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# A Study on the Impact of Personalized Vocal Instruction on Students' Learning Outcomes

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**Abstract:** *This study aims to investigate and compare the effects of personalized vocal pedagogy against traditional standardized teaching methods on students' technical proficiency, artistic expression, and overall learning motivation. Through an analysis of instructional approaches, teacher-student dynamics, and the role of adaptive feedback, this paper highlights how tailored vocal training enhances skill acquisition and performance confidence. While traditional group-based methods emphasize uniformity and collective progress, personalized instruction focuses on individual vocal needs, learning pace, and expressive interpretation. Findings suggest that students under personalized pedagogy demonstrate faster technical improvement and stronger emotional engagement, though challenges such as instructor workload and resource intensity persist. The study concludes with recommendations for hybrid teaching models that balance customization with scalability in vocal education.*

**Keywords:** Vocal pedagogy, personalized learning, student outcomes, adaptive teaching, music education

## 1. Introduction

Vocal education in contemporary music training faces a critical divergence between standardized, curriculum-driven instruction and student-centred, adaptive methodologies. Historically, vocal pedagogy—particularly in conservatories and university programs—has relied on structured, group-based training that prioritizes uniform skill development and repertoire mastery (Gu & Koning, 2025). Students typically follow a fixed schedule, practice frequently, and obey their instructor's instructions in the organised learning environment that music lessons offer. They learn the value of regularity and time management, two essential elements of discipline, via this methodical approach, as stated by Chen (2024). According to Li (2024), the development of teaching methods in music education is greatly influenced by pedagogical ideas. Constructive ideas, like those put forth by Piaget and Vygotsky, place a strong emphasis on social production of understanding and active learning. These theories support personalized learning by recognizing the learner's individual developmental stage and the importance of guided interaction (scaffolding) in musical skill acquisition.

Wei et al. (2025) emphasized that student-centred learning environments, where students actively engage with material and collaborate with peers, are essential for constructing meaningful understanding. Similarly, Näykki et al. (2024) found that cognitive approaches

enable educators to design interactive, group-based, and responsive learning experiences, particularly in the context of voice training. McPherson, Blackwell, and Hattie (2022) further noted that strategies such as peer instruction, group discussion, and live performance evaluation significantly enhance students' comprehension of vocal practice and musical interpretation.

At the same time, the growing recognition of individual learning differences has led to increasing demand for personalized approaches that cater to each student's vocal physiology, artistic temperament, and specific technical challenges (Zhang & Lee, 2023). Technological integration in vocal instruction—defined as the use of various digital tools and methods to enhance learning—has enabled students to explore vocal concepts, practise techniques, and receive feedback in more innovative ways than in traditional settings (John, 2024).

The adoption of advanced digital tools, including AI-assisted pitch analysis and real-time vocal formant tracking, has allowed for more tailored instruction, enabling educators to identify and address student-specific needs with greater precision (Chen, 2022). Du (2024) acknowledged the global shift towards creative teaching strategies that extend beyond conventional music and vocal training. Moreover, Zhang, Sun, and Sun (2023) observed that in many Western countries, digital technologies, interactive tools, and cross-disciplinary collaborations have been increasingly integrated into vocal education, improving both student engagement and achievement.

Historically, higher education vocal instruction has centred around classical training methods that emphasize vocal health, technical mastery, and a pedagogical framework rooted in Western classical traditions (Zhang, Sun & Sun, 2023). The master-apprentice model—characterised by one-on-one instruction and personalized feedback—has long been a cornerstone of vocal pedagogy. However, ongoing debates question the relative effectiveness of personalized instruction compared to traditional ensemble-based approaches, particularly regarding their capacity to foster discipline, foundational technique, and collaborative musicianship.

This study investigates these two instructional paradigms—personalised and traditional—through the lenses of teaching methodology, feedback mechanisms, and long-term student outcomes. It aims to provide evidence-based insights for vocal educators seeking to optimise pedagogical strategies in contemporary contexts.

Music students bear significant responsibility for their own development. They often learn early on that consistent effort and dedication are central to their success. This sense of ownership promotes self-motivation, as students take initiative and continuously strive to improve (John, 2024). Feedback plays a critical role in music education; students are encouraged to take constructive criticism seriously and use it to refine their skills. This iterative process fosters a growth mindset, in which failure becomes a tool for learning and continuous improvement.

Accordingly, this study explores how standardised curricula and collective training environments influence student outcomes in vocal instruction. It evaluates the implementation of adaptive teaching strategies and personalised feedback mechanisms aimed at maximising student potential. Marougkas et al. (2023) argue that distinguishing between traditional and personalised approaches adds realism, relevance, and engagement to instruction. Student feedback reveals a strong preference for more inclusive and innovative pedagogies that support both individual creativity and collaborative learning. These findings underscore the need to re-

evaluate current instructional models to better align with the evolving expectations and learning styles of students in today's dynamic musical landscape.

## 2. Literature Review

### Teaching Characteristics of Traditional Vocal Pedagogy

#### Standardized Curriculum and Collective Training

Traditional vocal instruction typically follows a fixed progression of techniques—such as breath control, vowel placement, and tone production—delivered through group classes or master-apprentice models. In Chinese conservatories, for example, the emphasis on uniformity ensures that all students meet established institutional benchmarks (Wang, 2020). According to Lee (2025), voice pedagogy is a vast and multidimensional discipline encompassing various aspects of vocal instruction and learning. Mastery across different vocal categories is regarded as a fundamental component of comprehensive voice training.

Classical singing is particularly noted for its technical precision, including tone quality, pitch accuracy, and controlled breathing, and is often associated with operatic or orchestral performance contexts. In contrast, jazz singing emphasizes adaptability, personal expression, and improvisation (Chen, 2024). Contemporary vocal styles—such as pop, rock, and musical theatre—add further diversity to the field, requiring a broader pedagogical approach.

Key musical components such as tone, pitch, and rhythm remain central across all genres. In voice pedagogy, effective assessment of these elements is crucial, as it provides students with constructive feedback and guidance for continuous improvement (Du, 2024). A well-structured curriculum that integrates traditional methods with clearly organized learning pathways underpins most institutional voice training programs.

One-on-one instruction remains an essential feature of these programs. In such sessions, students work closely with instructors to refine expressive capabilities, diction, breath control, and pitch accuracy. Complementing these are group workshops, where students perform in front of their peers and receive collective critique. As Du (2024) notes, this collaborative environment fosters resilience and builds self-confidence among students.

Despite these strengths, the curriculum's traditional focus on Western classical music often dominates, overshadowing other musical genres. While coursework in music theory, history, and performance technique provides a solid foundation, the exploration of modern and global repertoires is still limited.

Students are typically given multiple opportunities to apply their skills in real performance settings, including solo recitals and ensemble concerts, allowing them to adapt to varied audiences and performance demands (Du, 2024). However, there is a growing demand among students for more inclusive, participatory, and stylistically diverse learning experiences that extend beyond the conventional classroom format.

#### Strengths: Discipline and Baseline Proficiency

Structured exercises, such as scales and arpeggios, play a crucial role in establishing a solid technical foundation for vocalists. Arpeggios, in particular, are highly versatile and appear across nearly all musical genres. Composers often use arpeggiated melodies as an organizing principle, enabling the creation of flowing, lyrical lines that reinforce harmonic structure. When students practice transitioning between scales and arpeggios, they gain greater flexibility and control in their musical performance. In group learning environments, peer comparisons can

serve as a motivating factor, encouraging students to track communal progress and strive for improvement (Li, 2021). The emphasis on discipline and repetition fosters consistency and technical precision—skills that are essential for long-term success in vocal performance.

Institutions offering standardized vocal curricula often benefit from extensive course structures, experienced faculty, and access to well-equipped facilities. These elements contribute significantly to student development. As Pandit (2024) notes, a strong focus on foundational techniques ensures that graduates possess the technical competencies necessary for competitive performances and professional opportunities. Moreover, international exchange programs and collaborative learning experiences expose students to diverse musical traditions, broadening their artistic perspectives and fostering cultural adaptability.

**Limitations: One-Size-Fits-All Approach**

Each learner brings distinct preferences, aptitudes, and challenges to the educational process. However, traditional music institutions often adhere to rigid, standardized curricula that do not account for individual learning needs (Raj, 2025). A one-size-fits-all approach can overlook the nuances of vocal typologies and physiological differences. For instance, vocal health issues such as vocal cord paralysis due to throat infections or neurological disorders can significantly affect speech and singing ability (Goodeve, 2025). Additionally, differences in voice type—such as the deeper, heavier tone of mezzo-sopranos compared to sopranos—highlight the importance of customized instruction. Mezzo-sopranos typically produce a higher pitch than contraltos, yet standard curriculum structures rarely accommodate these distinctions in vocal range and resonance.

This lack of individualization makes it challenging for teachers to address the specific needs of each student (go2rose.com, 2023). In contrast, alternative pedagogical models emphasize smaller class sizes, fostering a supportive and collaborative environment where instructors can give more targeted attention to learners (Li, 2024).

Another critical limitation of standardized instruction is its inflexible pacing. Students who learn at a slower pace may experience heightened anxiety and reduced rehearsal opportunities due to the rapid delivery of content (Park, 2022). Conversely, advanced students may become disengaged when faced with tasks that are overly simple or repetitive, leading to decreased motivation and boredom. This imbalance can hinder both groups' progress and undermine the overall learning experience.

## 3. Teaching Characteristics of Personalized Vocal Pedagogy

**Adaptive Techniques and Customized Feedback**

Personalized instruction in vocal training tailors exercises to align with each student's physiological traits—such as vocal range and tessitura comfort—as well as their individual artistic goals. The use of advanced tools, such as spectrogram analysis, enables instructors to make precise corrections related to pitch accuracy and timbre refinement (Zhou, 2023). Within contemporary vocal education, personalized teaching methods are central to student-centred learning, shifting away from traditional teacher-led instruction toward approaches that emphasize active participation, autonomy, and self-directed development (Du, 2024).

Customized feedback empowers students to address their unique vocal qualities, including texture and stability, by implementing techniques that are specifically suited to their needs. Adaptive strategies are individually selected to support vocal improvement, enhance control,

and strengthen overall technique. Modern vocal pedagogy also integrates collaborative learning models and digital technologies, enabling real-time feedback and more interactive learning environments. These methods contribute significantly to improved learning outcomes in vocal instruction.

The integration of digital tools into personalized learning represents a forward-thinking approach to addressing individual student needs. When paired with adaptive feedback, these tools help students refine various aspects of vocal performance—such as melody, pitch accuracy, timbre, and breath control—based on their personal strengths and areas for improvement (Maier & Klotz, 2022). In the context of vocal training, targeted feedback on voice control is particularly valuable, as it directly influences technical and expressive development (Şakalar & Gürel, 2024). Thus, implementing digital feedback systems in personalized instruction proves to be a powerful strategy for enhancing student performance and engagement.

**Strengths: Accelerated Skill Acquisition**

One of the key strengths of adaptive and technology-enhanced vocal training is the ability to deliver immediate feedback on individual technical weaknesses, such as breath support imbalances. Repertoire selection can also be tailored to align with each student's expressive strengths—for instance, choosing lyrical pieces for those with fluid phrasing or dramatic works for students with greater vocal power and projection.

Vocal education differs from many other educational disciplines due to its abstract and performance-oriented nature. It is an art form that engages both the intellect and the body and is increasingly enhanced by technology. The integration of digital tools allows abstract vocal concepts—such as resonance, breath control, and tone placement—to be visualized, contextualized, and concretely understood. With the growth of online learning platforms, students can now access instructional materials and receive ongoing guidance from expert instructors regardless of geographical or time constraints (Lin & Mao, 2022).

Moreover, big data and AI technologies are being incorporated into vocal pedagogy to enhance both theoretical understanding and practical skill development. For example, 3D animation tools enable students to visualize internal vocal mechanisms, helping them better understand and apply techniques like breath control. Advanced AI-driven software can analyze vocal performances in real time, offering precise feedback on pitch, dynamics, articulation, and other performance variables (Yuhao, 2025). These tools also allow instructors to monitor progress over time and adjust training methods accordingly.

Although AI-enabled tools such as keystroke sensors have been widely used in instrumental training (e.g., piano), the underlying technologies—like deep learning and intelligent audio processing—are increasingly being adapted for vocal applications. This enables more data-informed, personalized, and efficient vocal instruction.

**Challenges: Resource Intensity**

Personalized vocal training often necessitates one-on-one sessions or small class sizes to effectively address each student's unique vocal needs. While this individualized approach can lead to superior learning outcomes, it also significantly increases operational costs. Maintaining such resource-intensive formats poses financial challenges for both institutions and students. In particular, the cost of in-person instruction may discourage participation, especially among students with limited access to funding or institutional support (Grebosz-Haring et al., 2022).

Additionally, consistent attendance becomes critical in personalized instruction. Since each session builds on highly tailored feedback and progression, missing even a single class can result in substantial setbacks for learners. This dependency on uninterrupted continuity presents logistical difficulties, especially for students balancing other academic or professional commitments.

Another key challenge lies in the demands placed on instructors. Personalized and adaptive vocal instruction requires teachers to possess a wide range of skills, including diagnostic precision and pedagogical flexibility. As Reuker and Künzell (2021) argue, instructors must develop what is known as "professional vision"—the ability to identify critical moments in a student's development and respond with targeted interventions. This requires knowledge-based reasoning that enables the teacher to assess individual strengths and weaknesses and to adjust instruction accordingly. For example, some students may require intensive work on breath control, while others need support with pitch accuracy or vocal tone. Providing such differentiated instruction to multiple students simultaneously is both cognitively and emotionally demanding. The level of individualized attention needed in adaptive vocal training challenges not only institutional resources but also the professional capacity and workload of instructors.

## 4. Key Differences Between Traditional and Personalized Approaches

| Aspect | Traditional Pedagogy | Personalized Pedagogy |
|---|---|---|
| **Instruction** | Group-focused, fixed curriculum | Student-driven, dynamic adjustments |
| **Feedback** | Periodic, generalized | Real-time, anatomically specific |
| **Outcomes** | Uniform technical baseline | High individual artistic growth |
| **Accessibility** | Cost-effective for institutions | Resource-heavy; favors privileged learners |

### Difference in Instruction

Traditional vocal pedagogy typically emphasizes group-based instruction and follows a fixed, standardized curriculum. It adopts a holistic approach that addresses both the artistic and psychological dimensions of vocal production (Fang & Yu, 2023). This method supports foundational aspects of vocal training, such as breath control, resonance, posture, performance practice, and stylistic interpretation. Additionally, it enhances students' understanding of the physiological mechanisms involved in sound production, including the function of the vocal folds, respiratory system, and resonators.

In contrast, personalized pedagogy focuses on dynamic, student-centered adjustments. It involves tailoring both content and teaching methods to align with each student's learning style, individual needs, and specific goals (Bakar, 2021). Rather than adhering to a fixed sequence, personalized instruction allows for flexible pacing and adaptive feedback. This individualized approach supports students in achieving their personal vocal goals more effectively and encourages greater autonomy in the learning process.

### Feedback differentiation

In traditional vocal pedagogy, feedback is generally periodic and generalized. It tends to focus on broad instructional aspects delivered at specific intervals, often during or after performance sessions. This approach typically involves explicit and direct instruction, allowing students to improve their technical accuracy and adherence to standard vocal techniques (Agostini & Picasso, 2024). Teachers using traditional methods often demonstrate correct technique and

provide structured verbal cues, which can support improved learning outcomes in music education by reinforcing standardised skill development.

In contrast, personalized pedagogy emphasizes real-time, individualized feedback that is often anatomically specific (Maier & Klotz, 2022). This type of feedback allows teachers to address each student's unique vocal characteristics, such as vocal range, breath support patterns, and learning style. By recognizing and responding to students' individual progress and pacing, personalized feedback fosters a more supportive and adaptive learning environment. Such differentiation in feedback plays a key role in enhancing student engagement and optimizing vocal development.

**Difference of Outcomes**

The outcomes of traditional vocal pedagogy are largely centred on developing a uniform technical foundation across all students (Chun et al., 2025). This approach emphasizes the cultivation of a natural and clear vocal tone, proper breath posture and support, accurate articulation, and overall pitch precision. Such a standardized focus supports the development of technical consistency, vocal health, and general musical competence. Teachers assess students' vocal tone, pitch accuracy, and breath control in connection with the psychological and physiological processes involved in singing. As a result, traditional pedagogy remains fundamental in establishing reliable technique and maintaining long-term vocal health.

In contrast, personalized vocal pedagogy is more conducive to fostering individual artistic growth and expressive development. It supports outcomes such as increased self-confidence, refined musicality, enhanced vocal technique, and a deeper emotional connection to singing (Grájeda et al., 2024). Personalized instruction enables targeted exercises and optimized breathing strategies tailored to the student's unique needs and goals. This individualization allows for more meaningful learning experiences and contributes to higher levels of engagement and motivation.

**Accessibility differences**

Traditional vocal pedagogy is generally more cost-effective for institutions, as it often relies on standardized curricula delivered through one-on-one or in-person group lessons (Zhang et al., 2022). This structured and scalable model allows institutions to offer vocal instruction to a broader range of students with fewer resources. In many cases, traditional pedagogy is considered more accessible because of its predictable format and lower operational costs. Moreover, experienced teachers may still account for students' physical limitations, learning preferences, and cultural backgrounds within this standardized framework, thereby supporting diverse learners.

In contrast, personalized pedagogy is more resource-intensive and often favours students with greater access to financial or institutional support (Maier & Klotz, 2022). Smaller class sizes, individualized feedback, and the integration of advanced digital tools can limit accessibility for under-resourced learners or institutions. However, when implemented equitably, personalized instruction promotes inclusivity by addressing each student's unique needs, fostering engagement through tailored instruction, and supporting diverse artistic and educational goals.

## 5. Discussion

### Implications for Educators

**Hybrid Models:** Educators can adopt hybrid instructional approaches that combine group-based training, such as choral rehearsals, with individualized coaching. Choral singing serves as a powerful and collaborative medium that brings together singers of varying abilities to produce a unified, expressive sound. Teachers can foster cohesion by standardizing elements such as vowel formation, phrasing, and pronunciation. Adjusting vocal dynamics across different sections also helps produce a balanced ensemble sound. To develop ensemble sensitivity, instructors can encourage singers to actively listen and respond to each other, enhancing awareness, blend, and emotional depth. Simultaneously, individualized coaching sessions can target each student's technical and expressive challenges, allowing for tailored feedback and progress.

**Technology Integration:** The integration of digital tools into vocal pedagogy enables educators to modernize instruction while enhancing student engagement and learning outcomes. Applications such as ***VocalizeU*** can offer real-time pitch tracking and correction, supporting both self-guided practice and instructor-led feedback. These technologies help refine vocal performance by enabling detailed adjustments in pitch, tempo, breath control, and tone quality. Additionally, cloud-based platforms allow students to connect and collaborate remotely, facilitating peer learning and performance sharing even beyond the classroom. This approach not only supports flexibility and access but also aligns with how digitally native students interact with their environment, making the learning process more relevant and dynamic.

### Future Directions

Future research should include longitudinal studies that compare the career trajectories, artistic development, and skill sustainability of students trained under traditional versus personalized vocal pedagogy models. As the landscape of music education continues to evolve, higher education institutions must consider more integrated approaches—blending traditional vocal training with emerging technologies, multicultural repertoire, and collaborative learning environments. Such a holistic framework preserves the core values of classical training while equipping students with the versatility and adaptive skills necessary for a range of contemporary musical careers.

Expanding cultural competency is also critical. Incorporating faculty and guest musicians from diverse musical traditions can broaden students' musical experiences and foster a deeper appreciation for global vocal practices. In parallel, the development of continuous feedback systems—where both instructors and peers provide constructive, ongoing evaluations—can enhance students' self-awareness, track progress, and support targeted improvement.

In terms of technological advancement, AI-driven vocal analysis presents a promising avenue for reducing the costs associated with personalized instruction. A growing number of mobile applications—ranging from anatomy and vocal physiology visualizations to real-time pitch correction—are available on various platforms, some free and others more sophisticated, depending on institutional budgets. Recording software can be used to capture and analyze ensemble performances, providing valuable insights into pitch consistency, blend, and tone quality. Additionally, visual feedback tools such as spectrograms and waveform display allow singers to receive immediate, detailed feedback on pitch, tone, articulation, and breath support.

These innovations not only enhance individual learning but also extend access to high-quality instruction in remote or resource-constrained contexts.

## 6. Conclusion

While traditional vocal pedagogy provides a strong foundation in technical skills and vocal health, personalized approaches significantly enhance technical precision, expressive nuance, and artistic individuality. The optimal path forward lies in the strategic integration of both methods, using emerging technologies to overcome issues of scalability and access. Digital tools such as vocal monitoring software, virtual reality (VR) environments for performance simulation, and social media platforms for collaborative learning can make instruction more engaging and reflective of contemporary performance contexts.

Moreover, fostering a collaborative educational culture—through student-led projects, group performances, and peer-to-peer feedback—can encourage critical thinking, creativity, and teamwork. These elements are increasingly vital in preparing vocalists for modern artistic careers.

Looking ahead, the findings of this study open avenues for further research. Comparative studies across different music departments could offer deeper insights into effective pedagogical innovations. Longitudinal research may help assess the long-term impact of multicultural and technology-integrated methods on student outcomes. Additionally, exploring postgraduate and professional development pathways can expand our understanding of lifelong learning in vocal education.

Finally, the design and evaluation of new instructional models that emphasize student ownership, creativity, and adaptability may lead to transformative changes in music education. This study ultimately advocates for pedagogical flexibility to cultivate a new generation of versatile, empowered vocalists ready to thrive in diverse musical landscapes.

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**Conflict of Interest Statement**
The authors declare that there is no conflict of interest regarding the publication of this study.

## References

Agostini, D., & Picasso, F. (2024). Large language models for sustainable assessment and feedback in higher education: Towards a pedagogical and technological framework. *Intelligenza Artificiale*, *18*(1), 121-138. DOI 10.3233/IA-240033

Bakar, S. (2021). Investigating the dynamics of contemporary pedagogical approaches in higher education through innovations, challenges, and paradigm shifts. *Social Science Chronicle*, *1*(1), 1-19. https://doi.org/10.56106/ssc.2021.009

Chen, A. (2024). Harmony Teaching Research—Implication for Music Education. *Art and Society, 3*(1), 13-44. https://doi.org/10.56397/AS.2024.02.02

Chen, Y. (2022). AI in voice training: Real-time feedback systems. *Journal of Music Technology, 15*(3), 45–60.

Chun, J., Kim, J., Kim, H., Lee, G., Cho, S., Kim, C., ... & Heo, S. (2025). A Comparative Analysis of On-Device AI-Driven, Self-Regulated Learning and Traditional Pedagogy in University Health Sciences Education. *Applied Sciences*, *15*(4), 1815. https://doi.org/10.3390/app15041815

Du, Q. (2024). A Systematic Approach to Innovative Strategies for Vocal Instruction in Higher Education: Enhancing Student Performance. *Pacific International Journal*, *7*(5), 68–73. https://doi.org/10.55014/pij.v7i5.696

Fang, Z., & Yu, S. C. (2023). Cross-level influence of group-focused transformational leadership on organizational citizenship behavior among Chinese secondary school teachers. *Behavioral Sciences*, *13*(10), 848. https://doi.org/10.3390/bs13100848

go2rose.com. (2023, July 28). *Rose Video Blog - The Limitations of a One-Size-Fits-All Approach to Education | Rose Academies*. Www.go2rose.com. https://www.go2rose.com/the-limitations-of-a-one-size-fits-all-approach-to-education/

Goodeve, A. (2025, February 11). *The Illusion of Uniformity: Why a "One-Size-Fits-All" Approach Fails Our Schools Education, at its core, should be a personalised journey. Yet, many educational systems cling to a "one-size-fits-all" approach, treating students as interchangeable units within a standardised framework.* Linkedin.com. https://www.linkedin.com/pulse/illusion-uniformity-why-one-size-fits-all-approach-fails-andy-goodeve-l2rke/

Grájeda, A., Burgos, J., Córdova, P., & Sanjinés, A. (2024). Assessing student-perceived impact of using artificial intelligence tools: Construction of a synthetic index of application in higher education. *Cogent Education*, *11*(1), 2287917. https://doi.org/10.1080/2331186X.2023.2287917

Grebosz-Haring, K., Schuchter-Wiegand, A. K., Feneberg, A. C., Skoluda, N., Nater, U. M., Schütz, S., & Thun-Hohenstein, L. (2022). The psychological and biological impact of "in-person" vs. "virtual" choir singing in children and adolescents: A pilot study before and after the acute phase of the COVID-19 outbreak in Austria. *Frontiers in Psychology, 12*, 773227. https://doi.org/10.3389/fpsyg.2021.773227

Gu, Y., & Koning, S. I. (2025). Challenges and Opportunities in Localizing Gordon's Music Learning Theory in Chinese Elementary Music Education: A Critical Perspective. *Uniglobal Journal of Social Sciences and Humanities, 4*(2), 79-87. https://doi.org/10.53797/ujssh.v4i2.10.2025

John, S. (2024, April 3). *Singing Education Future Trends - What Parents Should Know?* Music Pandit Online Music School. https://www.musicpandit.com/blog/singing-educations-future-trends-and-innovations-parents-should-know/

Lee, S. (2025). *The Art of Choral Blend*. Numberanalytics.com. https://www.numberanalytics.com/blog/art-of-choral-blend-strategies-for-unified-sound

Li, Y. (2024). The Impact of Music Education on the Quality of Talent Cultivation. *Transactions on Comparative Education*, *6*(1). https://doi.org/10.23977/trance.2024.060110

Lin, Y., & Mao, K. (2022). [Retracted] Optimization of Vocal Singing Training Methods Using Intelligent Big Data Technology. *Computational Intelligence and Neuroscience, 2022*(1), 8589517. https://doi.org/10.1155/2023/9765386

Maier, U., & Klotz, C. (2022). Personalized feedback in digital learning environments: Classification framework and literature review. *Computers and Education: Artificial Intelligence*, *3*, 100080. https://doi.org/10.1016/j.caeai.2022.100080

Marougkas, A., Troussas, C., Krouska, A., & Sgouropoulou, C. (2023). Virtual Reality in Education: A Review of Learning Theories, Approaches and Methodologies for the Last Decade. *Electronics*, *12*(13), 2832. https://doi.org/10.3390/electronics12132832

McPherson, G. E., Blackwell, J., & Hattie, J. (2022). Feedback in Music Performance Teaching. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.891025

Näykki, P., Pyykkönen, S., Latva-aho, J., Nousiainen, T., Ahlström, E., & Toivanen, T. (2024). Pre-service teachers' collaborative learning and role-based drama activity in a virtual reality environment. *Journal of Computer Assisted Learning*, *40*(6), 3264–3277. https://doi.org/10.1111/jcal.13079

Pandit, M. (2024, August 7). *Arpeggios - Definition, Structure, Types, Uses, Practice Tip*. Music Pandit Online Music School. https://www.musicpandit.com/resources/articles/arpeggios/

Park, S. (2022). Student engagement in group vs. individual vocal classes. *Music Education Review, 41*(2), 112–129.

Raj, S. (2025, February 2). *One-Size-Fits-All Education: A Critical Examination - 21K School India*. 21K School India. https://www.21kschool.com/in/blog/one-size-fits-all-education/

Reuker, S., & Künzell, S. (2021). Learning diagnostic skills for adaptive teaching–a theoretical foundation. *Cogent Education, 8*(1), 1887432. https://doi.org/10.1080/2331186X.2021.1887432

Şakalar, A., & Gürel, S. (2024). Academic perspectives on the use of digital platforms and mobile applications in vocal training. *Online Journal of Music Sciences, 9*(2), 389-404.https://doi.org/10.31811/ojomus.1564925

Wei, X., Wang, L., Lee, L.-K., & Liu, R. (2025). The effects of generative AI on collaborative problem-solving and team creativity performance in digital story creation: an experimental study. *International Journal of Educational Technology in Higher Education*, *22*(1). https://doi.org/10.1186/s41239-025-00526-0

Yuhao, C. (2025). Cross-dimensional integration and innovative applications of vocal music and piano sound assets in the AI era. *Humanities and Social Science Research, 8*(1), p99-p99.https://doi.org/10.30560/hssr.v8n1p99

Zhang, G., Sun, J., & Sun, Y. (2023). Mapping interdisciplinary collaboration in music education: analysis of models in higher education across North America, Europe, Oceania, and Asia. *Frontiers in Psychology*, *14*. https://doi.org/10.3389/fpsyg.2023.1284193

Zhang, L., Ren, T., Xie, Y., Tian, Z., Tang, T., & Li, Y. (2022). Student Choirs and Virtual Social Practices by LivePBL: Linking Vocal Education with Project Based Learning. *Literacy Information and Computer Education Journal*, *13*(1), 3860-3666. DOI: 10.20533/licej.2040.2589.2022.0482

Zhou, L. (2023). Spectrogram-assisted pedagogy in contemporary voice teaching. *Journal of Singing, 79*(4), 401–415.