

다운증후군 아동의 음악적 기술을 개발하기 위한 코다이 방법을 활용한 음악 게임 프로그램 A Musical Games Program Using the Z. Kodály Method to Develop Musical Skills in Children with Down Syndrome

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Abstract This study investigated the effectiveness of a musical games program based on the Kodály approach in enhancing the musical skills of children with Down syndrome. A single-group pre-test-post-test experimental design was employed to evaluate the program's impact. The participants were eleven children with Down syndrome residing at the Al-Falak Charitable Foundation in Akwa Al-Hissa, Kafr El-Zayat, Tanta, Gharbia, during the 2022-2023 academic year. They participated in a structured musical program grounded in Kodály's pedagogy, which emphasizes singing, rhythm, and auditory training through musical games. The program was implemented once a week for 60 minutes over a 20-week period. Data were collected using a musical skills observation checklist designed to assess core musical abilities, supported by a teacher's guide for the implementation of Kodály-based activities. The findings revealed statistically significant improvements in both overall musical performance and individual sub-skills, with post-test scores significantly higher than pre-test scores. Furthermore, the program demonstrated a high level of effectiveness in enhancing musical skills, underscoring the pedagogical value of the Kodály approach for children with Down syndrome. These results highlight the potential of Kodály-based musical interventions and recommend their broader application, alongside future studies exploring their long-term impact and integration within inclusive educational contexts.

Key words: musical games, Kodály method, musical skills, children with Down Syndrome

초록 본 연구는 다운증후군 아동의 음악적 기술 향상을 위해 코다이 접근법을 기반으로 한 음악 게임 프로그램의 효과를 검증하였다. 프로그램의 영향을 평가하기 위해 단일 집단 사전-사후 검사 실험 설계를 사용하였다. 연구 참여자는 2022-2023 학년도에 가르비아 탄타 카프르 엘자야트 아크와 알히사에 위치한 알팔락 자선재단에 거주하는 다운증후군 아동 11명이었다. 이들은 노래, 리듬, 청각 훈련을 강조하는 코다이 교육학에 기반한 체계적인 음악 프로그램에 참여하였으며, 프로그램은 20주 동안 주 1회 60분씩 실시되었다. 자료는 코다이 기반 활동의 실행을 위한 교사 안내서와 함께 핵심 음악 능력을 평가하도록 설계된 음악 기술 관찰 체크리스트를 통해 수집되었다. 연구 결과, 전체 음악 수행과 하위 기술 모두에서 통계적으로 유의한 향상이 나타났으며, 사후 검사 점수가 사전 검사 점수보다 유의하게 높았다. 또한 본 프로그램은 음악적 기술 향상에 높은 효과를 보여 다운증후군 아동을 위한 코다이 접근법의 교육적 가치를 입증하였다. 이러한 결과는 코다이 기반 음악 중재의 잠재력을 강조하며, 포용적 교육 환경에서의 장기적 영향과 통합 가능성을 탐구하는 후속 연구와 함께 그 광범위한 적용을 제안한다.

주제어: 음악 게임, 코다이 방법, 음악 기술, 다운증후군 아동

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I . Introduction

In the modern era, education aims to include all children, including those with special needs such as Down syndrome, with the goal of enhancing their abilities, integrating them into society, and reducing their dependence on others. Categories of disabilities include intellectual disabilities, learning difficulties, emotional and behavioral disorders, communication disorders, and physical, auditory, and visual impairments. Children with cognitive disabilities experience deficits in intellectual and adaptive functioning, leading to delays in attention, memory, language, and problem-solving skills. The severity of intellectual disabilities varies based on intelligence quotient (IQ), ranging from mild to profound, with Down syndrome being one of the most prominent conditions. Today, these disabilities are viewed positively as natural phenomena that require appropriate intervention and support.

Down syndrome is a condition where an individual has an extra chromosome. Typically, a child is born with 46 chromosomes, but children with Down syndrome have an additional copy of chromosome 21. The medical term for this condition is ‘trisomy’ and it is specifically referred to as Trisomy 21. This extra copy alters the development of the body and brain, which may lead to intellectual and physical challenges (Centers for Disease Control and Prevention, 2021). Chromosomal abnormalities result in delays in fine and gross motor skills, as well as intellectual abilities, make it significantly difficult for individuals with Down syndrome to function in typical educational or professional environments. These challenges may also include, but are not limited to: hearing problems, gastrointestinal disorders, congenital heart disease, delayed speech and language, and very low IQ (Newton et al., 2015). The combination of these limitations often prevents individuals with Down syndrome from performing daily social and occupational tasks with the same independence, productivity, and intensity as their neurotypical peers (Dierssen & Torre, 2012).

The Education for All Handicapped Children Act of 1975 (P.L. 94-142) emphasizes the importance of providing education and care to students with special needs. The Individuals with Disabilities Education Act (IDEA) further affirms the right to free and appropriate public education for all students with disabilities, mandating that each school district provide a suitable environment and individualized educational programs (U.S. Department of Education, 2014). The Council for Exceptional Children (CEC) also advocates those services for children and youth with disabilities should be provided within general education classrooms in schools (CEC, n.d.). Implementing these laws requires addressing the needs of students with disabilities, including

those with Down syndrome, in regular classrooms, music education programs included (Chen, 2007).

Historically, philosophers, scholars, and policymakers have emphasized the essential role of music education as a fundamental component of society (Abril & Gault, 2016). The primary purpose of music education programs for students with special needs is to provide them with meaningful musical experiences, develop their understanding of music, and enhance their individual performance levels. Researchers have long recommended further studies on music education for children with special needs (Brown & Jellison, 2012).

One of the most prominent approaches to music education is the Z. Kodály Method, which aimed to establish a unified system for musical literacy and the learning of cultural heritage (Poquette, 2023). The Kodály method aligns with children's cognitive and physical development during the early school years and incorporates various age-appropriate teaching techniques (Bowyer, 2015). Kodály integrated diverse components into his method, including solfège from Italy, tonic sol-fa from England, rhythmic patterns by Maurice Chevé, techniques from Émile Jaques-Dalcroze, and hand signs based on the psychological effects studied by John Curwen-Glover, weaving them into a cohesive teaching approach (Choksy et al., 2001).

The Kodály method emphasizes a sequential progression in musical instruction. Younger students begin with basic singing skills, echo singing, and singing games. As they grow, they progress to learning musical concepts through rhythmic patterns and solfège. Later, they are introduced to musical notation that corresponds with the rhythms and melodies they have already sung and played (Mason, 2012).

Another important aspect of the Kodály method is 'movement', used to internalize musical patterns. Movement is employed as a strategy to teach musical concepts, beginning with simple body-focused movements and gradually incorporating more structured forms like walking, jumping, clapping, and patting, all accompanied by children's singing (Spurgeon, 2010, Cha, 2023).

Several factors and indicators have contributed to the formulation of the research problem. Based on the researchers' field experience, particularly during their visits to the Al-Folk Charity Foundation for the care of children with Down Syndrome in Akwa Al-Hissa Village, affiliated with Kafr El-Zayat Center in Gharbia Governorate, it was observed that despite the commendable efforts of the foundation, children with Down syndrome face numerous challenges in music education. Among the most prominent issues are severe deficiencies in musical education knowledge, as these children exhibit significant gaps across multiple domains such as rhythmic solfège, reading solfège, melodic solfège, singing, listening and appreciation, and instrumental

performance. Additionally, there is a marked weakness in essential musical skills, particularly in rhythm performance, melody execution, singing, and playing musical instruments. Furthermore, many of these children rely heavily on trial and error to train themselves in musical skills and instrument use, indicating an urgent need for innovative, structured educational approaches and teaching methods tailored to their specific learning needs.

Research indicates that the prevalence of Down syndrome is approximately 1.5 per 1,000 children, increasing to 28 per 1,000 children among mothers over the age of 44 (Al-Zreiqat, 2012). Annually, between 3,000 and 5,000 children are born with this condition, (Farouq, 2023), and around 250,000 families in the United States are affected by it. Children with Down syndrome often experience sensory development issues, with 60% exhibiting hearing or visual impairments, which negatively impact their ability to learn language and acquire musical skills. Additionally, they face slower learning rates, further complicating their motor and musical performance (Al-Kubaisi, 2020).

Several international conferences on Down syndrome have recommended allocating resources to establish a permanent, creative curriculum for the training and employment of individuals with Down syndrome. These recommendations emphasize the importance of encouraging research and providing financial support to ensure their right to free education, call for the placement of training counselors in schools, and advocate for the development of a clear social model integrating health, education, and training services.

While numerous studies have examined music education for children with special needs and highlighted the general benefits of musical interventions, such as developing speech and language skills (Ballone, 2011), enhancing general cognitive and motor abilities (Adamek & Darrow, 2010), and promoting physical, sensory, and brain development (Campbell & Scott-Kassner, 2013; Langer, 2013), there remains a notable lack of empirical research specifically focused on the application of the Kodály method for children with Down syndrome. This study aims to fill that gap by designing and evaluating a structured music training program grounded in Kodály principles, tailored to the unique developmental and sensory needs of children with Down syndrome. By systematically investigating the program's conceptual framework and effectiveness, this research contributes a novel pedagogical model to the field of inclusive music education and offers practical implications for music educators, special education teachers, and curriculum developers.

The research problem centers on the clear necessity to design a program that enhances the musical skills of children with Down syndrome, as previous studies have shown a decline in

these abilities. While musical education activities are known to contribute to skill development and help alleviate challenges associated with the syndrome, no prior research has examined the effectiveness of the Kodály method in this context. Accordingly, this study seeks to address two central questions: first, what is the conceptual framework for a program based on the Kodály method to develop specific musical skills in children with Down syndrome; and second, how effective is such a training program in helping these children acquire targeted musical skills. The overarching aim of the research is to assess the program's effectiveness in developing rhythm, motor expression, and singing abilities.

II. Literature Review

Given that the current research aims to investigate the effectiveness of a program based on the Kodály method in developing certain musical skills among children with Down syndrome, the theoretical framework addresses the following variables: categories of disability, Down syndrome, the Kodály method, musical skills.

1. Categories of disability

Disability in educational contexts encompasses a broad spectrum of conditions that influence students' cognitive, behavioral, communicative, and physical functioning. These conditions are typically classified into several categories, each requiring distinct educational approaches and support systems. The major categories include intellectual or cognitive disabilities, learning disabilities, emotional and behavioral disorders, communication disorders, physical disabilities, hearing impairments, visual impairments, giftedness, severe or multiple disabilities, and autism spectrum disorders (Wetrs, 2007).

Cognitive disabilities, previously referred to as intellectual disabilities, are characterized by deficits in intellectual, adaptive, and developmental functioning compared to peers. Children with these disabilities often display delays in attention, memory, language, and problem-solving skills. Intellectual disabilities are commonly categorized based on IQ levels as mild (55-70), moderate (40-55), severe (25-40), or profound (below 25), with Down syndrome being one of the most recognized examples (Wetrs, 2007). Learning disabilities, whose causes are linked to neurological or environmental factors, result in delays in one or more learning processes such as reading,

writing, or mathematics (Langer, 2013). Common characteristics include hyperactivity, poor motor perception, emotional instability, coordination deficits, attention disorders, impulsivity, and difficulties in memory, thinking, and speech (Wetrs, 2007). Emotional and behavioral disorders (EBD) encompass conditions involving significant anxiety, depression, aggression, or social withdrawal. Students with EBD may experience academic difficulties, inappropriate behaviors, social isolation, and psychosomatic complaints, despite often having average or above-average intelligence (Rodriguez, 2017).

Communication disorders include both speech and language difficulties. Speech disorders involve problems such as substitution, omission, or distortion of sounds, and irregular vocal quality, whereas language disorders affect vocabulary, comprehension, and conversational skills. Children with such disorders often struggle with storytelling, questioning, and turn-taking (Al-Bahas, 2023). Physical disabilities and other health impairments (OHI) refer to limitations in physical functioning or chronic health conditions that impact school performance. Examples include cerebral palsy, limb loss, brain injury, and medical conditions such as ADHD, asthma, cancer, or leukemia, all of which may require medical and educational support (Wetrs, 2007). Hearing impairments are defined by the degree and type of hearing loss, often affecting the development and comprehension of spoken language. Although most students with hearing impairments have normal intelligence, they may face challenges in reading and mathematics and often rely on visual cues and body language for communication (Langer, 2013). Similarly, visual impairments, ranging from low vision to complete blindness, influence students' ability to perceive distance, size, and color, potentially leading to social withdrawal or dependency. Aids such as Braille and magnification tools are essential for supporting their learning (Wetrs, 2007).

Children with severe or multiple disabilities exhibit complex physical, mental, or emotional impairments that require intensive and individualized educational services. These may include conditions such as schizophrenia or autism combined with other disabilities, making participation in general education programs challenging (Cole, 2020). Finally, autism spectrum disorder (ASD) encompasses a range of developmental conditions characterized by challenges in communication, social interaction, and repetitive behaviors. The spectrum includes classic autism, Asperger's syndrome—where individuals show milder symptoms without intellectual delays—and pervasive developmental disorder-not otherwise specified (PDD-NOS), which involves atypical or milder forms of autism (Autism Society, 2023).

Following a detailed review of these categories, researchers have emphasized the vital role that music education plays in supporting the development of children with disabilities. Music

contributes to the enhancement of speech and language skills by improving verbal expression, auditory discrimination, and awareness—all essential elements of language development. Through singing and rhythmic imitation, children strengthen their speech timing, pronunciation, and conversational abilities (Ballone, 2011). In addition, music lessons promote general skill development by encouraging students to experiment with instruments, recognize shapes and sizes, and engage collaboratively with peers. Such activities foster cooperation, turn-taking, and social communication (Adamek & Darrow, 2010). Music also supports physical and sensory development by offering a multisensory learning experience that engages sight, hearing, and movement, thereby improving fine motor skills and neuromuscular coordination. Even when one sensory system is impaired, children can still actively participate using alternative senses (Campbell & Scott-Kassner, 2013). From a neurological perspective, music education benefits brain development in children with special needs. It stimulates both hemispheres of the brain—the right hemisphere associated with emotion and intuition, and the left linked to logical and sequential thinking. Research by Vinod Menon of Stanford University indicates that listening to and playing music activates brain areas responsible for attention, memory, and predictive processing, which can enhance cognitive functions (Langer, 2013). As spatial and temporal reasoning improve through musical engagement, children with cognitive impairments often show advancements in pattern recognition, memory, and overall learning performance (Campbell & Scott-Kassner, 2013). These findings underscore that music is not only a form of artistic expression but also a powerful educational and developmental tool for individuals with disabilities.

2. Down syndrome

Down syndrome is a common chromosomal disorder that leads to intellectual disabilities, accounting for one-third of moderate to severe intellectual disability cases. Most individuals with Down syndrome have cognitive impairments, with IQ scores typically ranging from mild to moderate (Fernhall, 2003; He et al., 2023). Due to the presence of an abnormal number of chromosomes, children with Down syndrome face intellectual and motor disabilities, along with other challenges (American Psychiatric Association, 2013). Genetically, Down syndrome is a condition caused by the presence of an extra copy of chromosome 21, resulting in a genetic abnormality during cell division in fetal development (Dierssen & Torre, 2012). Children with Down syndrome have 47 chromosomes instead of 46, which affects physical and brain development, leading to mental and physical challenges. Down syndrome is the most common

chromosomal condition and is divided into three types: trisomy 21, translocation Down syndrome, and mosaic Down syndrome.

Individuals with Down syndrome experience a variety of challenges that include delays in both physical and cognitive development, resulting in difficulties with language, memory, and social interaction. Motor skill delays further hinder their ability to function independently in educational and occupational contexts, while accompanying health complications such as hearing difficulties and gastrointestinal disorders may also affect their quality of life (Centers for Disease Control and Prevention, 2021). Cognitively and behaviorally, individuals with Down syndrome typically display mild to moderate intellectual impairments and speech delays, with studies showing that challenging behaviors are more common among those with IQ scores below 70 (Channell et al., 2021). These individuals may also exhibit maladaptive or repetitive behaviors that share similarities with (ASD), and when both conditions co-occur, behavioral difficulties tend to intensify.

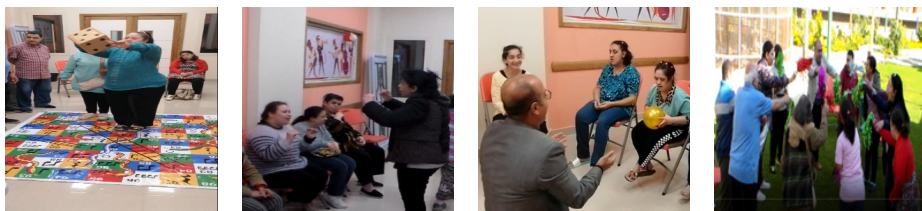
Despite these challenges, children with Down syndrome also demonstrate significant strengths. They often form strong family bonds, show heightened empathy, and exhibit warmth and openness in emotional expression. However, they may struggle with inattention, repetitive thoughts, anxiety, and depressive symptoms. Moreover, stuttering is more prevalent among individuals with Down syndrome, affecting 10% to 45% of this population, compared to 1% to 5% in the general population (Eggers & Van Eerdenbrugh, 2018). Such cognitive, emotional, and linguistic profiles underscore the importance of designing educational interventions that leverage their strengths while addressing their developmental needs.

Among the educational approaches that have proven effective for learners with Down syndrome is music education. Research indicates that children with moderate intellectual disabilities can achieve notable progress when exposed to structured and stimulating learning environments. Musical activities, in particular, offer meaningful stimuli that foster engagement, enjoyment, and developmental growth, helping children with special needs—including those with Down syndrome—overcome learning difficulties (He et al., 2023). Within this context, the Kodály method has shown promise in enhancing the educational development of children with Down syndrome. This method supports improvements in visual learning, reading skills, motor coordination, expressive language, and social interaction.

Visual Learning, Reading Skills, and Educational Support: A significant portion of what we learn is processed visually. Approximately 70% of individuals with Down syndrome experience visual complications or processing difficulties (Stray-Gundersen, 1995). There is also a high

prevalence of eye disorders and refractive errors, such as: Astigmatism (22%), Strabismus (57%), Myopia (nearsightedness) and Hyperopia (farsightedness) (22%) (Ljubikj, 2010).

Visual learning plays a crucial role in the education of children with Down syndrome, as a significant proportion—approximately 70%—experience visual complications or processing difficulties (Stray-Gundersen, 1995). Common eye disorders include astigmatism (22%), strabismus (57%), and refractive errors such as myopia and hyperopia (22%) (Ljubikj, 2010). These challenges make it essential for educators to present information in visually engaging ways that incorporate videos, images, and movement (Horstmeier, 2016). Despite such difficulties, many learners with Down syndrome demonstrate strong word recognition and early reading abilities, which are vital for vocabulary and academic language development. In the current research, visual learning was emphasized through musical activities grounded in the Kodály method. Rhythms from songs such as *Cherry Beet* were taught using visual representations—linking rhythmic divisions like ‘ta’ and ‘ta ti’ to the performer’s gestures in instructional videos. Fruits and vegetables were used to visually symbolize rhythmic patterns, while Kodály hand signs, based on J. Curwen’s psychological principles, reinforced the association between musical notes and hand movements. Additionally, the visual element was incorporated into the educational game *Snakes and Ladders*, where the numbers on dice were visually linked to musical rhythms within gameplay.



[Figure 1] Selected musical activities (snakes and ladders, Curwen hand sign, musical ball, and colorful ribbon stick) conducted with children with Down syndrome as part of the experimental program

Children with Down syndrome are born with weak and hypotonic muscles, leading to delays in motor skill development compared to typically developing individuals. This delay affects writing skills and personal development, making it difficult for students with Down syndrome to keep up with their peers. Some of these students learn better through touch and sensory interaction, as they often experience sensory issues related to hearing, vision, touch, and movement. Due to muscle weakness, they face challenges in using musical instruments,

necessitating modifications in teaching methods to suit their needs. They tend to learn more effectively through visual, tactile, and kinesthetic senses. Based on the Kodály method, the research focused on motor development by training children to perform movements associated with various songs. This included practicing basic units, rhythms, and accompanying movements for songs such as: *Rain Rain Go Away*, *Baby Shark*, *A Ram Sam Sam*, *Kaki Kaki Kaki*. Additionally, the research emphasized motor development through the use of educational balls to practice rhythms, serving as a reinforcement tool for correct performance.

Delays in language and communication among individuals with Down syndrome are attributed to muscular factors, such as weak oral muscles and atypical mouth structure. This delay creates a gap between comprehension and expression, leading to frustration, behavioral issues, and impacts on cognitive and perceptual abilities. Despite these challenges, individuals with Down syndrome possess significant knowledge but struggle to express it, which can create a misleading impression of limited understanding. Studies suggest that sign language can improve communication. In this research, hand signs were used to teach musical notes and rhythms, enhancing speech and expressive skills. Training in singing and group musical games also strengthened social and non-verbal communication skills. Overall, individuals with Down syndrome exhibit strong social skills and empathetic natures.

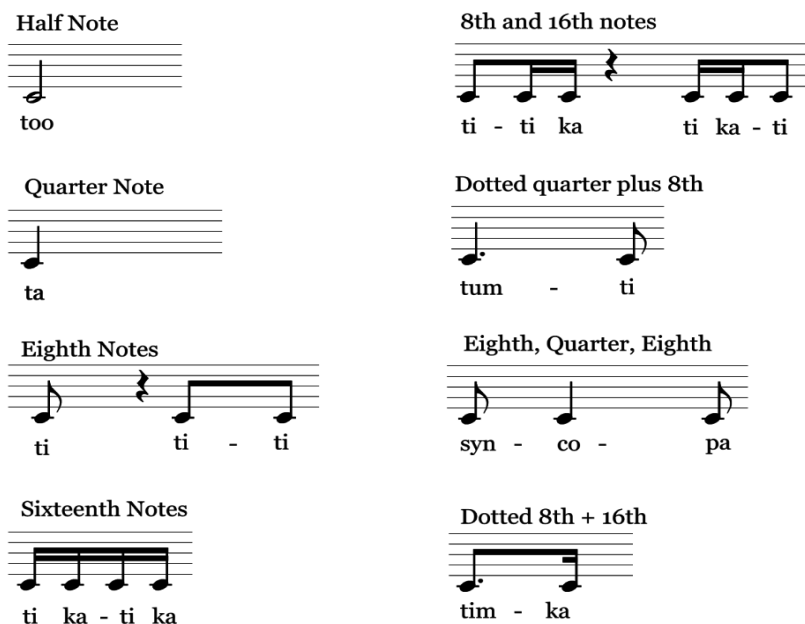
3. The Kodály method

The Kodály method is a comprehensive music education system developed in Hungary by Kodály to promote musical literacy and the appreciation of musical heritage. It is founded on the belief that music is essential for human development and that music education should begin early in life, using folk music as the ‘mother tongue’ of musical learning. Singing serves as the foundation of all musical instruction, as it provides direct and accessible engagement with melody, rhythm, and expression (Poquette, 2023). The method emphasizes the use of folk songs and singing games to teach rhythm, melody, harmony, and musical expression while simultaneously fostering listening, movement, and music reading skills. Learning through the Kodály method is experiential; children engage in musical experiences that help them construct conceptual understanding through active participation (Houlahan & Tacka, 2015).

Kodály’s pedagogical approach rests on several core principles: the importance of singing as the basis of all music learning, the early introduction of music education through folk songs, and a child-centered teaching process in which the teacher creates a supportive and developmentally

appropriate learning environment. Core materials in this method include movable-do solfège, rhythmic syllables, hand signs, folk songs, folk tales, and selected musical instruments. Instruction follows a structured process of preparation, presentation, and practice to ensure that musical concepts are internalized through experience and repetition (Casarow, 2015).

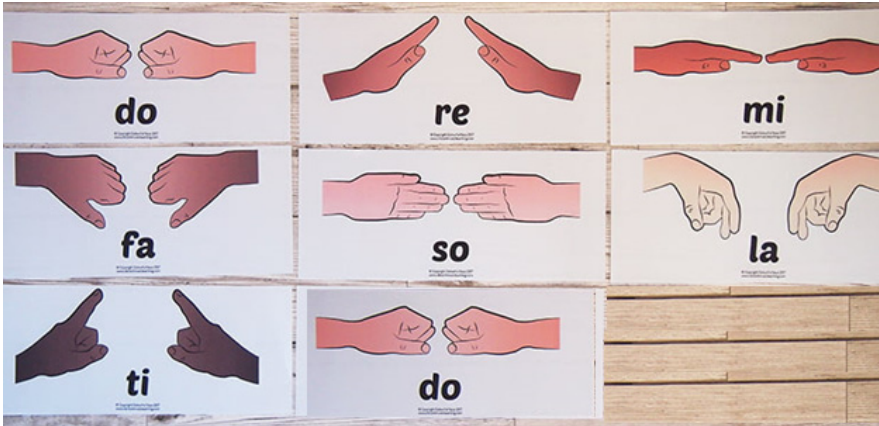
Movable-do solfège, one of the key components of the method, uses a flexible tonal system in which ‘do’ serves as the tonic of any major or minor scale. This allows learners to perceive and internalize the relationships between notes rather than memorizing fixed pitches. Once the tonic is known, other notes are easily identified, reinforcing tonal awareness and relative pitch (Siromoto, 2016). The Kodály method also employs specific rhythmic syllables to teach rhythm intuitively—for instance, a quarter note is ‘ta’, two eighth notes are ‘ti-ti’, a dotted quarter note is ‘tim’, and a sixteenth note is ‘ti-ka-ti-ka’ (Moon, 2020). These rhythmic syllables provide learners with a concrete and verbal means of understanding rhythmic duration and pattern.



[Figure 2] Rhythmic syllables in the Kodály method (Young, 2024)

Another essential aspect of the method is the use of Curwen hand signs to represent the notes of the scale. Each hand sign represents a specific note in the do scale, with the position of the hand indicating the pitch. The intervals between hand signs directly correspond to the intervals

between notes. Kodály's use of hand signs enhances children's motor skills and improves music reading abilities through visual aids. Kodály envisioned those children would experience music daily under the guidance of trained teachers, forming the foundation of his educational approach (Costanza, 2021).



[Figure 3] Hand signs for psychological effect (Cantan, 2024)

In practice, music teachers following the Kodály method begin rhythm instruction with simple rhythmic patterns such as the rond rhythm before advancing to more complex note values like double crochets. Melodic instruction typically starts with the major scale, progressing gradually according to the learner's capacity. Young children often face difficulties in perceiving pitch accuracy and understanding rhythmic value; therefore, the Kodály sequence develops these skills through a progression from listening and singing to movement and, eventually, to music notation and theoretical understanding (Moon, 2020).

The Kodály method, as applied in this study, offered a developmentally sensitive and inclusive pedagogical framework well suited to the needs of children with Down syndrome. Its emphasis on multisensory and experiential learning proved particularly effective for this population. Children with Down syndrome often present with a range of cognitive, linguistic, and motor challenges, including delays in auditory processing, speech development, and fine motor coordination. The Kodály method, through its integration of singing, rhythmic syllables, hand signs, and movement, directly addresses these developmental domains using accessible and engaging strategies.

In this study, the use of solfège and rhythmic syllables (e.g., ta, ti-ti) facilitated an intuitive

understanding of pitch and rhythm, while Curwen hand signs provided a powerful visual-motor tool for reinforcing scale degrees and pitch relationships. This was especially beneficial for children with limited verbal expression, as the kinesthetic aspect of the hand signs enhanced memory, pitch accuracy, and fine motor control. Furthermore, the sequential presentation of musical concepts, from listening and singing to more advanced musical tasks, supported gradual skill acquisition in alignment with the learning profiles of children with Down syndrome.

To promote engagement and conceptual internalization, the researchers incorporated interactive, play-based activities rooted in the Kodály philosophy, including *Snakes and Ladders*, *Musical Ball*, *Colorful Ribbon Stick*, and *Musical Movement Train*. These activities not only reinforced rhythmic and melodic understanding but also encouraged social interaction, turn-taking, and cooperative play key developmental goals for this population. The rhythmic games and singing exercises supported language development by enhancing articulation, timing, and expressive communication.

By embedding musical learning within culturally relevant, movement-rich experiences, the Kodály-based intervention strengthened neural pathways associated with auditory-motor integration, attention, and executive functioning. In summary, the researchers found that the Kodály method's structured, multimodal approach significantly facilitated musical engagement, skill acquisition, and social participation among children with Down syndrome.

4. Musical skills

Musical skills refer to the performance of musical tasks with a suitable level of proficiency and efficiency, relying on acquired knowledge and practice. They involve the coordination of sensory and motor processes, integrating cognitive, auditory, and physical abilities such as sight-reading, eye movement, and hand coordination. These skills are developed gradually through training and repetition until mastery is achieved (Attia, 2004; Zaher, 2013).

Musical skills encompass four core domains: solfège, singing, listening and appreciation, and instrumental performance. The term 'solfège' or 'solfeggio' refers to singing scales and performing melodic exercises using solfège syllables. These syllables originated from the work of the monk Guido d'Arezzo in the 11th century, who used the first syllables of the hymn *Ut Queant Laxis*. The syllables include Ut, Re, Mi, Fa, Sol, La, and later Si. In the mid-17th century, Ut was replaced by Do in most countries. Solfège skills encompass various types, such as: Rhythmic Solfège: Focuses on time and rhythmic notation. Reading Solfège: Involves reading musical notes.

Melodic Solfège: Develops singing ability. Harmonic Solfège: Enhances understanding of polyphony (Khalil, 2018).

Singing is a fundamental skill in music education, helping children with Down syndrome learn proper breathing, vocal production, and pronunciation. This enhances their vocabulary and facilitates the transfer of information and the acquisition of new concepts. Group singing fosters collective participation, a sense of teamwork, and the development of social skills and responsiveness to rhythms and melodies. Singing provides developmental experiences, including aesthetic appreciation, enjoyment, imagination, and positive behaviors, contributing to physical, mental, emotional, and social growth (Al-Shawadfi, 2018).

Listening and appreciation skills play an essential role in developing focus and attention during musical experiences. Children with Down syndrome often require structured listening experiences to reduce distractions and increase comprehension of musical ideas. Structured listening activities, supported by repeated exposure to short, engaging musical excerpts, help children develop sustained attention and musical vocabulary, forming the foundation of all musical learning, beginning with sound perception and discrimination, followed by interpretation and comprehension (Campbell & Scott-Kassner, 2013). Instrumental performance provides valuable opportunities for auditory-motor integration and musical expression. Playing percussion instruments, in particular, promotes rhythmic synchronization, coordination, and cooperative participation in ensemble settings, allowing children with Down syndrome to experience both the physical and social dimensions of musical performance. Through these activities, children learn to recognize tonal colors, identify different instrument types, and develop a sense of rhythm and timing. Participation in instrumental performance also fosters essential social behaviors such as cooperation, turn-taking, and shared engagement in group music-making, all of which contribute to emotional regulation, self-expression, and social development (Zaher, 2013).

In this study, the development of musical skills, including solfège, singing, listening, and instrumental performance, was approached through Kodály method, which emphasizes experiential learning through singing, movement, hand signs, and visual aids. This pedagogical approach is particularly well-suited to children with Down syndrome, who often face cognitive, auditory, and motor challenges that can hinder traditional learning methods. The multisensory, repetitive, and developmentally appropriate nature of the Kodály approach allowed the participants to engage meaningfully with the musical material at their own pace. Activities such as *Cherry Beet* and *London Bridge* chants were used to reinforce rhythmic solfège, simplifying complex rhythmic patterns into accessible, language-based structures. Curwen hand signs were integrated to help

children visualize and physically internalize melodic direction, thereby strengthening pitch awareness and musical memory.

To enhance engagement and provide varied learning opportunities, the intervention incorporated playful and structured musical activities such as *Snakes and Ladders* (for rhythm recognition and sequencing), *Musical Ball* (to foster auditory attention and response), *Colorful Ribbon Stick* (to support motor coordination and musical expression), and *Musical Movement Train* (to encourage group movement and rhythm synchronization). These activities not only reinforced rhythmic skills and motor coordination but also promoted essential social behaviors such as turn-taking, cooperation, and group synchronization. Singing exercises supported the development of vocal imitation, and expressive communication, while listening tasks were carefully designed to build sustained attention, and musical vocabulary. Instrumental performance involved adapted percussion instruments that provided immediate auditory and tactile feedback, helping children improve their timing, coordination, and ability to perform in ensemble settings. Overall, the Kodály-based intervention offered a supportive and inclusive educational environment, enabling children with Down syndrome to acquire and express musical skills in a way that aligned with their unique developmental profiles. The combination of movement, repetition, and multimodal engagement contributed to observable improvements in both individual skill development and group participation.

III. Methods

1. Research methodology

The current research adopts both descriptive and experimental methodologies. The descriptive methodology was employed to prepare the program based on the Kodály approach for developing musical skills among children with Down syndrome, review previous studies and literature related to musical skills and children with Down syndrome, design an observation checklist for assessing musical abilities, and analyze and interpret the research results. The experimental methodology was applied to investigate the effectiveness of the program based on the Kodály approach in enhancing specific musical skills among children with Down syndrome.

2. Experimental design of the research

The researchers used a single-group experimental design (pre-test and post-test). Means, standard deviations, and the t-test were calculated for the experimental group to determine the differences between pre-test and post-test scores.

The program consisted of 20 weekly lessons, each lasting 60 minutes, during the 2022-2023 academic year. The lessons were structured into progressive stages designed to enhance musical skills among children with Down syndrome. Following the Kodály method, the sessions emphasized singing, rhythm training, aural development, and musical games to foster both musical and cognitive growth.

3. Research hypotheses

In light of the results of previous research and studies, as well as the objectives of the current research, the following hypothesis was formulated: There is a statistically significant difference at the level of ($p \leq .05$) between the mean ranks of the scores of children with Down syndrome taught using the Kodály method in the pre-test and post-test applications of the musical skills observation checklist (as a whole) and for each sub-skill.

4. Research sample

The research sample consisted of 11 children with Down syndrome (3 males and 8 females), aged between 18 and 30 years, residing at the Al-Falak Charity Foundation in Akwa Al-Hissa, Kafr El-Zayat, Tanta, Gharbia Governorate, during the academic year 2022-2023. Participants were selected using purposive sampling based on the following inclusion criteria: confirmed diagnosis of Down syndrome, ability to participate in musical activities, and absence of severe hearing impairments or behavioral disorders that would interfere with the intervention. Children who did not meet these criteria were excluded.

5. Data collection procedures

Data were collected individually in a quiet room at the Al-Falak Charity Foundation. Trained researchers conducted pre-test and post-test sessions, where participants' musical skills were

observed and rated using the Musical Skills Observation Checklist. The intervention program spanned 20 weeks, with one lesson conducted weekly. Observations were systematically documented at baseline (pre-test) and immediately after the intervention (post-test).

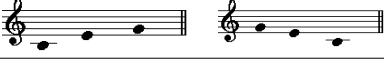
6. Research tools

The intervention tools included a teacher’s guide for teaching musical skills to children with Down syndrome based on the Kodály method, prepared by the researchers. The research tools consisted of a musical skills observation checklist for children with Down syndrome, also developed by the researchers to evaluate the effectiveness of the musical games program using the Kodály approach in developing specific musical skills. To ensure the checklist’s validity and suitability for use, its items were formulated in clear, operational terms to accurately describe the musical performance of children with Down syndrome. Each item represented a single observable behavior, allowing for precise and consistent assessment of musical skill development.

<Table 1> Musical skills observation checklist for individuals with Down syndrome

No.	Musical skills performances	Level of performance practice		
		High	Medium	Low
		3	2	1
	I. Rhythm and movement expression			
1	Claps regular units equal to the half note ‘blanche’ rhythm 			
2	Claps regular units equal to the quarter note ‘noire’ rhythm 			
3	Claps regular units equal to the ‘ta-ti’ rhythm 			
4	Claps regular units equal to the ‘ta-fa-ti-fe’ rhythm 			
5	Claps regular units equal to the ‘ta-fa-ti’ rhythm 			
6	Claps regular units equal to the ‘ta-fe’ rhythm 			
7	Walks regular steps equal to the half note ‘blanche’ rhythm 			
8	Walks regular steps equal to the quarter note ‘noire’ rhythm 			
9	Walks regular steps equal to the ‘ta-ti’ rhythm 			
10	Claps the following rhythmic pattern after listening to it 			
11	Claps the following rhythmic pattern after listening to it 			

<Table 1> Continued

No.	Musical skills performances	Level of performance practice		
		High	Medium	Low
		3	2	1
	II. Singing			
1	Sings the perfect fifth interval (P5) between the notes C and G with the syllable ‘la,’ after listening to it 			
2	Combines singing the perfect fifth interval (P5) between the notes C and G with the syllable ‘la’ and Curwen hand sign, after listening to it. 			
3	Sings the perfect fifth interval (P5) between the notes C and G using solfège syllables, after listening to it. 			
4	Combines singing the perfect fifth interval (P5) between the notes C and G using solfège syllables and Curwen hand sign, after listening to it. 			
5	Sings the arpeggio notes C, E, G with the syllable ‘la,’ both ascending and descending, after listening to it. 			
6	Sings the arpeggio notes C, E, G using solfège syllables, both ascending and descending, after listening to it. 			
7	Combines singing the arpeggio notes C, E, G with the syllable ‘la,’ both ascending and descending and Curwen hand sign after listening to it. 			
8	Combines singing the arpeggio notes C, E, G using solfège syllables both ascending and descending and Curwen hand sign after listening to it. 			
9	Sings the following melodic pattern with the syllable ‘la.’ 			

<Table 1> Continued

No.	Musical skills performances	Level of performance practice		
		High	Medium	Low
		3	2	1
10	Distinguishes between ascending and descending melodies with hand movements. 			

1) Reliability of the observation checklist for the musical skills performance

The current research employed two methods to verify the validity of the observation checklist for musical skills performance skills among individuals with Down syndrome: Content validity, and internal consistency validity.

(1) Content validity

To ensure content validity, the preliminary version of the checklist was reviewed by a panel of experts in the field. Their feedback focused on the scientific formulation of the items, the logical sequence of statements, the alignment of items with the objectives, and the relevance of each item to the content. Based on the experts' suggestions, the researchers revised the wording of several items. As a result, the checklist was refined and finalized to include 21 items. The following table presents the agreement coefficient for the musical skills observation checklist.

<Table 2> Agreement coefficient for the observation checklist for the musical skills performance

Judging criteria	Number of agreements	Number of disagreements	Agreement coefficient
Accuracy of linguistic phrasing of the statements	6	0	100%
Clarity and simplicity of the statements	5	1	83.33%
Appropriateness of the number of items per dimension	6	0	100%
logical sequence of the statements within each dimension	5	1	83.33%

The researchers employed the method of inter-rater agreement among six experts to calculate the reliability of the raters and establish the evaluation criteria. Each expert independently

recorded their observations without consulting the others. The number of agreements among the raters was calculated using Cooper's formula: Agreement percentage = (Number of agreements / (Number of agreements + Number of disagreements)) × 100. The resulting agreement percentages ranged between 83.33% and 100%, which are considered high and acceptable levels of agreement.

(2) Internal consistency validity

The checklist was applied to a pilot sample consisting of five individuals with Down syndrome. Following the application, the internal consistency validity of the items was assessed using Cronbach's Alpha coefficient to calculate the overall reliability and item validity. This method is based on the internal consistency model, which relies on the average inter-item correlation between the individual items and the overall observation checklist for musical skills. The resulting overall reliability and item validity coefficient was .88, indicating a high level of reliability.

The following table presents the Pearson correlation coefficients between the sub-items and the total score of the observation checklist for musical skills among individuals with Down syndrome.

<Table 3> Pearson correlation coefficients between the sub-items and the overall observation checklist for the musical skills performance

Skill area	Item	Correlation coefficient	Item	Correlation coefficient	Item	Correlation coefficient
Individual and group performance on rhythmic and motor expression	1	.58**	2	.63**	3	.67**
	4	.54**	5	.63**	6	.60*
	7	.54**	8	.66**	9	.65**
	10	.66**	11	.68**		
Individual and group performance on singing	1	.61**	2	.62**	3	.61**
	4	.67**	5	.67**	6	.61**
	7	.66**	8	.66**	9	.64**
	10	.60**				

*p < .05, **p < .01

By interpreting the above table, it is evident that all the correlation coefficients between each item and the musical skills observation checklist are strong positive correlations, significant at the .01 level. Based on these results, it can be concluded that the sub-items exhibit a high degree of internal consistency for the scale.

2) Reliability of the observation checklist for the musical skills performance

To assess the reliability of the observation checklist for musical skills, the checklist was applied to a sample of five children with Down syndrome. The reliability was calculated using two methods: Test-retest reliability and Split-half reliability.

(1) Test-retest reliability

The test-retest method was used to calculate the reliability coefficient of the observation checklist for musical skills. The researchers applied the checklist to a sample of five children with Down syndrome and then reapplied it after a three-week interval. The statistical analysis was conducted using the SPSS software, version 21. The reliability coefficient for the overall checklist was .83, indicating a high level of reliability. This suggests that the results provided by the checklist are trustworthy and that it can be reliably used as a research instrument.

(2) Split-half reliability

This method involves administering the checklist once and then dividing it into two equivalent halves. The correlation coefficient between the scores of the two halves is then calculated. Based on this, the predicted reliability coefficient for the full checklist was estimated to evaluate the consistency of the observation checklist for musical skills.

<Table 4> Reliability coefficient using the split-half method for Spearman/Brown and Guttman

Guttman	Spearman/Brown	
	Unequal length	Equal length
.55**	.54**	.55**

**p < .01

It is evident that the total reliability coefficient for the musical skills observation checklist using the Spearman/Brown Split-Half method equals (.55) in the case of equal test halves, and (.54) in the case of unequal test halves. Furthermore, the total reliability coefficient for the musical skills observation checklist using the Guttman Split-Half method equals (.55), indicating a high total reliability coefficient. Based on the above, the final version of the musical skills observation checklist consists of (21) items.

7. Data analysis

The musical skill scores were coded and entered into SPSS version 21 for analysis. Due to the small sample size and the non-normal distribution of the data, the Wilcoxon Signed Rank Test, a non-parametric alternative to the paired-samples t-test, was used to assess the significance of differences between pre-test and post-test scores. Descriptive statistics, including means and standard deviations, were calculated to summarize the participants' performance before and after the intervention. Statistical significance was determined at the level of $p \leq .05$.

IV. Results

To verify the validity of the research hypothesis, which states: There is a statistically significant difference at the level of ($p \leq .05$) between the mean ranks of the scores of children with Down syndrome taught using the Kodály method in the pre-test and post-test applications of the musical skills observation checklist (as a whole) and for each of its sub-skills., the results of applying the observation checklist in both the pre-test and post-test were analyzed for the Down syndrome participants. The means and standard deviations of the scores for the children with Down syndrome in both the pre-test and post-test applications of the Musical Skills Observation Checklist (as a whole) and for each of its sub-skills were calculated. The following table summarizes these results.

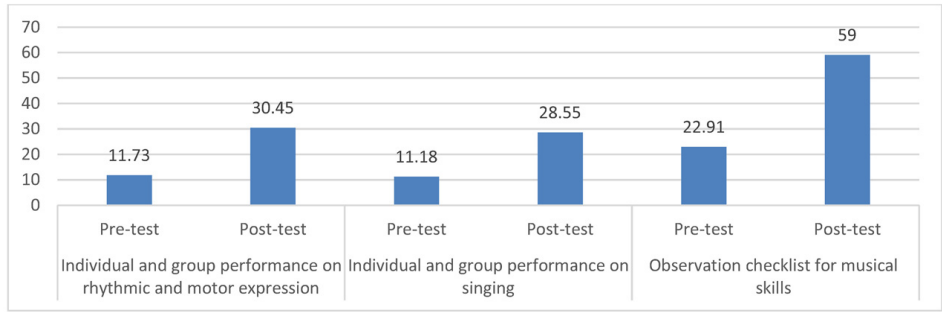
To verify the validity of the research hypothesis, which states: There is a statistically significant difference at the level ($p \leq .05$) between the mean ranks of the scores of the Down syndrome participants, taught using the Kodály method, in the pre- and post-test applications of the observation checklist for musical skills. The results of applying the observation checklist in both the pre- and post-tests were analyzed for the Down syndrome participants. The means and standard deviations of the participants' scores in both the pre- and post-tests of the observation checklist were calculated, and the following table summarizes these results.

It is evident from the results summarized in the previous table that there is an improvement in post-test performance; this is inferred from the comparison of the means and standard deviations of the pre- and post-assessments.

The Wilcoxon Signed Rank Test was applied, which is a non-parametric test used as an alternative to the t-test for related samples when the conditions for using the t-test for paired

<Table 5> Means and standard deviations of the scores of Down syndrome participants in the pre- and post-application of the observation checklist for musical skills

Component	Type of assessment	Mean	Standard deviation
Individual and group performance on rhythmic and motor expression	Pre-test	11.73	.79
	Post-test	30.45	1.51
Individual and group performance on singing	Pre-test	11.18	1.17
	Post-test	28.55	1.04
Observation checklist for musical skills	Pre-test	22.91	1.76
	Post-test	59.00	1.95



[Figure 4] The mean scores of individuals with Down syndrome in the pre- and post-application of the observation checklist for musical skills

data are not met, due to the small sample size. The following table summarizes these results.

The results summarized in the previous table show that the Z-values are statistically significant at the .01 level. This indicates the presence of statistically significant differences between the mean ranks of the scores of individuals with Down syndrome in the pre- and post-application of the musical skills observation checklist, both overall and for each of its sub-skills, in favor of the post-test performance. Accordingly, the first hypothesis can be accepted, which states:

There is a statistically significant difference at the level of ($p \leq .05$) between the mean ranks of the scores of children with Down syndrome taught using the Kodály method in the pre-test and post-test applications of the musical skills observation checklist -both overall and for each of its sub-skills- in favor of the post-test performance.

It is evident from the results summarized in the previous table that the Z statistic value is significant at the .01 level, indicating a statistically significant difference between the mean ranks of the scores of the Down syndrome participants' scores in the pre- and post-applications of

<Table 6> The value of ‘z’ and its statistical significance for the difference between the mean ranks of the Down syndrome participants’ scores in the pre- and post-applications of the observation checklist for musical skills and for each of its sub-skills

Component	Sign ranks	N	Mean ranks	Sum of ranks	Z statistic	Significance level	Rank-biserial correlation (effect size = rprb)
Individual and group performance on rhythmic and motor expression	Negative	0	.00	.00	2.958	.003	1.00 (very strong)
	Positive	11	6.00	66.00			
	Tied	0					
Individual and group performance on singing	Negative	0	.00	.00	2.965	.003	1.00 (very strong)
	Positive	11	6.00	66.00			
	Tied	0					
Observation checklist for musical skills	Negative	0	.00	.00	2.965	.003	1.00 (very strong)
	Positive	11	6.00	66.00			
	Tied	0					

**p < .01

the observation checklist for musical skills (as a whole) and for its subskills favoring the post-performance. Therefore, the researchers can accept the hypothesis, which states: There is a statistically significant difference at the level ($p \leq .05$) between the mean ranks of the Down syndrome participants taught using the Kodály method in the pre- and post-test applications of the observation checklist for musical skills, favoring the post-test performance.

V. Discussion

The findings of this study demonstrate that the training program based on the Kodály method significantly enhanced the musical skills of children with Down syndrome, particularly in improving singing accuracy, rhythmic stability, and musical engagement, accompanied by notable gains in attention, coordination, and self-confidence. Statistically significant improvements between pre- and post-test scores, along with the large effect size, indicate that the program was highly effective in addressing the initial challenges observed in the participants, such as difficulties in maintaining focus, developing auditory memory, and synchronizing rhythmic movement with music. The structured engagement in singing, rhythmic exercises, and listening activities grounded

in Kodály pedagogy served as powerful tools for promoting auditory perception, vocal control, and expressive musical participation.

The success of the program can be attributed to the strategic use of multiple instructional techniques derived from the Kodály philosophy. Lessons were built upon core elements, solfège, Curwen hand signs, rhythmic syllables, and musical games, which together fostered a multisensory learning environment. The integration of auditory (listening to rhythm and pitch), visual (observing hand signs and colors), and kinesthetic (clapping, movement, and body percussion) modalities activated different sensory channels, enabling children with Down syndrome to internalize musical concepts more effectively. Activities such as *Cherry Beet*, *A Ram Sam Sam*, and *Baby Shark* were particularly effective, as they combined clear rhythmic structure with engaging lyrics and movements, stimulating attention and supporting retention through repetition and play.

Structured repetition and gradual progression formed the cornerstone of the program's effectiveness. Each lesson began with simple rhythmic patterns 'ta' and 'ta-ti' and gradually introduced more complex elements such as the first five notes of the musical scale and combined hand signs. This systematic scaffolding allowed children to consolidate their skills before moving to higher levels of difficulty. For instance, when children initially struggled to coordinate singing with Curwen hand signs, the researchers decomposed the task into smaller steps—first isolating each sign and then integrating them sequentially. Over time, the children were able to perform the complete melodic sequence accurately and confidently. Similarly, rhythmic challenges such as 'ta-fa-ti' were addressed through modeling, hand-over-hand guidance, and slow-paced repetition, which significantly improved precision and confidence.

The use of educational and musical games proved to be a particularly effective strategy in maintaining engagement and motivation. Activities such as the *Musical Ball*, *Musical Train*, *Colorful Ribbon Stick*, and *Snakes and Ladders*, transformed the learning process into an interactive, joyful experience. These games not only strengthened rhythm comprehension and timing but also promoted social interaction, cooperative play, and turn-taking skills, which are essential developmental areas for children with Down syndrome. For example, in the Musical ball activity, clapping and throwing the ball in time with rhythmic syllables 'ta', 'ta-ti' enhanced attention and coordination while fostering peer communication and anticipation. Likewise, the musical train activity encouraged group synchronization and collective rhythm, which supported teamwork and social awareness.

Another powerful feature of the Kodály-based program was the modeling and simulation strategy used throughout instruction. The researchers and trainers consistently demonstrated the

target movements and vocal patterns before inviting the children to imitate them. This modeling technique, coupled with verbal praise, tangible rewards, and positive reinforcement, contributed to a supportive emotional climate that encouraged children's participation. The gradual increase in task complexity, from imitation to independent performance, allowed for visible improvement in confidence, rhythmic precision, and vocal production. Teachers' responsiveness to each child's pace and needs ensured that learning remained adaptive and inclusive.

Observations recorded during the intervention revealed that the children's attention spans and engagement levels increased significantly when lessons incorporated colorful visuals, familiar melodies, and physical movement. For example, when visual aids such as colored cards or rhythmic symbols were used, children demonstrated better focus and recall of rhythm patterns. Similarly, songs with associated actions, such as *Rain Rain Go Away* using colorful ribbons and the Moving train activity, enhanced both memory and expressive communication. These results affirm that multisensory, play-based music learning can effectively address both cognitive and motor challenges often associated with Down syndrome. Overall, the Kodály-based program not only improved the participants' musical competencies, such as rhythmic accuracy, pitch recognition, and melodic memory, but also supported broader developmental outcomes. Improvements in fine motor coordination, listening attention, and social-emotional expression were consistently observed during and after the training sessions.

These findings align with previous research that confirmed the effectiveness of Kodály-based music programs in enhancing musical skills, cognitive abilities, and social development among children with special educational needs (Abril, 2016; Houlahan & Tacka, 2015; Moon, 2020; Siromoto, 2016; Young, 2024). However, the present study extends this work by focusing specifically on children with Down syndrome and by providing detailed, evidence-based insights into improvements across multiple musical sub-skills, including pitch accuracy, rhythmic performance, hand-sign coordination, and expressive singing.

From an educational perspective, the results underscore the value of integrating Kodály pedagogy into inclusive and special education settings. The Kodály approach offers a structured, developmentally appropriate, and culturally adaptable framework that promotes both musical and non-musical development, encompassing cognitive, motor, and social domains. By combining singing, Curwen hand signs, rhythmic syllables, and movement-based activities, it fosters a multisensory learning environment that enhances attention, fine motor coordination, expressive communication, and cooperative interaction—core developmental areas for children with Down syndrome.

Despite these promising results, the study has some limitations. The sample size was small and drawn from a single institution, limiting generalizability. The research design did not include a control group, which constrains the ability to attribute improvements solely to the intervention. Additionally, the study focused on musical skills and did not directly measure broader developmental or life skills. Future research should employ larger, more diverse samples, experimental designs with control groups, and longitudinal assessments to examine the maintenance of gains and potential transfer to other areas of learning and daily life.

VI. Conclusion

In conclusion, this study provides strong evidence that a structured Kodály-based program can effectively enhance the musical skills of children with Down syndrome, particularly improving their abilities in rhythmic performance, melodic memory, and expressive singing. The program's emphasis on singing, solfège, Curwen hand signs, rhythmic syllables, and movement-based activities contributed substantially to its effectiveness, fostering engagement, coordination, attention, and expressive communication. These findings demonstrate the potential of Kodály pedagogy as a powerful arts-based approach within special and inclusive education contexts. The results suggest that such programs can serve as valuable tools not only for musical development but also for broader cognitive, motor, and social-emotional growth. Overall, the findings contribute to the growing body of evidence supporting arts-based pedagogies as inclusive, developmentally appropriate interventions for children with intellectual disabilities. It is recommended that music educators and special education practitioners integrate Kodály-based activities into inclusive curricula, and that future research explore long-term outcomes, transfer effects, and implementation across diverse educational settings to further support the holistic development of children with intellectual disabilities.

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