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EDITED BY
Alice Cancer,
Catholic University of the Sacred Heart, Italy

REVIEWED BY
Andrew Davidson,
University of Surrey, United Kingdom
Damien Sagrillo,
University of Luxembourg, Luxembourg

*CORRESPONDENCE
Mustafa Kendüzler
✉ kenduzlermustafa@gmail.com

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Development and testing of a new pedagogical model in beginner-level solfège education

Mustafa Kendüzler* and Salih Akkaş

Department of Music Education, Institute of Educational Sciences, Gazi University, Ankara, Türkiye

Accurate vocal use and intonation skills are fundamental components of beginner-level solfège education. This pilot study aimed to develop and test a new pedagogical model designed to enhance beginner-level students' vocal use and intonation skills in solfège performance. The model, developed specifically for this study, is referred to as the *Vocal Use-Based Solfège Teaching Model*. This study employed a true experimental pretest-posttest control group design. The pilot study involved a small sample of 12 beginner-level solfège students voluntarily recruited from Ankara Private La Vita Music Academy and randomly assigned to either the experimental or control group. Both groups completed a pretest using excerpts from solfège *1* textbook and were assessed with the *Musical Reading Performance Test*. During a six-week intervention period, the experimental group engaged in the newly designed solfège exercises, while the control group followed traditional curriculum materials. The pretest scores do not show a statistically significant difference between the experimental and control groups ($p > 0.05$). The posttest scores, however, indicate a statistically significant improvements in the experimental group, with a moderate effect size (Cohen's $d = 0.29$). The findings demonstrate that the *Vocal Use-Based Solfège Teaching Model* offers a replicable and more effective approach to beginner-level solfège education compared to traditional methods.

KEYWORDS

beginner-level solfège education, solfège pedagogy, vocal use-based solfège teaching model, vocal use, intonation skills

1 Introduction

The practice of solfège is used by beginner musicians to learn and improve the ability of the musical reading through the repeated singing of musical notes from a music score. In fact, this kind of exercise is a fundamental part of the music learning process. It guides the student to build their own musical perceptions by creating an internal image of the sound along the vocal emission of a note (or sequences of notes as intervals, scales and melodies) (Schramm et al., 2015).

Solfège has been defined in various ways, reflecting its multifaceted nature in music education. According to Holmes (2009, pp. 17–18), solfège was initially understood as the performance of scales, intervals, and melodic exercises using specific solmization syllables. Over time, its ease of application, effectiveness in facilitating memorization, and ability to express tonal functions have made it a widely recommended instructional method among music educators, particularly after its systematic formalization in 19th-century France.

In a more concise description, Sun (2019, p. 1) defines solfège as the reading of musical notes together with their names, sounds, and durations. Complementing this definition, Petzold (as cited in Holmes, 2009, p. 15) uses the term musical reading to refer directly to

solfège, defining it as the process of interpreting musical symbols and converting them into corresponding sounds.

Building upon these definitions, the ability to read music — in other words, to perform solfège — can be regarded as a fundamental component of musical understanding, as it reinforces both the perception and interpretation of sounds (hearing) and the ability to transcribe them into notation (writing). In this regard, solfège is considered to play a crucial role in fostering these skills within formal music education.

While solfège contributes significantly to basic musical literacy, its importance becomes even more pronounced at the professional level, where advanced skills must be developed. According to Vujović (2014, p. 6), in the context of professional music education, solfège not only involves theoretical instruction but also the development of skills that promote the automation of inner hearing. While sight-singing strategies can be taught relatively easily, making them automatic requires structured and sustained effort. Mursell (1956, p. 137) emphasizes that learning to read music is essentially equivalent to understanding music, and any decline in comprehension leads to a corresponding decline in musical development. Similarly, Smith (1934, p. 16) underscores that solfège is a foundational component of musical competence, asserting that without proper solfège instruction, musical development may remain incomplete or inadequate.

The beginner level is considered the most critical and attention-demanding stage of solfège education. This is primarily because it involves a large number of students who are encountering solfège for the first time, making the structured development of fundamental musical skills at this stage particularly important. One of the primary challenges frequently encountered in beginner-level solfège education is students' inability to use their voices properly, which in turn negatively affects their ability to perform solfège with accurate intonation.

Although some pedagogical approaches have been proposed in the literature for students who experience difficulties in proper vocal use and intonation development, these approaches have not yet been transformed into systematic exercises and integrated into solfège education. According to Yönetken (1952, pp. 26–28), some children struggle to imitate the sounds they hear during vocal exercises with proper intonation. This difficulty is often attributed to various physical or auditory deficiencies. In the United States, these children are labeled with terms such as 'Out-of-Tune' or 'Monotones'. It is emphasized that these children need special attention in music classes and should be encouraged to develop correct intonation. To achieve this, they should be placed next to successful students to hear correct intonation and supported with imitation games and high-pitch exercises. It is suggested that consistent practice can help these students acquire the ability to produce accurate sounds.

Existing beginner-level solfège education lacks systematically designed exercises that focus on developing students' vocal use skills. In existing beginner-level solfège education, only 30% of practices focus on intonation exercises and 50% on interval exercises. However, none of the current instructional approaches include specially designed solfège exercises aimed at developing vocal use or diaphragmatic control (Kendüzler, 2025). The lack of specific exercises in existing beginner-level solfège education poses a significant challenge, particularly for those with no prior knowledge of vocal use. 'Vocal use' refers to controlling diaphragm tension and air pressure, adjusting vocal thickness and thinness according to pitch, and balancing the airflow. Existing solfège education typically begins with direct pitch instruction and includes solfège exercises corresponding to each newly introduced pitch. Consequently, it is considered that students with no prior experience in solfège education or vocal use are likely to develop accurate pitch production skills at this stage in a manner that is often unsystematic and incidental. Furthermore, students who are able to reproduce pitches correctly without a consciously structured methodological approach may lack sufficient awareness of vocal technique. In addition, the absence of a systematic approach to developing vocal use skills in beginner-level solfège education may lead to inconsistent and uneven learning outcomes among students.

The pedagogical approach proposed in this study suggests that the human voice may operate through a mechanism similar to that of brass instruments. In brass instruments, by adjusting diaphragm tension and regulating air pressure, performers can vibrate their lips at the target frequency to produce the desired pitch. Similarly, by adjusting diaphragm tension and air pressure, the vocal cords in the human voice can vibrate at the target frequency, thereby producing the desired pitch. Building on this parallel in the mechanisms of vocal production and brass performance, this study focuses specifically on the Dr. Charles Colin trumpet method, which is widely used in trumpet education. The exercises included in this method are specifically designed to enhance students' ability to fine-tune diaphragm tension, regulate air intensity, and direct air pressure efficiently, thereby enabling them to internalize these essential skills and apply them reflexively during performance (Colin, 1980).

This pedagogical perspective, which emphasizes the systematic development of accurate pitch production through the mastery of physical mechanisms, may offer valuable insights for solfège pedagogy as well. Drawing on this approach, it can be suggested that students who develop proper vocal use skills through structured exercises—similar to those in Dr. Charles Colin's trumpet method—will be able to accurately reproduce the sounds they hear and perform solfège with precise intonation (Kendüzler, 2023, p. 1). Although the model draws inspiration from the pedagogical principles of Dr. Charles Colin's *Trumpet Method*, the connection is conceptual rather than structural. The aim was not to replicate Colin's exercises, but to adapt selected physiological principles—such as diaphragm tension and breath regulation—for vocal use in beginner-level solfège education. For this reason, the model does not position the analogy as a theoretical foundation but rather approaches it as a pedagogical inspiration grounded in shared physiological mechanisms.

The researcher has identified a notable lack of studies focusing on the accurate use of the voice in beginner-level solfège education, revealing a critical gap in the field. To address this gap, the present pilot study developed a new pedagogical model—*the Vocal Use-Based Solfège Teaching Model*—designed to enhance students' vocal use control and intonation skills.

Although the model primarily focuses on technical control—such as diaphragmatic engagement, breath regulation, intonation accuracy, and pitch interval precision—these foundational skills are essential prerequisites for more advanced musical expression. Effective diaphragm use enables the production of a resonant and focused tone, which is critical for clear articulation and expressive phrasing. Likewise, accuracy in intonation and interval recognition forms the basis for performing complex musical passages with tonal stability. Accordingly, the systematic structure of the model not only supports

the acquisition of technical skills but also aims to lay the groundwork for expressive capabilities such as dynamic nuance, interpretive sensitivity, and phrasing. The pedagogical logic of the model is thus clarified: to express music meaningfully, students must first learn to produce it accurately and consciously—beginning with effective vocal use.

This study aims to reveal the effect of *the Vocal Use-Based Solfège Teaching Model* on beginner-level students' ability to perform solfège accurately with correct pitches. Its significance lies in presenting experimental evidence based on an original pedagogical approach tailored for beginner-level solfège education. Accordingly, the study is expected to make a novel contribution to the field of solfège pedagogy by proposing and empirically testing a structured model for training vocal use and intonation.

2 Literature review and conceptual framework

2.1 Conceptual background: the relationship between voice use and Brass instrument sound production

The conceptual foundation of this study is based on the physiological and mechanical similarities between human voice production and the performance of brass instruments, particularly the trumpet. Both processes rely on shared principles such as proper diaphragmatic use and air pressure management to achieve accurate sound production. Building upon these principles, *the Vocal Use-Based Solfège Teaching Model* integrates voice use strategies into beginner-level solfège education, aiming to systematically develop students' vocal use and intonation skills.

2.2 Principles of sound production in brass instruments

There are four fundamental elements involved in sound production for brass instruments:

- Airflow (Blowing)
- Lip vibration
- Tongue movement to initiate the sound
- The mouthpiece and the instrument

The instrument itself serves only as a medium for carrying and shaping the sound. To achieve the highest level of performance, the instrument and the performer must work in harmony. A set of muscles is used to inhale air and then transport it from the trachea to the lips at the appropriate pressure. Another set of muscles (tongue) is responsible for articulation, while a third group (lips) controls the frequency of vibrations and the production of correct pitch intervals. Lip muscles can function in ratios of 50:50 or 70:30, depending on the required balance. The performer must determine how much strain these muscles will endure and adjust their technique for optimal comfort. The mouthpiece should be positioned where the performer feels most comfortable, as there are no fixed rules for placement. Additionally, the interaction between the mouthpiece and the lips depends on breath support. If the breath support is sufficient, less pressure is exerted by the mouthpiece on the lips. However, if breath support is inadequate, inevitable issues related to excessive lip pressure arise. For this reason, brass instrument instructors provide students with specific solutions. For example, the instrument can be suspended from the ceiling with a string, requiring the player to blow into it without using their hands. This method encourages the player to control the instrument using only breath support, rather than unnecessary hand pressure. The pressure exerted by the mouthpiece on the lips is directly proportional to register changes. Beginners often attempt to reach higher octaves by applying excessive lip pressure, which may cause lip muscle strain or injury. To prevent this, the importance of breath control must be thoroughly explained, and students should be guided toward proper practice techniques (Baydar, as cited in Açıksöz, 2007, pp. 21–22).

2.3 Proper breath control

"Every wind instrument performer must have sufficient knowledge of proper breath control. A correct technique is a crucial factor in enabling the musician to achieve high performance standards. Performers must understand the details of breath control in order to develop this technique further." (Açıksöz, 2007, p. 28).

The diaphragm is an extremely powerful muscle system, capable of controlling sneezing, which manages the body's allergic reactions. The stomach muscles contract with enough force to expel unwanted substances from the body at a speed of 140 km/h. Due to this characteristic of the stomach muscles, wind instruments should be practiced using a technique known as diaphragmatic breathing. This method relies not only on the lungs but primarily on the long-lasting and supportive structure of these muscles to facilitate sound production (Baydar, as cited in Açıksöz, 2007, p. 28).

2.4 Diaphragmatic breathing

The diaphragm is the most important respiratory muscle, separating the rib cage from the abdominal cavity. It forms right and left domes, which flatten when inhaled air pushes against them, expanding the chest cavity and allowing the lungs to draw in air. As the diaphragm relaxes, exhalation occurs. The pressure from breathing pushes the soft spot beneath the sternum forward. When this happens, the diaphragm applies pressure to the organs in the abdominal cavity. A slow and controlled exhalation allows the diaphragm to rise higher than its natural position. At this point, with the increased need for deep breathing, a larger intake of air forces the diaphragm down to its lowest possible position. The flexibility gained by the diaphragm through this process is crucial for proper instrumental breathing. All muscles work in opposition to one another. While the rib cage muscles move in opposite directions, the abdominal muscles pull the ribs downward, maintaining the connection between the chest and the diaphragm. By resisting the abdominal muscles, the diaphragm regulates the proper, steady, and prolonged flow of sound. Ultimately, it can be concluded that the diaphragm functions as the inhalation muscle, while the abdominal muscles control exhalation. The amount of air used in diaphragmatic breathing and the controlled release of air necessary for the

instrument are essential for high-quality sound production. It is crucial to understand that exhalation is not just an automatic habit but a process requiring mental effort. The three stages of breathing inhalation, retention, and exhalation can be better understood and mastered through simple and comprehensible exercises (Açıksöz, 2007, pp. 31–33).

Inhalation; The breathing phase is crucial when playing wind instruments. The timing of inhalation and air storage determines how long the stored breath will last until the next inhalation. *Breath retention;* This is the period in which the diaphragm is held in a lowered position between inhalation and exhalation. *Exhalation;* While playing notes, the diaphragm regulates the airflow from the lungs, allowing for controlled and proportioned exhalation through conscious practice. To ensure healthy and controlled breath usage, adequate breathing exercises must be practiced regularly (Öztunç, as cited in Açıksöz, 2007, p. 40).

2.5 The human voice in relation to brass instruments

In the beginning stages of brass instrument training, "warm-ups" are commonly practiced, consisting of exercises that actively engage the diaphragm. In brass instruments, different pitches can be produced from the same fingering position by utilizing the correct diaphragm tension and the appropriate amount of air pressure. The primary reason for this is the airflow directed upward with varying force/pressure. When air pressure and diaphragm tension increases, the produced pitch is higher, whereas when air pressure and diaphragm tension decreases, the pitch is lower. Through these exercises, students learn to:

- Utilize the correct diaphragm tension
- Direct the right amount of air pressure upward according to the desired pitch
- Control this airflow effectively

This process enables them to achieve proper lip vibration and consequently produce the correct pitch. From this perspective, the mechanics of the human voice function similarly to brass instruments. The first step in the proper use of the human voice is mastering correct diaphragmatic breathing. To produce the desired pitch, the correct diaphragm tension and appropriate air pressure must be applied so that the vocal cords vibrate at the correct frequency, allowing for accurate pitch production. When air pressure and diaphragm tension is high, the vibration frequency increases, resulting in a higher pitch. Conversely, when air pressure and diaphragm tension is low, the vibration frequency decreases, producing a lower pitch.

Although there is a conceptual similarity between brass instrument technique and human voice production, there are significant structural and physiological differences between the two domains. In particular, concepts such as lip formation (embouchure), mouthpiece-lip interaction, and the use of the tongue for initiating sound are central to brass instrument pedagogy, whereas these elements do not have direct equivalents in vocal use. In vocal pedagogy, on the other hand, elements such as costal (rib) reserve breathing, laryngeal positioning, and the use of resonance cavities are emphasized.

While both forms of sound production share fundamental principles such as the effective use of the diaphragm and the proper management of air pressure, their methods differ considerably in terms of pitch control, sound initiation, and the development of muscle memory-based skills. Therefore, the pedagogical model presented in this study does not aim to transfer brass instrument techniques directly to vocal exercises. On the contrary, it seeks to conceptually adapt only the fundamental physiological principles, such as diaphragmatic tension and breath support.

The model deliberately excludes technical elements specific to brass instruments (e.g., lipvibration, embouchure formation, mechanical contact with the mouthpiece) and instead focuses solely on principles that can pedagogically contribute to vocal production. This approach delineates the conceptual framework of the '*Vocal Use-Based Solfège Teaching Model*' and clearly demonstrates its applicability within the context of beginner-level solfège education focused on vocal use skills.

2.6 Using the human voice like a trumpet

The human voice is the oldest known instrument and is considered the most complex structure among all musical instruments. It possesses the ability to produce both speech and singing. When speaking, and especially when singing, the entire body is engaged to produce a correct, effective, and aesthetically pleasing sound (Kavşat et al., 2020, p. 463). In other words, the human voice is produced by utilizing the entire body as a musical instrument. Consider a skilled and well-trained singer—they understand that in addition to using their vocal cords, they must also engage their breathing system, recognizing that healthy breathing is directly related to proper vocal resonance. In this process, certain muscles must be active, while others must remain passive, ensuring that the entire body functions in a coordinated manner (Sabar, as cited in Kavşat et al., 2020, p. 463).

Acoustic and anatomical features play a crucial role in the formation of the human voice and, consequently, in singing. The mechanical properties of the laryngeal muscles, along with the vocal fold vibration frequency and air pressure from the lungs, determine the quality of the produced sound. The greater the air pressure, the more stretched and thinner the vocal folds become, leading to higher frequency vibrations and a higher-pitched sound (Sundberg, as cited in Kavşat et al., 2020, p. 463).

When producing low-pitched (chest) sounds, the vocal muscles relax, shorten, thicken, and vibrate along their entire length. In contrast, when producing high-pitched (head) notes, the vocal muscles lengthen and become thinner, and only a small portion of the vocal folds vibrates (Smith, as cited in Uyar, 2017, p. 54).

The vocal folds function similarly to the buzzing mechanism of a trumpet mouthpiece. The structures above the vocal folds act as components of the resonator system, comparable to the bell of a horn or a trumpet. The buzzing sound produced by the vocal folds is transformed into the unique human voice through resonators (American Academy of Otolaryngology, as cited in Uyar, 2017, p. 54).

The first stage of singing lessons focuses on correcting breathing techniques. Breathing exercises continue until the student fully masters diaphragmatic breathing both technically and practically, without any exceptions. Once this foundation is established, vocal training begins. At this stage, the focus shifts to

teaching the vocal cords, determining the student's vocal range, proper use of facial muscles, and identifying the vocal timbre. At the core of singing lessons, the correct use of the diaphragm is fundamental. A singer who masters proper breath control can effectively regulate voice output and vocal range, enabling them to produce desired sounds with ease and accuracy (Özel ders alanı, 2021).

For proper phonation (sound production) to occur, several prerequisites must be met, including adequate and controlled breath support, the approximation, shape, and tension of the vocal folds, mental relaxation, heightened awareness, and psychological readiness for singing. There is a direct relationship between balanced vocal onset, sound production, resonator utilization, intonation control, volume balance, phrasing awareness, and musical sensitivity (Çevik, as cited in Özaydın and Yiğit, 2016, p. 186).

2.7 Solfège teaching systems in music education

In the tradition of Western music education, solfège practices that have endured for centuries have been shaped by various teaching systems aimed at developing musical sensitivity, fostering music reading skills, and strengthening auditory memory. These systems have evolved within different geographical and pedagogical contexts throughout history, becoming one of the fundamental pillars of music education.

Solfège teaching systems often differ in how they name pitches, the strategies they use to guide auditory perception, and their pedagogical goals. The distinction between movable-do (relative do) and fixed-do systems constitutes the most basic division in this regard. Methods such as the Kodály approach, the Curwen system, and Dalcroze eurhythmics serve as examples of approaches that integrate solfège with both auditory and kinesthetic learning processes.

This section will explore the solfège teaching systems commonly used in music education from both historical and pedagogical perspectives, highlighting the key differences and shared features among these diverse approaches.

2.7.1 Movable-do solfège teaching systems

In the early nineteenth century, Sarah Glover pioneered one of the earliest structured solfège teaching systems, later known as the *Norwich Sol-fa System*. Although her method remained relatively obscure until its later rediscovery, it initially emerged from her educational work with low-income children and gradually spread across different social classes. Glover's early experiments, which began two decades before the system's formal publication in 1835, laid the foundation for a pedagogical approach that aimed to make music reading accessible to broader segments of society. Her influence expanded notably through the formation of the first Charity Choir, a group that played a key role in demonstrating the effectiveness of her method. Despite limited recognition during her time, the *Norwich Sol-fa System* eventually gained wider attention when John Curwen encountered it in 1841, marking a turning point in the history of music education. In Glover's system, the full solfège syllables initially used were soon replaced by a more symbolic letter system, with each letter corresponding to the initial of a solfège syllable. Alongside this change, a movable-do approach was adopted, in which each syllable was structured to represent a specific scale degree regardless of the starting note of the scale (Bennett, 1984, pp. 52–53).

Movable do refers to a relative system in which the tonic, or first degree of any key, is designated as "do" (Campbell, 1991; as cited in Holmes, 2009, p. 18). According to Bentley (1959, pp. 163–168), the movable do system is based on the idea that solfège syllables (do, re, mi, etc.) represent the degrees of the major scale independently of key. In this approach, "do" consistently signifies the tonic, or the first degree, of any major scale. Rather than focusing on fixed pitch values, the system emphasizes relative pitch relationships.

While developing her method of teaching music through letters, Glover devised a plan to help students produce representative sounds for each letter symbol. She soon realized, however, that establishing these associations required more than just listening and singing; visual aids were also essential in supporting musical understanding. As a result, she created what would later become known as the *Norwich Sol-fa Ladder*, a visually supported instructional system designed to reinforce the connection between pitch and symbol (Bennett, 1984, p. 53). However, due to the system's limitations in handling modulation—leading to issues such as singers being unable to enter at the correct time—Glover eventually abandoned it (Rainbow, 1967, as cited in Bennett, 1984, p. 54).

John Curwen derived the fundamental elements of what would later be known as the Tonic Sol-fa Notation System from Sarah Glover's procedure (Bennett, 1984, p. 50). John Curwen adopted Sarah Glover's ideas—making certain modifications of his own—to develop the Tonic Sol-fa system. In the twentieth century, Hungarian composer Zoltán Kodály built upon Curwen's work to establish the Relative Solfa system, which forms the foundation of the Kodály Concept in music education (Dick, 1996, as cited in Davidson, 2024, p. 4).

In solfège education, the use of visual-kinesthetic aids such as hand signs plays a crucial role in reinforcing pitch relationships and enhancing musical understanding. Hand signs have long been among the essential tools used in music education in various forms, and today, one of the most widely used examples is the Curwen–Kodály hand sign system (Steeves, 1984, p. 1). According to Simpson (1973, as cited in Steeves, 1984, p. 9–11), the development of hand signs was based on the idea that each tone in the scale evokes a distinct mental or emotional response. It is noted that Curwen believed learning would become easier if children associated each note with a specific character or feeling, and for this reason, he assigned a unique expressive direction and emotional quality to every pitch. Curwen developed a series of hand signs composed of specific shapes and positions designed to evoke the character of each scale degree, aiming to help students recall and internalize the associated mental impressions more effectively.

Later in the century, Zoltán Kodály (1882–1967) incorporated Curwen's hand signs into his own system and modified them with a new set of gestures. Kodály changed the orientation of the hand signs so that flat notes pointed downward and sharp notes pointed upward. Although Curwen and Kodály were not aware of the different types of learners, they developed a solid method for teaching notes and solfège that effectively addressed the needs of visual, auditory, read-write, and kinesthetic learners (Earl Haig Secondary School, n.d.). This historical evolution of hand sign systems illustrates how the integration of visual and kinesthetic strategies can provide a more holistic and accessible framework for developing pitch awareness in early music education.

There are various historical and regional approaches based on the movable-do principle. Among these are the French Numerical Music Method (1639), the English Tonic Sol-fa Method, the German Tonika = Do Method (1897), the Max Battke Method (1909), the Cmiral-Dolezil Method, the Wünsch Method, the Ptaçinski Color Method, the Carl Eitz Tonwort Method, the Wilhem French Method (1830), the Maurice Chevais Method (1923). These approaches, grounded in the movable-do system, aim to develop students' skills in perceiving and producing relative intervals within a tonal context, as well as enhancing musical listening and reading abilities (Kendüzler, 2023, p. 19).

2.7.2 Fixed-do solfège teaching systems

In this system, each note has a fixed, unique name. In solfège methods based on the fixed-do principle, solfège syllables are permanently assigned to specific pitch names. Unlike movable-do approaches, where syllables shift depending on the key, fixed-do methods require students to read and sing the exact pitches as they appear on the staff, without transposition or tonal reinterpretation (Özaltunoğlu, 2003, p. 21).

According to Davidson (2024, p. 5), Emile Jaques-Dalcroze adopted a fixed-do system—also known as *solfège-rythmique*—as the foundation for the method he developed, Dalcroze Eurhythmics. However, in the contemporary Anglophone world, ear training practices based on this method have become considerably diversified, resulting in a landscape where both fixed-do and movable-do systems are widely used across different countries.

The Dalcroze Eurhythmics Method is an innovative pedagogical approach that integrates musical learning with bodily movement. The primary aim of this method is to transform concepts such as rhythm, nuance, and meter into bodily expressions that are cognitively understood, thereby fostering a lasting musico-plastic awareness (the process of expressing, modeling, and internalizing musical concepts through physical movement). According to Dalcroze, education should not be limited to purely cognitive processes; instead, it should promote holistic development by addressing sensory, motor, and emotional domains. In this context, rhythmic gymnastics allows students to physically feel and express rhythm using their feet, hands, arms, and entire body. However, this method is not to be mistaken for physical education or dance; rather, it is a systematic practice aimed at establishing rhythmic consciousness through the harmonious cooperation of body and mind under the influence of music. Dalcroze's pedagogy provides a structured environment where children, especially in stages of intertwined physical and mental development, can externalize both their internal emotions and musical understanding. As Dalcroze states, the method enables the establishment of continuous and regular currents between body and mind, will and power, the creation of imagery and emotional stimulation, and their external expression (Yönetken, 1952, p. 120–121). In this sense, rhythm education becomes not merely a technical skill but a vehicle for aesthetic, cognitive, and emotional growth.

This holistic approach directly shapes Dalcroze's perspective on solfège instruction. In his method, solfège is not merely an auditory activity but a bodily process integrated with rhythmic awareness. Rhythmic exercises and solfège practice are conducted simultaneously, aiming not only for accurate pitch reading but also for the internalization of meter, nuance, and musical expression through bodily movement. Dalcroze complements solfège instruction with full ear training, enabling students to express what they hear through physical gestures and to perceive musical meaning in a multidimensional way. Dalcroze does not only offer rhythm training, but also integrates solfège and provides comprehensive ear training (Yönetken, 1952, p. 121–122). In this respect, the Dalcroze method goes beyond rote-based approaches to solfège, offering a learning environment rooted in active engagement, sensory awareness, and physical embodiment.

According to Yönetken (1952), the main solfège teaching methods based on the fixed-do principle include the Alphabetic System, Carl Eitz's Tonwort Method, the Danel Method, Jaques-Dalcroze's Eurhythmics Method, and the Orff Method. In addition, under the category of chromatic methods, systems developed by scholars such as Boisgelou, Manchaca, Frémond, and Eyquem also exemplify the fixed-do approach. Furthermore, a variety of other systems such as Bocedisation, Bebisation, Damenisation, Schiegg, Hövker, Freimuth, Thiessen, Winkelhake, and Framery, are also structured around the fixed-do principle (Yönetken, 1952, pp. 98–122). While these methods employ different instructional strategies to develop sight-reading and pitch recognition skills, they all share a common foundation based on a fixed pitch-syllable relationship.

In light of the information presented above, this study offers original contributions that distinguish it from existing approaches to solfège instruction in the current literature, as outlined below.

Use of visual support enhanced by diaphragm-based physiological feedback

While traditional hand sign systems are primarily based on the functional or emotional representation of tones, the *Vocal Use-Based Solfège Teaching Model* introduces an innovative approach by directly linking visual cues to a form of physiological feedback. Whereas systems such as Curwen–Kodály visualize the characteristics of scale degrees through hand gestures, this model concretizes intervallic distances and pitch levels via diaphragmatic tension and guides the process visually. In particular, dynamic markings such as crescendo and decrescendo are drawn with varying slopes that not only help students visually perceive interval sizes but also provide direct guidance for diaphragmatic control. Steeper slopes correspond to higher levels of diaphragmatic tension, while shallower slopes indicate lower tension. In this respect, the model offers a unique structure that integrates visual-kinesthetic support with physiological regulation, contributing both to intonation accuracy and the development of proper vocal production technique.

Focus on the beginner level

The research specifically targets the beginner level, which represents the most critical and challenging stage of solfège education. It addresses common issues observed at this stage, particularly students' difficulties in using their voices effectively and problems related to intonation.

Teaching vocal use skills

Unlike many solfège methods in the literature, this study prioritizes teaching students how to use their voices correctly. This approach directly supports the development of students' ability to perform solfège with accurate pitch.

Focusing on intonation and interval training

The study stands out for its targeted focus on intonation and interval training, which are fundamental to accurate sound production. Existing solfège education generally does not implement such goal-oriented and systematic methods.

Pilot study and applicable pedagogical model

The Vocal Use-Based Solfège Teaching Model is technically simple, time-efficient, and easily applicable by educators. In this regard, it presents a strong original alternative both pedagogically and in terms of practical implementation.

Suitability for a broad target audience

The Vocal Use-Based Solfège Teaching Model is applicable not only to students receiving professional music education but also to those at the amateur level. Professional students refer to individuals enrolled in formal programs such as music teacher education or conservatory training who intend to pursue music as a career. Amateur students, on the other hand, are those who begin music education for the first time but do not plan to pursue it professionally. Despite this distinction, both groups share a common characteristic: they are beginners in music education. Therefore, the model is equally replicable and applicable across both learner profiles.

Moreover, the standardized and systematic nature of the exercises enables effective implementation in group-based and repetition-oriented practices, especially within crowded classroom settings under teacher supervision. This flexibility makes the model well-suited for institutional contexts as well as individual instruction.

For younger learners, certain exercises—particularly those involving extreme pitch ranges (e.g., 2nd Position: A3–E4; 4th Position: G4–D5) —can be selectively omitted based on students' vocal development. However, because each position shares the same pedagogical objective—training the student to apply appropriate diaphragmatic tension in accordance with pitch through visual reinforcement—these omissions do not compromise the instructional integrity of the model.

Contribution to the future of music education

By enhancing the student's awareness of sound production, vocal control, and technical proficiency in performing solfège with correct intonation, the study establishes a solid foundation for the subsequent stages of music education; in this regard, it sets itself apart from other studies in the literature.

3 Materials and methods

3.1 Research model

This pilot study was carried out in two main stages. In the first stage, a set of solfège exercises was developed based on the fundamental principles of Dr. Charles Colin's Trumpet Method, particularly focusing on diaphragmatic control, air pressure regulation. These principles were adapted for vocal use and systematically transformed into pedagogical exercises designed for beginner-level solfège students. This set of exercises formed the foundation of the newly developed pedagogical model, named the *Vocal Use-Based Solfège Teaching Model*.

In the second stage, a true experimental design was employed to test the effectiveness of the *Vocal Use-Based Solfège Teaching Model* in beginner-level solfège education. A pretest-posttest control group design was used, and participants were randomly assigned to experimental and control groups. While the experimental group received instruction using the model's structured solfège exercises, the control group continued with traditional solfège practices. Both groups were assessed using the same musical reading performance test before and after the intervention. According to Karasar (2003), "experimental designs are research models in which the observed data are generated under the direct control of the researcher to determine cause-and-effect relationships" (p. 87). Similarly, Creswell (2017) states that "experimental research aims to determine whether a specific intervention has an effect on the outcome" (p. 13). The symbolic representation of the model is presented in Table 1 (Karasar, 2003, p. 97).

3.2 Participants

This study was conducted at Ankara Private La Vita Music Academy. The study group consisted of 12 students who voluntarily participated in the research at this institution. The academy provides music education to individuals of various ages and musical backgrounds. 12 voluntary participants were randomly assigned into two groups: six students in the experimental group and six students in the control group. All participants were between 18 and 22 years of age. Although the participants were between 18 and 22 years old, they were considered beginner-level students because they had no prior solfège training. In this study, the term 'beginner-level' refers to the participants' level of solfège experience rather than their age. This distinction is important, as solfège education at the beginner level can apply to learners of any age who are starting from the foundational stage.

The gender distribution of the participants is presented in Table 2. This study was designed as an experimental pilot research project that required systematic and intensive practice. The implementation process of the *Vocal Use-Based Solfège Teaching Model* involved regular small-groupsolfège sessions, individualized feedback, and detailed performance monitoring. Due to the practice-oriented and time-intensive nature of the exercises, a limited number of participants was preferred to ensure that the intervention could be delivered consistently and effectively to all participants.

This research serves as a preliminary investigation aimed at evaluating the applicability and effect of the *Vocal Use-Based Solfège Teaching Model* in beginner-level solfège *education*. One of the primary purposes of the findings is to lay the groundwork for future large-scale studies in solfège pedagogy. This study was approved by the Ethics Committee of Gazi University on 08.11.2022 (Approval No: 2022-1210).

TABLE 1 The symbolic representation of the research model.

G_1	R	$O_{1.1}$	X	$O_{1.2}$
G_2	R	$O_{2.1}$		$O_{2.2}$

G, group (experimental group/control group); R, random assignment, $O_{1.1}$, $O_{2.1}$, pretest scores; $O_{1.2}$, $O_{2.2}$, posttest scores; X, experimental process.

TABLE 2 Number of participants in the experimental and control groups and distribution ratios by gender.

Group	Female	Male	Total
Experimental group	1	5	6
Control group	1	5	6
Percentage (%)	%17	%83	%100

The table presents the gender distribution of participants assigned to the experimental and control groups ($N = 12$).

3.3 Data collection instruments and data collection

A single data collection instrument was used in this study.

3.3.1 Musical reading performance test

The Musical Reading Performance Test, developed by Özdemir (2012), was used to determine the pretest and posttest scores of participants in both the experimental and control groups.

The researcher modified some of the scoring coefficients related to specific target behaviors (specifically the 3rd, 4th, 5th, 6th, 8th, 9th, and 10th criteria) to better align the assessment with the objectives and priorities of the study. These modifications were limited to the weighting of specific criteria, particularly those associated with components such as voice use, diaphragmatic breathing and pitch accuracy, which are central to the solfège model proposed in this study. For instance, the coefficient for "Using breath correctly" (3rd behavior) was originally assigned as 1 but was increased to 3 due to its critical importance for accurate vocal use in solfège performance. A priority ranking was established accordingly, and the modified version of the measurement instrument is presented in Table 3.

3.4 Data analysis

The quantitative data were recorded and analyzed using SPSS program (Statistical Package for the Social Sciences) for Windows. Before conducting statistical tests, the necessary assumptions were evaluated to determine the appropriate statistical techniques (parametric or non-parametric). The normality of the data distribution was assessed using the Shapiro–Wilk test, as well as by examining kurtosis and skewness values and histogram plots. For comparisons between two independent groups (experimental and control groups), the Independent Samples *t*-test was employed. For comparisons between two related measurements (pretest and posttest scores within the same group), the Paired Samples t-test was utilized. The significance level obtained from the Shapiro–Wilk test was greater than 0.05, and the skewness and kurtosis values were within the range of ±2.0 (George and Mallery, 2010). Based on these findings, the data were considered to follow a normal distribution, and the analyses were conducted using parametric tests (Table 4).

3.5 Intervention procedure

Prior to the intervention, a pretest was administered to all participants under the supervision of a field expert. The pretest involved excerpts from four solfège pieces (No. 66, 68, 70, and 73) selected from the first section of Solfège 1 by Muammer Sun. To assess students' solfège performance, the Musical Reading Performance Test developed by Özdemir (2012) was used as the measurement tool.

The intervention was conducted over a period of six weeks. Participants attended the sessions once a week. Both the experimental and control group students participated separately in two sessions per day, each lasting 50 min. A 10-min break was provided between the sessions. Accordingly, a total of four sessions were held on each intervention day — two for the experimental group and two for the control group. In total, 12 sessions were conducted for each group, resulting in a total duration of 600 min (10 h) of instruction per group.

3.5.1 Experimental group

During the six-week intervention, the experimental group practiced solfège exercises derived from the *Vocal Use-Based Solfège Teaching Model*. The solfège exercises used in this study were carefully designed to develop correct vocal use, breath control, and pitch accuracy (intonation) skills in a systematic manner. The content of the exercises included stepwise melodic patterns, interval training, sustained tone production, and rhythmically varied passages. Exercises were structured to progress from simple to more complex tasks: they began with close intervals and long note values (whole and half notes) and gradually advanced to wider intervals and shorter note values (quarter and eighth notes), presented in various meters (4/4, 3/4, 2/4).

The exercises were first practiced collectively by the entire class and then, when needed, applied individually to students. This flexible approach enabled students to improve their vocal use and intonation skills in a group setting, while also allowing for targeted individual feedback that supported more effective vocal control and intonation development. Students began with the first position (Do4–Sol4/C4-G4 interval), practicing extensively until sufficient mastery was achieved, and then proceeded sequentially through the second (La3–Mi4/A3-E4 interval), third (Re4–La4/D4-A4), and fourth (Sol4–Re5/G4-D5) positions. Once proficiency in individual positions was established, Level 2 exercises integrating all 12 notes within the La3–Re5 (A3-D5) range were introduced.

All exercises were performed at a slow tempo to promote careful vocal use and accurate intonation skills. Throughout the process, attention was given to phrase integrity, breath control, including the use of crescendo and decrescendo markings to reflect variations in diaphragmatic tension rather than volume. Through this progressive and musically oriented approach, students were able to use their voices properly and perform solfège with accurate pitch (accurate intonation).

3.5.2 Control group

Participants in the control group continued with standard solfège exercises, following traditional instructional methods. Specifically, they practiced and performed exercises and reading pieces numbered 1 to 58 from the first section of Muammer Sun's Solfège 1, a widely recognized and commonly used textbook in solfège education in Turkey. Unlike the experimental group, these exercises did not specifically target vocal use or diaphragmatic control, and instead focused on conventional melodic reading skills.

Upon completion of the intervention period, a posttest identical to the pretest was administered to both groups under the supervision of an expert. The performances were independently evaluated by three

TABLE 3 Measurement instrument with modified coefficients.

No	Criteria skills	Coefficient	Score					Total
			1	2	3	4	5	
1	Making the necessary preparations before starting to read the piece (Accurately performing the cadence and scale of the given piece with the voice or piano, correctly identifying its tonality and time signature, etc.)	2						
2	Using the voice correctly and effectively (Proper and effective use of the resonator, generator, and vibrator systems, utilizing falsetto when needed, etc.)	2						
3	Using breath correctly (taking breaths at the right places, utilizing diaphragmatic breathing, etc.)	3						
4	Reading the piece with beats appropriate to its time signature	2						
5	Performing the note values with accurate durations	2						
6	Reading the piece at its actual tempo or a tempo close to the original, or in the absence of tempo markings, performing at a speed appropriate to the musical expression	1						
7	Performing the piece while staying in tonality (singing the notes accurately and clearly, recognizing alterations and modulations in the piece)	4						
8	Effectively applying dynamic markings in the piece or, in the absence of dynamic markings, performing at a volume appropriate to the musical expression	1						
9	Reading the piece in accordance with its form (accurately expressing motifs, phrases, etc.)	1						
10	Reading the piece fluently (without pauses)	2						
Total								

The coefficients were modified by the researcher to better align with the study's objectives and prioritize critical performance skills.

TABLE 4 Findings related to the assumption of normality.

Group	Shapiro–Wilk	df	*p*	Skewness	Kurtosis
Experimental pretest	0.93	6	0.57	0.22	−1.55
Experimental posttest	0.90	6	0.36	−1.04	0.12
Control pretest	0.96	6	0.81	0.78	0.29
Control posttest	0.95	6	0.74	0.54	1.70

Shapiro–Wilk test results and skewness-kurtosis values were examined to assess normality of data distribution.

TABLE 5 Days and hours of experimental implementation.

Group	Tuesday	Total
Experimental group	17.30–18.20 18.30–19.20	100 min
Control group	19.30–20.20 20.30–21.20	100 min

The schedule details the weekly intervention sessions for the experimental and control groups.

experienced solfège instructors. The schedule of the weekly intervention sessions and the experimental process are summarized in Tables 5, 6.

4 Results

4.1 Development and design of the vocal use-based solfège teaching model

To enhance beginner-level students' vocal use and intonation skills in solfège performance, the researcher developed a structured pedagogical model drawing upon the fundamental principles of Dr. Charles Colin's *Trumpet Method*. This method provided conceptual guidance in shaping the exercises with a particular emphasis on diaphragmatic control, pitch accuracy, and progressive vocal development.

The model, referred to as the *Vocal Use-Based Solfège Teaching Model,* consists of a series of exercises specifically designed to support accurate pitch production by regulating diaphragm tension and air pressure according to the target pitch, thereby enabling precise intonation and controlled vocal use in solfège performance. In the following section, the *Vocal Use-Based Solfège Teaching Model* is introduced, and the key characteristics of the exercises designed to support this model are described in detail.

1. *Vocal Range:* Exercises are structured within the A3 to D5 (La3–Re5) vocal range, which provides a safe tessitura for beginners and supports healthy vocal development.
2. *Positions and Difficulty Levels:* Four pitch positions were defined within the designated vocal range:
   - 1st Position: C4–G4 (Do–Sol)
   - 2nd Position: A3–E4 (La–Mi)
   - 3rd Position: D4–A4 (Re–La)
   - 4th Position: G4–D5 (Sol–Re)

   Exercises are divided into two difficulty levels:
   - Level 1: Each position is practiced separately.
   - Level 2: All twelve notes are practiced collectively across positions.
3. *Tonal Focus and Purpose:* The positions were created without tonal concerns, aiming to improve students' vocal production

TABLE 6 Experimental implementation process.

Experimental implementation process			
Group	Before the experiment	Experiment process	After the experiment
Control group ($n = 6$)	Pretest was administered using Muammer Sun's *Solfège 1*, Pieces No. 66, 68, 70, and 73.	Solfège training was conducted for six weeks using Muammer Sun's *Solfège 1*, Pieces No. 1–58, covering progressively more complex exercises up to the introduction of eleven pitches.	Posttest was administered using Muammer Sun's *Solfège 1*, Pieces No. 66, 68, 70, and 73.
Experimental group ($n = 6$)	Pretest was administered using Muammer Sun's *Solfège 1*, Pieces No. 66, 68, 70, and 73.	Solfège training was conducted for six weeks using exercises specifically developed by the researcher to enhance vocal use and pitch accuracy.	Posttest was administered using Muammer Sun's *Solfège 1*, Pieces No. 66, 68, 70, and 73.

The table summarizes the experimental implementation process for both groups across the pretest, intervention, and posttest phases.

and auditory perception. The Do-Sol and Sol-Re positions are associated with major scales, while the La-Mi and Re-La positions are associated with minor scales.

4. *Starting Point and Progression:* Exercises begin with the 1st Position (C4–G4) in the lower register, which demands minimal diaphragm tension. Upon mastery, students progress to higher positions, gradually increasing vocal and diaphragmatic control.
5. *Intervals and Notation-Based Exercise Design:* Intervals progress from small to wide, while rhythmic complexity increases from whole and half notes to quarters and eighths. Exercises are presented in various time signatures (4/4, 3/4, 2/4) to develop rhythmic flexibility.
6. *Melodic and Diaphragmatic Structure:* Each exercise maintains melodic cohesion and phrase shape. Dynamic markings (crescendo/decrescendo) are included to indicate changes in diaphragm tension rather than volume, reinforcing internal control of breath support.
7. *Teaching the Positions:* The same method is applied to each position, with the goal of developing the ability to produce and control all 12 pitches accurately.
8. *Level 2 Exercises:* More advanced exercises in Level 2 incorporate all tones within the La3–Re5 range and are designed to reinforce generalization, pitch accuracy, and fluency in both vocal use and intonation.

In this study, specific visual indicators (crescendo/decrescendo) were employed to concretize the physiological principles adapted from trumpet training to vocal use. For instance, the crescendo and decrescendo markings used in the model's exercises were designed with varying degrees of slope depending on the interval width. These linear curves enable students to visually perceive changes in diaphragmatic tension and air pressure, thereby helping them internalize the physical effort involved in sound production. In this way, it is aimed that technical concepts are learned not only at a theoretical level but also through practical application.

Research in the field of embodied cognition demonstrates that bodily states and modality-specific systems for perception and action form a basis for information processing, while bodily experiences contribute to various aspects and effects of mental phenomena (Foglia and Wilson, 2013, p. 319). Therefore, supporting learning processes with visual and kinesthetic representations of bodily experiences can enhance conceptual understanding.

In addition to its structured content and progression, the model was designed to be adaptable for a range of instructional contexts. Its exercise-based structure supports efficient application in both individual and group settings, including large classrooms, where teacher supervision, peer modeling, and repetition are essential strategies.

Furthermore, the flexible structure of the pitch positions allows educators to adjust content based on students' vocal maturity. For instance, in early childhood or elementary settings, educators may choose to exclude exercises from the lower (2nd Position: A3–E4) or higher (4th Position: G4–D5) pitch ranges, depending on the vocal range of the students. Because the same pedagogical process is applied in each position—linking pitch targets to appropriate diaphragmatic tension through visual cues—such adjustments do not hinder the overall instructional value or integrity of the model.

The examples provided below illustrate selected exercises developed by the researcher and assigned to participants in the experimental group during the implementation process. These exercises designed for Level 1 and Level 2 (Figures 1, 2).

4.2 Comparison of pretest and posttest scores within groups

The pretest and posttest scores of the experimental and control group were compared using a paired samples t-test. The results of this analysis are presented below in Table 7.

The results of the paired samples t-test revealed statistically significant differences between the pretest and posttest scores in both the experimental and control groups.

In the experimental group, posttest scores (75.50 ± 13.00) were significantly higher than pretest scores (48.17 ± 16.87), $t(5) = -5.59$, $p < 0.05$. This difference corresponds to a large effect size (Cohen's $d = 1.61$), indicating that the intervention exercises had a substantial impact on improving participants' performance. These findings

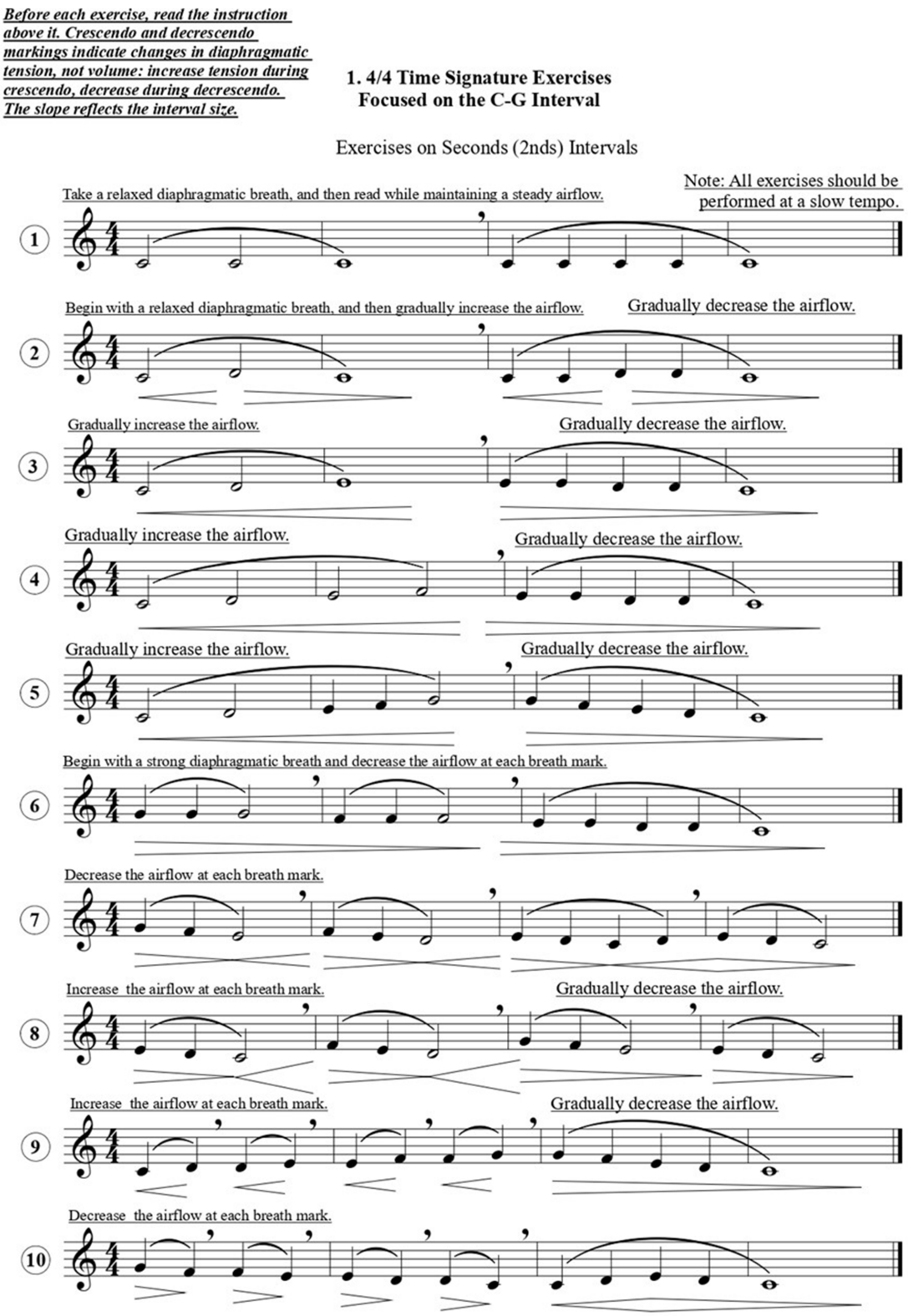

FIGURE 1
Exercise focused on the first position: C4–G4 (Do–Sol). Adapted from Kendüzler (2024).

suggest that the exercises implemented during the intervention were highly effective in enhancing students' vocal use and intonation accuracy.

Similarly, in the control group, posttest scores (47.00 ± 19.33) were significantly higher than pretest scores (39.83 ± 17.19), $t(5) = -2.58$, $p < 0.05$. However, the effect size in this group was

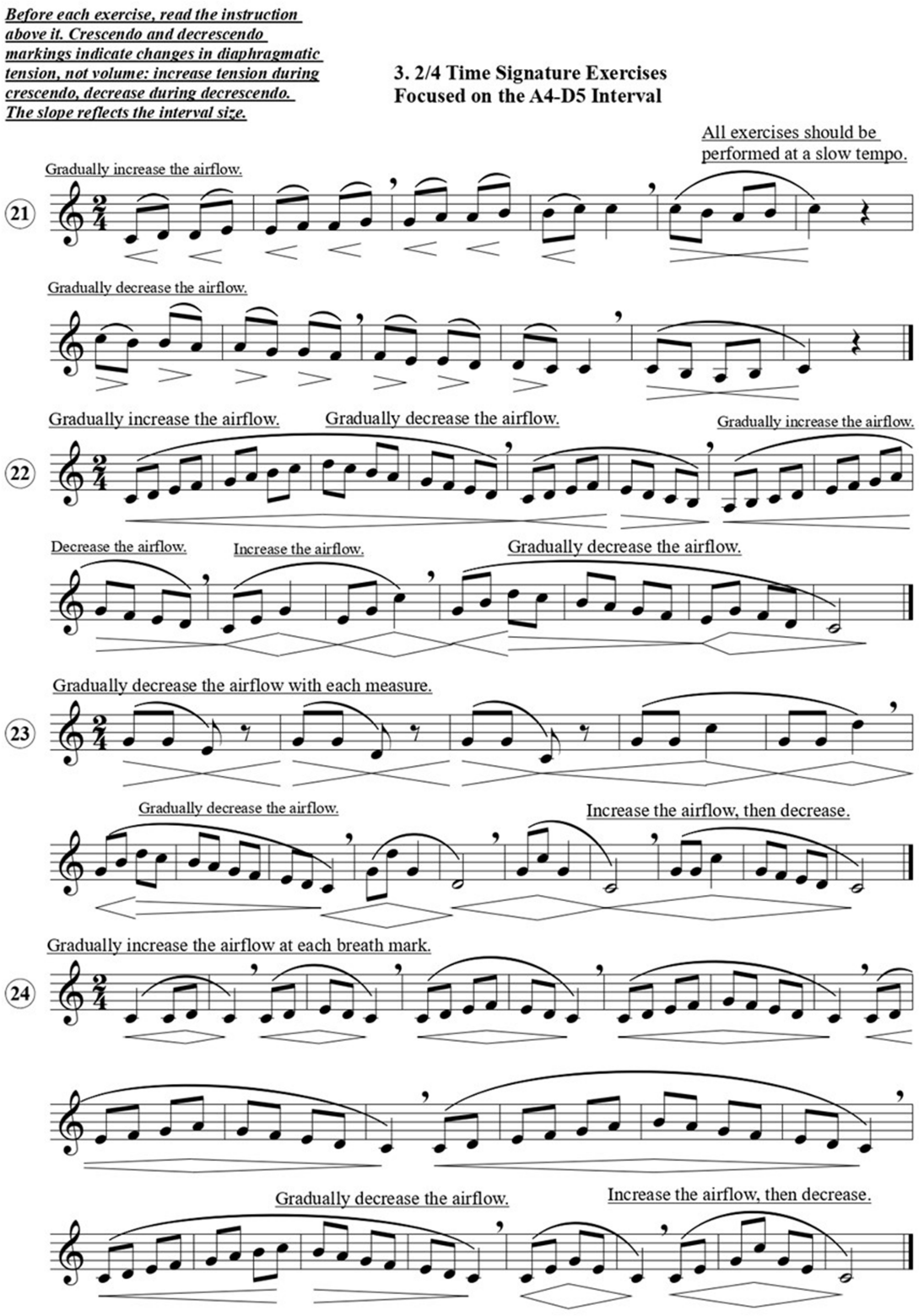

FIGURE 2
Exercise focused on the A3-D5 range (Level 2). Adapted from Kendüzler (2024).

smaller (Cohen's d = 0.75), representing a medium-to-large effect. This suggests that while traditional solfège exercises contributed to some improvement in performance, the magnitude of the effect was limited when compared to the experimental group.

Overall, the results indicate that the *Vocal Use-Based Solfège Teaching Model* and its associated exercises were more effective in improving beginner-level students' ability to perform solfège using correct pitches than the traditional instructional methods applied in the control group.

TABLE 7 Findings regarding the comparison of pretest and posttest scores within each of the experimental and control groups.

Group	*n*	$\bar{X} \pm SD$	*t*	df	*p*	Cohen's *d*
Experimental pretest	6.00	48.17 ± 16.87	−5.59	5.00	0.00	1.61
Experimental posttest	6.00	75.50 ± 13.00				
Control pretest	6.00	39.83 ± 17.19	−2.58	5.00	0.04	0.75
Control posttest	6.00	47.00 ± 19.33				

t refers to the paired samples *t*-test.

4.3 Comparison of posttest scores between experimental and control groups

To assess the overall effectiveness of the *Vocal Use-Based Solfège Teaching Model* compared to traditional instruction, an independent samples *t*-test was conducted to compare the posttest scores of the experimental and control groups. Additionally, a comparison of pretest scores was conducted to verify group equivalency prior to the intervention. The results are presented in Table 8.

The pretest scores do not show a statistically significant difference between the experimental and control groups ($p > 0.05$). The posttest scores, however, indicate a statistically significant difference between the experimental and control groups [$t(10) = 3.00$; $p < 0.05$]. When examining the mean values, it was found that the posttest scores of the experimental group (75.50 ± 13.00) were higher than those of the control group (47.00 ± 19.33). The observed significant difference was determined to have a moderate effect size (Cohen's $d = 0.29$).

4.4 Summary of findings and overall effect of the model

The results of the study show that the *Vocal Use-Based Solfège Teaching Model* developed in this research had a positive and statistically significant effect on students' pitch accuracy and vocal use skills. The *Vocal Use-Based Solfège Teaching Model*, based on the core principles of diaphragmatic breathing and controlled air pressure adapted from Dr. Charles Colin's Trumpet Method, was structured to address common vocal challenges in beginner-level solfège education.

According to the findings, the experimental group improved significantly from pretest to posttest [$t(5) = -5.59$; $p < 0.05$] with a large effect size (Cohen's $d = 1.61$), while the control group also showed improvement but to a lesser extent [$t(5) = -2.58$; $p < 0.05$; $d = 0.75$].

In addition, the posttest comparison between the two groups revealed a statistically significant difference in favor of the experimental group [$t(10) = 3.00$; $p < 0.05$], with a moderate effect size [Cohen's $d = 0.29$].

These findings suggest that the *Vocal Use-Based Solfège Teaching Model* was more effective than traditional solfège instruction in improving students' ability to produce accurate pitches (intonation) and use their voices correctly. The systematic structure and clear progression of the exercises contributed to better vocal use outcomes among beginner-level students.

5 Discussion

This study investigated the effectiveness of the *Vocal Use-Based Solfège Teaching Model* specifically designed for beginner-level solfège education, which focuses on proper diaphragmatic breathing, intonation, and interval exercises to support students in using their voices correctly. The findings revealed that the systematic solfège exercises implemented over a six-week period led to significant improvements in students' ability to use their voices accurately and to produce correct pitches (intonation) within the La4–Re5 range. These results support the study's hypothesis that, in the early stages of solfège education, students must first learn to use their voices correctly through proper diaphragmatic use and focus on developing accurate intonation skills. Such an approach is expected to foster accurate sound production and, consequently, enhance students' ability to perform solfège with correct pitches.

The Vocal Use-Based Solfège Teaching Model developed in this study, which aims to help students to use their voices correctly, makes a significant contribution to addressing the fundamental challenges frequently encountered in beginner-level solfège education. The findings indicate that common difficulties such as inaccurate sound production, inadequate diaphragmatic use, and intonation problems can be substantially reduced through systematic voice use training.

The Vocal Use-Based Solfège Teaching Model developed in this study, which is centered on voice use, not only enhances accurate sound production at the beginner level but is also grounded in the fundamental physiological principles of human voice production. Research on sound production processes in brass wind instruments (Baydar, as cited in Açıksöz, 2007) highlights the vital importance of correct diaphragmatic control and air pressure management for producing accurate sounds. Similarly, the formation mechanism of the human voice is based on principles of proper diaphragmatic breathing, appropriate air pressure, and correct vocal fold vibration (Kavşat et al., 2020; Uyar, 2017). Within this context, it becomes evident that in solfège education, priority should be given to teaching students proper diaphragmatic use to ensure accurate voice production. As emphasized in the literature, correct diaphragmatic control is also a critical factor in achieving accurate intonation and enhancing musical sensitivity (Çevik, as cited in Özaydın and Yiğit, 2016). In this respect, the findings of the study not only contribute to improving existing solfège teaching methods but also establish a strong link between the physiological foundations of human voice production and solfège pedagogy, thereby offering an original contribution to the literature.

Previous research has revealed that textbooks commonly used in beginner-level solfège education exhibit significant deficiencies, particularly regarding vocal use and proper diaphragmatic control. In a prior study conducted by Kendüzler (2025), it was found that among 20 solfège textbooks examined, only 30% included intonation

TABLE 8 Findings regarding the comparison of the pretest and posttest scores between two groups.

Test	Group	*n*	$\bar{X} \pm SD$	*t*	df	*p*	Cohen's *d*
Pretest	Experimental	6	48.17 ± 16.87	0.85	10.00	0.42	
	Control	6	39.83 ± 17.19				
Posttest	Experimental	6	75.50 ± 13.00	3.00	10.00	0.01	0.29
	Control	6	47.00 ± 19.33				

Independent samples *t*-test was used to compare the posttest scores between the experimental and control groups.

exercises and 50% included interval exercises; however, none of the textbooks contained specially developed solfège exercises targeting vocal use or diaphragmatic control. Detailed source analyses and evaluations of the relevant solfège textbooks were presented in Kendüzler's earlier research (Kendüzler, 2025). These findings demonstrate that the *Vocal Use-Based Solfège Teaching Model* developed in the present study addresses a critical gap by systematically teaching voice use at the initial stages of solfège education. Accordingly, the model not only contributes to the development of students' note-reading skills but also significantly enhances their ability to use their voices effectively—specifically improving proper diaphragmatic use, accurate sound production, correct intonation and interval performance.

Furthermore, although the model includes interval-based exercises in its early stages, its overall pedagogical orientation is grounded in absolute pitch production. Rather than emphasizing relative pitch perception, the model aims to develop students' ability to accurately produce specific target pitches within the vocal range (A3–D5) using correct diaphragmatic support. This approach positions the model beyond conventional relative pitch-based solfège methods by prioritizing the physiological control necessary to generate accurate pitches across various tonal positions. As such, the *Vocal Use-Based Solfège Teaching Model* introduces a novel perspective to solfège pedagogy by highlighting absolute pitch production as a skill that can be supported and developed through systematic vocal use training.

In this context, it is useful to briefly compare the pedagogical orientation of the current model with the widely recognized Kodály method. While both approaches aim to develop students' auditory perception and support the internalization of pitch and intervals through visual-kinesthetic strategies, they differ in terms of their theoretical foundations. The Kodály method is fundamentally based on relative pitch perception, employing movable-do solmization and hand signs to help students understand the functional role of each pitch within a tonal context. In contrast, the Vocal Use-Based Solfège Teaching Model emphasizes the accurate production of fixed pitches through diaphragmatic control, aiming to develop students' awareness and physical realization of pitch distances. This distinction highlights the model's focus on absolute pitch production and physiological control, offering a complementary but distinct pedagogical framework within solfège education. While further discussion may be warranted regarding the complementary use of both approaches, the present model offers a unique contribution grounded in physiological control and absolute pitch focus.

The Vocal Use-Based Solfège Teaching Model developed in this study offers a unique pedagogical approach that, while grounded in the fixed-do principle, diverges significantly from traditional fixed-pitch systems. The model maintains a consistent syllable-to-pitch association, directly linking each solfège syllable to a specific pitch. However, rather than relying solely on theoretical or auditory learning, it integrates visual aids and diaphragm-based physiological control to help students produce accurate vocal pitches.

As in the Dalcroze method, the integration of bodily awareness with musical perception is also present in this model; however, the focus is notably different. While Dalcroze pedagogy aims to internalize concepts such as rhythm, meter, and nuance through physical movement, the present model is structured around more pitch-centered and technical objectives, such as intonation accuracy, interval awareness, and control in sound production. The coordinated use of visual curves (e.g., crescendo and decrescendo slopes) alongside diaphragmatic tension allows students to form a conscious connection between air pressure and pitch height.

Unlike movable-do systems such as those of Curwen and Glover, which aim to teach pitch relationships and tonal function through relative perception, this model is firmly rooted in fixed-do pedagogy. While it shares visual and kinesthetic strategies with systems like Curwen–Kodály, it significantly differs in content. Instead of hand signs, the model employs graphical slopes representing the required level of diaphragmatic tension, ensuring that instruction is not only auditory but also supported by bodily and visual awareness. In this way, pitch knowledge is internalized not just cognitively but also somatically.

One of the model's distinctive features lies in the clarity and specificity of its instructional objectives. Whereas systems like Glover, Curwen, and Dalcroze can be applied across a broad spectrum of musical development and proficiency levels, the present model is specifically designed to address the challenges faced by beginners, particularly in terms of accurate sound production, breath control, and intonation development. In this regard, the model does not merely establish a technical foundation; it also functions as a preparatory stage for the development of advanced musical interpretation and expressive skills. Accurate pitch production, breath management, and conscious vocal use are foundational for later development of musical phrasing, expressive nuance, and stylistic interpretation.

In conclusion, while based on the fixed-do principle, this model moves beyond the mechanical applications of traditional fixed-pitch systems by offering a visual-physiological approach. In doing so, it distinguishes itself from conventional methodologies in the literature, providing a distinctive, practical, and pedagogically rich alternative for beginner-level solfège education.

Despite these promising results and conceptual contributions, certain limitations of the study must be acknowledged. This research was conducted as a pilot study involving only twelve participants, who were randomly assigned to experimental and control groups. Therefore, the findings are not intended to be generalizable or to present fully theorized conclusions. Rather, the primary aim of this study was to evaluate the initial applicability

of the proposed model at the beginner level and to establish a conceptual and methodological foundation for future research in music education. It is recommended that future studies replicate *the Vocal Use-Based Solfège Teaching Model* with larger sample sizes and more diverse participant profiles, and analyze the resulting data in greater depth.

In conclusion, this study demonstrates that solfège exercises focusing on correct vocal use, accurate intonation, and interval training at the beginner level enhance students' awareness of sound production, vocal control, and technical proficiency, thereby strengthening the foundational components of musical development. In this regard, *the Vocal Use-Based Solfège Teaching Model* not only departs from traditional instructional methods but also offers a practical and original contribution to the advancement of solfège pedagogy, providing a solid foundation for subsequent stages of music education.

6 Conclusion

6.1 Rationale of the study

This study was conducted to develope and test a new pedagogical model aimed at improving beginner-level solfège students' ability to use their voices correctly and to perform solfège with correct intonation. A review of the literature revealed that systematic approaches addressing this specific issue are limited. Therefore, the study aimed to fill this gap by offering a targeted solution.

6.2 Methodology applied

In this study, a pretest-posttest control group true experimental design was employed to test the effectiveness of the *Vocal Use-Based Solfège Teaching Model* in beginner-level solfège education. The model was developed based on the Dr. Charles Colin Trumpet Method, which focuses on diaphragm control and air pressure regulation for accurate pitch production. Drawing on this approach, the researcher designed specific vocal exercises aimed at helping students control their voices and produce accurate pitches. During the experimental process, 12 voluntary beginner-level participants were randomly assigned to either the experimental or the control group, with each group consisting of six students. Over a six-week period, the experimental group received training using the exercises developed by the researcher, while the control group studied using traditional solfège materials. At the beginning and end of the intervention, both groups were administered the same solfège excerpts as pretests and posttests. Performances were evaluated by experts using *Musical Reading Performance Test*.

6.3 Key findings

As a result of the experimental process, it was observed that students in the experimental group were able to use their voices more accurately and with better control, demonstrating significant improvements in intonation and interval exercises. Statistical analyses indicated that the posttest scores of the experimental group (75.50 ± 13.00), who received training with the researcher-developed exercises, were significantly higher than those of the control group (47.00 ± 19.33), who were trained using traditional methods. This difference was found to have a moderate effect size.

6.4 Final remarks

Based on the findings of the study, the following key points should be emphasized regarding beginner-level solfège education:

- To overcome the commonly observed problems of inability 'to use the voice' and to perform solfège with accurate pitches in beginner-level solfège education and to achieve the desired level of success, it is of critical importance to first teach students how to use their voices properly.
- Students who lack vocal use skills encounter significant challenges during the early stages of solfège education.
- In order to develop correct vocal use, students must learn to apply appropriate diaphragm tension and air pressure according to the target pitch, and they must be able to regulate these elements efficiently.
- It is important to note that the present study was limited to adult beginner-level students. Although the findings are not intended to be generalized to younger age groups, future studies may explore the adaptation of the model to different age populations, taking into account developmental characteristics and pedagogical needs.

7 Recommendations

1. In line with the *Vocal Use-Based Solfège Teaching Model* developed in this study, it is recommended that a comprehensive solfège method be developed for use in beginner-level solfège education, which can serve the needs of both professional educators and amateur learners.
2. It is recommended that the developed textbook be implemented prior to engaging with solfège reading exercises, such as those included in Albert Lavignac's *Solfège des Solfèges*, Volume 1A, and other traditional melodic reading materials. The duration of its application should be tailored to the specific needs of the class or individual learner; however, the implementation period should be kept within reasonable limits and not unnecessarily prolonged.

Data availability statement

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by the Ethics Committee of the Gazi University. The studies were conducted in

accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

MK: Formal analysis, Resources, Writing – original draft, Methodology, Data curation, Conceptualization, Investigation, Writing – review & editing. SA: Resources, Investigation, Conceptualization, Writing – review & editing, Supervision, Methodology, Formal analysis.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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