive learning strategies (Miendlarzewska & Trost, 2014).

The empowerment of music curricula could not only promote cognitive flexibility but also support emotional and social development. Furthermore, longitudinal educational practices could elucidate whether the benefits of musical training persist over time and across different contexts, adding to our understanding of its role in fostering lifelong learning and adaptive skills.

3.6 Musical Creativity and Cognitive Restructuring

The combination of creative and exploratory play (bottom-up learning) and structured creative tasks (top-down learning) promotes both the formation of new neural connections and the practical application of these strategies in solving everyday problems. Consequently, to the extent that creativity involves making new connections, connecting disparate ideas and unusual combinations becomes a key component of creative thinking in individuals with dyslexia.

Developing compensatory strategies enables students to achieve educational goals by reducing anxiety and leveraging their strengths, rather than focusing solely on difficulties. In music pedagogy, approaches that support and enhance expansion, connection, and reorganization procedurally reproduce the processual qualities and cognitive stages of creativity.

The simple act of learning to play a musical instrument causes the brain to adapt and reorganize. This process radically transforms neural architecture, inducing structural and functional neuroplasticity.

This is because it simultaneously activates auditory, visual, and motor networks, strengthening white-matter connectivity, increasing gray-matter density in sensorimotor regions, and creating complex multimodal networks (Rodrigues et al., 2010; Olszewska et al., 2021).

Furthermore, to the extent that music education activities are designed to include exploratory, playful manipulation of sounds, problem-solving, and multimodal interaction across different domains of cognitive experience, they almost mirror the procedural stages of creativity (expansion, association, and reorganization). Consequently, this dynamic engagement actively stimulates cognitive networks by integrating auditory perception, kinesthetic control, and visual processing, as outlined by the embodied, embedded, enactive, and extended (4E) model of musical creativity (van der Schyff et al., 2018).

Therefore, musical improvisation and opportunities for creative invention and independent exploration in general serve as a form of real-time exploration, forcing the brain to form new neural pathways and expanding the cognitive abilities of the students involved (Rodrigues et al., 2010; Wan & Schlaug, 2010; Bashwiner, 2018; Chatterjee et al., 2021; Jäncke, 2025).

This also paves the way for psychological adaptation, fostering identity development through self-regulation strategies, enabling students to manage performance anxiety, and ultimately creating a new, more confident self-image.

3.7 Paradoxes and Non-Contradiction: The Generative Engine of Creativity

Creative behavior in individuals with SLD appears to operate within a paradigm that is either opposite to, or at the very least complementary to, the one outlined by implicit theories of creativity—that is, the models of thought that correspond to the most widespread beliefs people express when they think about creativity.

First, creativity as an adaptive behavior does not guarantee the success of a creative idea; rather, its validity lies in an attitude of active inquiry, of non-passivity. Second, and as a consequence of the previous one, every student with dyslexia is the first to doubt that the creative solution contains the seeds of artistic excellence; each of them knows from experience that there is work to be done.

Third, the very fact that the creative response of people with SLD manifests itself in terms of adaptive organization, functional to overcoming a learning problem, helps us dispel the myth of inspiration or intuition of otherworldly origin.

Fourth, intersubjectivity and the sharing of objective knowledge foster the development of creative processes in interactions between students with learning disorders and other students, significantly reducing the allure of loneliness as a precondition for creativity.

Fifth and finally, the vast body of research conducted in recent years highlights the substantial sharing of creative attitudes, tactics, and strategies among individuals with learning disorders. This makes it difficult to argue that creativity is a rare or unique gift (Benedek et al., 2021).

The need for the dyslexic student to constantly monitor and control his cognitive behaviors and, consequently, his adaptive and creative responses makes the metacognitive framework closely resemble the one proposed by Lebuda and Benedek (2023) in their *systematic framework of creative metacognition* (CMC).

4. Methodological Perspectives

4.1 Cognitive Profile and Valorization of Music Learning in SLD

Scientific literature acknowledges, with some distinctions and occasional hesitation, that individuals with learning disorders, such as dyslexia, can exhibit unique cognitive profiles. Under certain contextual and procedural conditions, these profiles may promote specific aspects of creative thinking, such as divergent thinking and the generation of original ideas. These cognitive traits form the basis of modern strengths-based educational programs, which encourage alternative problem-solving strategies rather than focusing solely on academic deficiencies.

Recent research indicates that dyslexic students may develop enhanced creative abilities as they progress through school, potentially as an adaptive response to their challenges with reading and writing.

While dyslexic elementary school children show levels of flexibility and originality similar to those of their peers, significant differences emerge in middle school, where they often outperform non-dyslexic students on specific measures of creativity, leading to a progressive increase in their originality.

This suggests that individuals with dyslexia may develop creative abilities as an adaptive response to the challenges they face with literacy. Over the school years, this response tends to grow, leading to learning patterns that help offset the decline in creativity often seen in their peers. Additional research indicates that educational approaches that do not rely on "normalization" strategies can further enhance these creative strengths (Cancer et al., 2026).

The relationship between dyslexia and creativity remains poorly understood, despite various definitions of creativity in the research literature. However, a general connection has been identified, particularly indicating that individuals with dyslexia tend to achieve higher scores in certain areas of divergent thinking. Studies involving adults and adolescents reveal that those with dyslexia often excel at forming unique combinations of ideas and exhibit strong conceptual fluency (Gutiérrez-Ortega et al., 2023).

The connection between specific learning disorders and creativity is often linked to a preference for global, holistic, and visuospatial processing, rather than sequential or linear thinking. Because these factors are influenced by age and education, the creative advantages in younger children may not always be apparent. Research shows that educational approaches can significantly impact expressive creativity, either fostering or hindering the creative potential of neurodivergent students (Magenes et al., 2021).

Research on creative thinking in individuals with SLD, especially those with developmental dyslexia, shows that although they face challenges with traditional academic tasks—particularly those requiring verbal and linguistic skills—they often possess unique cognitive strengths in nonverbal and visuospatial areas. Recent studies suggest that dyslexia should be viewed not only as a disorder but also as a specialization that fosters exploration. Individuals with dyslexia tend to think outside the box and make connections between unrelated concepts. Additionally, adaptive compensation, particularly in terms of enhanced creativity, emerges in adults with dyslexia as a response to the reading and writing difficulties they experience (Taylor & Vestergaard, 2022).

The emergence of *adaptive compensation* illustrates how individuals continuously adjust their learning and problem-solving strategies. Instead of relying on traditional rote memorization or strictly linear processing, adults with reading difficulties often develop alternative coping mechanisms characterized by strong associative thinking and holistic processing. These skills are linked to enhanced problem-solving abilities and divergent creativity.

Research on adult readers indicates that those who successfully compensate for early reading challenges often utilize different brain regions, such as the right superior frontal gyrus and the middle temporal gyrus, to orient themselves and interpret text. Targeted educational interventions can accelerate their progress and help develop essential reading skills (Cancer et al., 2016; Megari et al., 2025).

Research has indicated that children with dyslexia often exhibit nonverbal creative abilities that are significantly greater than those of their typically developing peers, regardless of age or grade level. However, creativity does not appear to be closely linked to nonverbal intelligence or literacy skills. Acknowledging the creative strengths of dyslexic children is an important shift in educational support. Instead of focusing solely on literacy challenges, educators and clinicians should incorporate these children's unique creative problem-solving skills into personalized interventions and diagnostic assessments (Lam & Tong, 2021).

4.2 Cognitive Complementarity as Pedagogical Framework

Shifting from a deficit-based model to a strengths-based approach means no longer viewing dyslexia simply as a disorder. Instead, we recognize it as a type of neurodivergent cognition that excels in spatial reasoning, holistic thinking, and complex problem-solving.

An educational framework that prioritizes enhancing a student's unique cognitive strengths rather than systematically correcting their weaknesses can lead to better outcomes.

While neurotypical cognitive organization tends to focus heavily on exploitation processes—such as details, rules, and sequences—individuals with dyslexia often specialize in rapidly exploring environments and situations, making connections between unusual and disparate ideas.

From this perspective of cognitive complementarity, dyslexic individuals often exhibit improved visual memory and advanced narrative reasoning. Furthermore, because they must navigate a world designed for linear and phonetic learners, dyslexic individuals are naturally encouraged to develop their problem-solving and emotional coping skills continually.

It is essential to consider the differences in the cognitive profiles of dyslexic children and their peers without reading difficulties. However, it is also important to recognize that having reading difficulties does not necessarily equate to a decline in the functional quality of other cognitive abilities.

Research conducted over the past few decades suggests that the creative abilities and divergent thinking of dyslexic children can be comparable to, or sometimes even surpass, those of their peers without such difficulties. As a result, adopting a different perspective on the creative cognitive strategies used by dyslexic students could significantly influence the planning and implementation of alternative, effective educational approaches (Bigozzi et al., 2016).

According to Dietrich (2004), creative thinking arises from normal mental processes. The same neural circuits that process specific information to create conventional combinations are also responsible for generating creative or innovative combinations of that information.

It is now evident that any pedagogical approach aimed at integrating specific learning disorders into the curriculum must transition from traditional text-based instruction to a multimodal approach. This new approach should incorporate nonverbal and creative methods, such as music, visual arts, and physical expression.

This shift in pedagogy is rooted in the fundamental principles of Universal Design for Learning, which advocates for multiple means of representation, expression, and engagement in inclusive educational settings—not merely for special or supplementary education. The objective is to help individuals with learning disabilities overcome verbal barriers, boost self-esteem, and nurture the unique and valuable qualities of each person.

A second essential element of this pedagogical framework is the active and participatory construction of meaningful, relational, and socially situated learning. We understand embodied learning as not just the integration of physicality or motor skills into musical education, but as a broader approach to the cognitive encoding and decoding of sound experiences, acknowledging their various symbolic, formal, and structural values.

Additionally, while music, along with the visual arts and theater, offers students with learning disorders valuable tools for expression and communication, which help them navigate institutional curricular barriers, it is increasingly clear that simultaneously engaging the visual, auditory, and kinesthetic channels enhances cognitive processing and improves memorization.

4.3 A Localized and Diffuse Neural Network

Specific challenges in phonological decoding characterize dyslexia. However, some functional neuroimaging studies indicate that the brain's compensatory mechanisms often adapt by utilizing significant portions of the right hemisphere and frontoparietal networks. This structural and functional arrangement appears to enhance macro-level thinking, exploration, and creative cognition. It is important to note that musical creativity depends on a complex, domain-specific neural network. Research shows that the right fusiform gyrus is essential for holistic processing, such as reading musical notation. Meanwhile, the right postcentral gyrus and the surrounding motor and somatosensory areas play a crucial role in integrating bodily feedback during improvisation and performance.

Research suggests that a specific development in the right hemisphere of the brain, as well as enhanced functional connectivity in these areas, is often linked to the ability to think holistically and to engage in musical creativity (Beauchamp, 2005; Zhang et al., 2016; Proverbio et al., 2024; Arias Gómez, 2025).

Regardless of the creative methods and processes used to generate new and original ideas, the transition into creative behavior is governed by circuits in the prefrontal cortex. The activation of these circuits heightens awareness of novelty and helps assess its appropriateness, facilitating its expression in creative forms (Dietrich, 2004).

The functional hierarchy of the brain suggests that while the prefrontal cortex is not the sole seat of creativity, it plays a crucial role in integrating conscious experiences. In this framework, conscious and deliberate creativity is primarily driven by the anterior part of the brain. In contrast, spontaneous intuition originates in the posterior and inferior regions, specifically the temporal, occipital, and parietal lobes.

Experimental observations suggest that intuitive creativity may result from a *blurry form* of attention that coexists with the ability to focus on relevant information deliberately. This dual mechanism appears to be essential for both creative thinking and problem-solving (Dietrich, 2004). Creativity showcases cognitive flexibility, allowing individuals to break from traditional patterns and embrace new rules to cultivate diverse forms of thought.

Essentially, knowledge is organized and manipulated in different neural structures, particularly in the frontal and prefrontal cortex. Therefore, it is important to understand the interplay between knowledge and creativity, as well as the distinct functional characteristics that define creative thinking, including both productive and reproductive thinking (Dietrich, 2004).

To effectively translate these neurobiological and neurocognitive insights into impactful educational projects and teaching activities, it is crucial to be clear and mindful when setting educational objectives and selecting appropriate teaching methods.

Creativity is essential to educational development, as it supports various stages of learning and problem-solving, particularly in the implementation of curricular proposals for children with specific learning disorders. The activation of creative motor and gestural skills enhances reflective and critical thinking processes. This happens because awareness of one's body encourages the exploration of diverse and meaningful approaches to producing personal and alternative solutions (Di Palma & Tafuri, 2024).

In a study by Tarver et al. (1979) on attentional strategies in individuals with SLD, the researchers found a notable tendency for these individuals to learn and memorize secondary information readily. This often led to a diversion of attention from the primary task, rather than focusing on the central information necessary for problem-solving and dismissing what is considered less relevant. Consequently, divergent thinking was prevalent over convergent thinking, suggesting a form of out-of-the-box reasoning akin to creative thinking.

Research has shown a negative correlation between selective attention and creativity among students with learning disorders, but this relationship varies by age group. In younger children, there is a strong correlation between figurative originality and selective attention, while in older children, selective attention shows some correlation with originality but not with fluency (Cancer et al., 2016).

Many researchers are hesitant to rely solely on fluency scores. While fluency is important, originality and flexibility are considered more critical. A fluent individual generates numerous ideas, whereas an original individual seeks out or conceives new ideas.

Additionally, a flexible and coherent approach encourages the production of diverse ideas drawn from a wider range of conceptual categories (Bigozzi et al., 2016). Another study (Shondrick et al., 1992) found a positive correlation between creativity and interpersonal problem-solving ability in students with learning disorders. Although these students may struggle with analyzing and formulating problems using relevant aspects, they often achieve high scores in verbal fluency. In this context, verbal fluency is associated with the ability to analyze problems and utilize alternative solutions (Cancer et al., 2016).

5. Didactical Framework

5.1 Creative and Intersubjective Components as Neurocognitive Constants

The contribution of the great musical traditions (Dalcroze, Orff, Kodály) to the creation of effective teaching resources to support students with specific learning disorders' musical literacy has long been debated. What should the teaching framework be for rhythmic, rather than melodic, coding and decoding exercises aimed at improving music reading skills?

One primary goal is to prevent cognitive overload and interference between the processing of rhythmic-motor spatiotemporal development (such as tempo, rhythm, durations, pauses, etc.) and melodic-intonative development (including intervals, distances, relationships, etc.). This goal can be achieved through educational practices that start with individual and collective motor appropriation, which are then complemented by exercises in syllabic articulation and overlapping rhythmic patterns.

The learning process begins with the internalization of rhythm and fundamental rhythmic structures through common, everyday movements like walking, clapping, or swaying. This is followed by coordination and synchronization between functional movements and external rhythmic cues created by the teacher or other classmates. During these phases of learning, body percussion and rhythmic syllabification help students become more aware of the relationship between their performance and the sounds they produce.

The coding of musical actions is based on kinesthetic and tactile learning, as well as the use of structured materials. This approach helps develop forms of transcription that precede traditional paper transcription.

To reinterpret Dalcroze teaching—and even extend beyond it—in an embodied way, we need more than just a concept of a multisensory musical learning experience. It is essential to incorporate the creative and interpersonal components of interaction with peers and the teacher.

In fact, even the simplest auditory-musical event—whether perceived, interacted with, or performed—extends beyond merely regulating the spatial and temporal aspects of motor coordination. Such events can become a source of shared, interactive meaning, leading to spontaneous or intentional behaviors, whether exploratory or formalized, and facilitating self-regulatory and interactive processes (Altenmüller & Scholz, 2016).

In Jacques-Dalcroze's pedagogical principles of eurythmy, the distinction among implemented educational practices, methodologies, analysis of the educational context, specific learning objectives, and general educational goals is not always immediately clear.

It is possible to highlight certain *educational and neurocognitive constants*, such as *the connection between music and motor responses*. This connection begins with an enhancement of neuromotor activation, known as entrainment. When a person listens to a rhythm, it stimulates the generation of low-frequency brain waves that help synchronize brain activity with the sound event (Ten Oever et al., 2017; Rosso et al., 2023; Dupont et al., 2025).

As a result, the release of neurotransmitters like dopamine and endorphins promotes and stabilizes motor synchronization, influencing impulses, accents, pauses, and more. This process helps create predictive models of movement organization in both space and time (Alm, 2021; Zalta et al., 2024).

There are also *biunivocal, affective, and intersubjective relationships between bodily movements and various musical rhythms*. These relationships re-establish coherence among our phenomenal experience of time, narrative forms, and gestural and musical intentions (Trevarthen et al., 2011; Laroche et al., 2014).

Creative musical activities can help develop a sense of rhythm and enhance rapid responses by using auditory stimuli, typically of a rhythmic nature, to synchronize neural oscillations within a playful context.

This process aligns brain waves with rhythm, optimizing processing speed and reducing reaction time. When we also consider the activation of the basal ganglia and the supplementary motor area, which promote anticipation of auditory stimuli before they occur, it becomes clear how the brain prepares for the execution of quick motor responses (Boyarsky, 2009; Emmery et al., 2023).

Moreover, *musical activities can improve concentration, awareness, and motor control related to musical executive functions*. In recent years, academic literature has sought, with mixed results, to clarify the neurocognitive benefits of musical activities.

Research has focused on the hypothesis that rhythmic musical stimulation enhances attention by inducing multifrequency oscillatory neuronal activity originating in the motor system and closely connected to the auditory system (Dumont et al., 2017; Loui & Guetta, 2018; Anand, 2022).

5.2 Thinking Outside the Box

Curriculum adaptation, also known as continuous context modification, is an effective educational framework for teaching music to students with learning disorders. This approach employs various teaching techniques that encourage *lateral thinking*. These techniques include breaking down and reorganizing components, segmenting tasks into smaller units, and utilizing multisensory supports, such as tactile, visual, and olfactory stimuli.

Among the different forms of *lateral thinking in music*, the deconstruction and reorganization of familiar musical elements—such as rhythm, melody, timbre, and structure—are employed to generate new ideas. These methods foster musical creativity by shifting from simply following established rules to actively exploring and solving problems.

Educational projects have undergone various name changes over the years while retaining similar characteristics, with John Paynter among the most influential creators (Finney, 2011).

These activities may involve the fragmentation and reorganization of sound material, akin to an anagram or a pun. For instance, one might break down a short, commonly used melodic sequence into individual notes or groups of intervals.

Creative play involves reassembling these fragments without reverting to the original form. This can include reversing the timeline or expanding or compressing the individual durations. The ultimate goal is to generate a new and sufficiently original musical idea, whether individually or collectively, that is significantly different from the initial one.

One approach to composition, reminiscent of 1950s jazz, is to maintain the harmonic background while replacing the main melody. References to improvisation stay consistent, though copyright laws have evolved. This strategy focuses on the interplay between the background and the foreground, preserving some Gestalt features while diminishing or eliminating others. At this stage, the bass line and implicit harmonies serve as the foundation. We then work on rhythmic, genre-specific, lexical, and stylistic modifications. Once the musical background is sufficiently refreshed, students can progress towards new melodic developments that align with their individual performance styles and creative abilities.

Another effective way to promote lateral thinking in music is to swap the roles and functions—particularly the timbres—of the instruments used in a piece. While the material remains essentially the same, it takes on a sense of alienation from its original context. This shift leads to the perception of different Gestalt relationships within the same structure. In this way, form converts to content, and timbral elements become the most apparent formal aspects.

If we take a moment to reflect on this from a didactic and neurocognitive perspective, it becomes evident that this approach has a significant weakness. True musical creativity should arise from both individual and intersubjective processes. However, we find ourselves dealing with methods understood as transmissive, teaching sequences of executive procedures that predominantly showcase the creativity of the teacher or pedagogue, leaving limited room for student creativity. Nonetheless, this pedagogical approach remains valid and interesting, particularly for students with specific learning disorders (SLD), who often thrive in such learning environments (Coss, 2019; Clipper & Lee, 2021).

The main hypothesis remains the same: the potential to explore the transformation of learned external procedures into internalized and spontaneous processes.

The cognitive and neural mechanisms involved in musical composition rely on an overlapping network of frontotemporal and parietal systems. These processes engage the prefrontal cortex (responsible for executive control) and the superior temporal gyrus (associated with structural decoding), along with expansive neural networks such as the default mode network and the central executive network. These networks facilitate smooth real-time interaction (Villareal et al., 2013).

Musical creation involves a process of *iterative, recursive thinking that* continuously generates, evaluates, and modifies musical ideas. Recursion involves creating new hierarchical levels, such as inserting sentences, whereas iteration involves repeating motifs without changing the overall structure. At the procedural level, the creation of musical ideas (divergent thinking) alternates with their evaluation against structural rules (convergent thinking). The prefrontal cortex plays a key role in testing hypotheses and monitoring errors, working in conjunction with the superior temporal gyrus, which helps generate and maintain melodic hierarchies (Martins et al., 2020).

Creative musical thinking encompasses both *micro and macro subdivisions*, identifying effective strategies for working at detailed (measure-by-measure) and broad (structural) levels. The ability to concentrate on immediate details while simultaneously overseeing the overall shape of the piece is crucial. These processes require effective communication between specific sensory cortices and the associative areas that manage global working memory and structural planning (Peretz & Zatorre, 2005).

The *reformulation of the problem* adapts Gestalt principles to enhance musical intuition. This involves altering the internal representation of musical elements to create unexpected connections. The process engages the predefined neural network (DMN), which is responsible for spontaneous thinking and conceptual integration. Following this, the right hemisphere of the brain, particularly the right angular gyrus and right anterior insula, plays a crucial role in cognitive flexibility and artistic intuition (Danek & Flanagin, 2019; Hodges & Limb, 2025).

Moreover, *parallelism* is a cognitive process that simultaneously combines various cognitive strategies in real time. For example, it allows for the maintenance of harmonic structure, rhythmic improvisation, and anticipation of the listener's expectations all within the same creative action (Collins, 2005). In this scenario, the brain operates not through isolated, localized areas, but rather as a vast, synchronized network. Auditory, visual, and motor networks are co-activated, driven by rhythmic and temporal neural oscillations that integrate various musical creative actions into a single, fluid experience.

5.3 Updating Mind Maps through Improvisation

Musical improvisation for students with learning disorders is a powerful and effective learning experience. It serves as a natural neurological training program that connects large-scale brain networks, particularly those responsible for generating spontaneous ideas, with conscious assessment centers (Ramon & Chacon-Lopez, 2021). When coordinated properly, this activity helps build new and stronger neural connections, thanks to the brain's remarkable plasticity.

Spontaneous creative processes, regardless of individual capabilities or the complexity of the musical event produced, involve both automatic, bottom-up processes—specifically, dynamic interactions within the default mode network (DMN)—and top-down control processes that engage the executive control network (ECN). Furthermore, the continuous flow between idea generation (DMN) and refinement (ECN) trains the brain in planning, impulse control, and rapid decision-making.

Distinct brain networks perform specific tasks during musical improvisation. The Default Mode Network (DMN) is responsible for spontaneous thoughts, memory, abstract thinking, mental simulation, and autobiographical retrieval.

This network enables individuals to project their actions and thoughts into music, allowing them to anticipate performance and integrate personal experiences. The brain structures and memory networks involved are similar to those used for recalling past experiences. This overlap facilitates the flexible recombination of stored memories to simulate and plan future scenarios.

On the other hand, the Executive Control Network (ECN) is associated with cognitive processes that require ongoing and targeted evaluation. These processes include working memory, reasoning, problem-solving, planning, intersubjectivity, and the management of differentiated tasks (Beaty, 2015; Da Mota et al., 2025).

Musical improvisation engages students with learning disorders in a deeply multisensory manner. It necessitates complex auditory-motor mapping, which stimulates brain memory, motor skills, limbic responses, and linguistic networks, allowing for the spontaneous fusion of musical concepts in real time (Loui, 2018).

Lastly, musical improvisation enhances the activation of neural networks associated with both verbal and nonverbal processing, leading to a more informal acquisition of phonological awareness and communication skills.

In essence, it involves a complex set of audio-motor representations that are retrieved from memory and combined in real time based on formal, structural, lexical, and stylistic connections. These representations are assimilated and reworked through the gestural and motor dynamics of execution and interpretation (Erkkinen & Berkowitz, 2018).

6. Recommendations

Musical creativity is inherently active and intersubjective, arising from dynamic interactions among musicians and their instruments. Emphasizing its social nature can help the audience feel connected and engaged with the collaborative process.

Creativity is much more than a widely held concept; it exists not only as a mental construct but also manifests concretely through shared physical experiences, at both the personal and collective levels. For individuals with specific learning disorders (SLD), this creative process offers a significant developmental learning journey. By transforming both successes and failures into meaningful feedback, musical experiences serve as catalysts for self-realization, enhancing personal growth and understanding.

We hope that the theoretical and practical findings of this study on creativity and specific learning disorders (SLD) in a musical context will provide tools for reflection, study, and research, as well as valuable insights for educational planning.

In promoting inclusive practices within music communities, it is imperative to establish collaborative workshops that facilitate collective music-making. Not only enhances intersubjective engagement among participants but also consolidates social connections among musicians. To achieve these objectives, it is essential to provide a wide array of instruments that cater to varying skill levels and sensory requirements, also emphasizing the importance of creating accessible environments for all individuals.

Finally, the systematic adoption of improvisation practices—in their various forms and modes—should be complemented by brainstorming and feedback-sharing sessions among participants, supported by research indicating their effectiveness in fostering engagement and skill development for individuals with SLD. This approach fosters the sharing of both successes and challenges, creating an atmosphere of mutual support.

By leveraging these support structures and the social nature of music, it is possible to enrich the creative journey of individuals with SLD significantly.

7. Conclusions

Extant research has identified key characteristics of creativity, such as cognitive processes, motivational factors, and emotional engagement. Nevertheless, a more comprehensive understanding of the multilevel interactions between cognitive and emotional factors remains essential, particularly as these interactions are central to research on creative processes in individuals with specific learning disorders (SLD). Our study, aligned with a broad sector of research, defines musical creativity as emerging from a complex interplay among intuition, talent, knowledge, problem-solving abilities, creative thinking, and combinatorial reasoning. Collectively, these elements inform a more nuanced understanding of the behavioral and neurocognitive foundations of creativity (Khalil et al., 2022; Zheng et al., 2025).

Musical talent manifests in diverse forms. Intuition extends beyond sudden insight or neural shortcuts, also arising from accumulated knowledge and internalized musical frameworks. Implicit memory structures facilitate rapid and effective decision-making, especially when integrated with psychological flow. Research on choice-supporting memory shows that individuals learn and recall the positive aspects of their selected options more effectively. Additionally, studies on preference change reveal that the perceived value of chosen options often increases, while the value attributed to unchosen options tends to decrease (Biderman & Shohamy, 2021). This process depends on maintaining a delicate, often unstable balance between rationality and emotion.

Musical creativity significantly influences the development of adaptive learning pathways, particularly for students with learning disorders. Within the framework of extended cognition, integrating musical learning tools with diverse learning challenges—including linguistic processing, logical-mathematical reasoning, and motor sequencing—creates alternative opportunities for comprehension. This integration can facilitate structured learning across a range of cognitive tasks. The multimodal nature of musical interventions holds considerable potential to modify brain architecture and stimulate cognitive change (Ribeiro & Santos, 2020).

In music education, the cultivation of creativity is intricately linked to collaborative learning experiences across various levels. This process emphasizes joint study and the expressive exploration of shared musical frameworks, encompassing diverse languages, social interactions, and cultural norms. Creative methodologies arising from collective composition—whether spontaneous, progressive, improvised, or part of more structured projects—flourish across different educational contexts. Elements such as rhythm and timbre serve as essential foundations, fostering dynamic interactions between social engagement and musical expression. In these environments, creativity is closely associated with collaboration, the development of interpersonal dynamics, and the cultivation of a strong sense of identity (Barrett et al., 2021). Consequently, creativity in these musical settings is both embodied and enacted.

For all individuals, and especially for students with learning disorders, learning and musical expression are fundamentally physical processes. Gestures play a crucial role in conveying meaning, and contextual factors shape musical practices. Institutional, societal, and cultural influences further inform these experiences. The 4E model—embodied, integrated, enacted, and extended—reconceptualizes creativity as an active, physical, and relational phenomenon in which mind, body, and intersubjective environment collectively generate new meanings. From this perspective, research and educational reflection on specific learning disorders benefit from adopting a more inclusive concept of musical creativity, one that encompasses a broader range of characteristics and approaches capable of expressing multidimensional creative thinking in music. This psychopedagogical construct transcends a personalistic conception of the individual creative subject and is not limited to the performative dimension of the artistic product or performance. Rather, it captures the overall dynamic by emphasizing the embodied, relational, and interactive aspects of human creativity (Schyff et al., 2018).

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The author declares no conflicts of interest.

About the Author

Mauro Carboni's academic profile reflects an interdisciplinary integration of music, cognitive psychology, clinical pedagogy, and special education. From 2000 to 2014, he worked as a tenured researcher at the University of Rome "Foro Italico", where his research focused on special education and educational studies aimed at developing inclusive processes. In particular, his work addressed empathic motor and gestural behaviors in inclusive learning contexts, as well as the design of virtual learning environments mediated by sensory and motor experiences. In 2014, after fifteen years of academic activity, he joined the Conservatory of Music in Perugia as Full Professor of Music Pedagogy, a position he held until October 31, 2025. He formally retired on November 1, 2025. From 2020 to 2025, he served as Delegate for Disabilities and Specific Learning Disorders at the "Morlacchi" Conservatory of Music in Perugia. In this institutional role, in addition to addressing individual student learning and inclusion needs, he aimed to bridge the gap between institutional academic expectations and the learning potential of students with cognitive and functional disabilities. To this end, he worked to strengthen accessibility criteria and promote more inclusive educational environments. He is a reviewer for the *International Journal of Psychological and Brain Sciences*. For detailed information about his academic profile and a comprehensive list of his publications, you can visit his profiles on ResearchGate, Academia.edu, and ORCID (0009-0000-4671-6387).

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