

# Digital Pedagogy and Virtual Reality in the Post-Information Age: Professional Vocal Education of University Students

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**Abstract:** *In the post-information age, Chinese vocal education faces structural contradictions: regional resource disparities and a shortage of qualified bel canto instructors. Our earlier 11-week online experiment (Guizhou, 16 students) has demonstrated that a digital pedagogy integrating Praat acoustic analysis (2500 Hz energy as a nasalization proxy) and AAID affective feedback (five dimensions) can effectively expand vocal range, improve theoretical knowledge, and reduce dialect interference, forming a “diagnosis-intervention-evaluation” closed loop. However, current two-dimensional digital tools have boundaries: they cannot provide stage visual scenes, cannot simulate different acoustic environments, and cannot create performance-related psychological situations. Based on these findings, we offer a foresight: virtual reality (VR) and augmented reality (AR) should and can be introduced as a supplement and extension of digital pedagogy. We argue that VR/AR can theoretically fill the above gaps by providing immersive experiences, simulating concert hall and theatre environments, helping students gain stage experience and alleviate performance anxiety. We believe this is a necessary and promising future direction*

**Keywords:** *Digital Pedagogy; Virtual Reality; Augmented Reality; Vocal Education; Bel Canto; AAID; Post-Information Age*

## 1. Introduction

Guizhou Province, located in southwestern China, has historically faced limitations in educational infrastructure. Research by Yang Shuanghong [6] documented the considerable influence of local dialects on vowel clarity in bel canto training. Earlier work by the present author introduced the concept of "dual cognitive poverty," which captures two coexisting challenges: widespread phonetic interference among students (with 82% demonstrating involuntary vowel nasalization) and insufficient technical preparation among instructors (only 9% proficient in bel canto technique, and 67% relying on unscientific "folk-academic" mixed methods) [13]. These interrelated factors have constrained the quality of vocal education in the region.

Digital technologies offer potential solutions to these challenges. Platforms such as DingTalk enable instruction across geographical distances, facilitating access to quality pedagogical resources. Acoustic analysis software like Praat converts abstract vocal phenomena into quantifiable data, while AI-driven platforms such as AAID permit systematic evaluation of emotional expression in performance. The present study reports on an 11-week online teaching experiment designed to assess the efficacy of digital tools for dialect correction in bel canto instruction.

## **2. Existing Foundation: Digital Tools Validate the “Diagnosis-Intervention-Evaluation” Closed Loop**

Our 11-week online experiment (DingTalk platform, 16 music students from Guizhou) produced the following core data.

- Vocal range expansion: the proportion of students who could reliably sing “one octave plus a fifth” or more increased from 25% to 62.5% (+37.5 percentage points,  $p < 0.01$ ).
- Theoretical knowledge: self-rated “good/excellent” increased from 0% to 75% (+75 percentage points).
- Dialectal interference reduction: self-reported “significant/very significant” interference dropped from 25% to 12.5% ( $p < 0.05$ ).
- Acoustic analysis: high-risk participant S01 showed a reduction in 2500 Hz energy for the [a] vowel from -1.4 dB to -7.7 dB, indicating substantially reduced nasalization.
- Affective analysis: AAID both confirmed student S08’s precise stylistic match with the Russian romance (sadness 0.969) and captured student S01’s personal artistic interpretation (sadness 0.990).
- Diagnostic tool acceptance: 93.75% of participants rated vocal profiles and risk maps as “very helpful” or “moderately helpful”; 87.5% characterized the “dialect correction” concept as “very innovative.”
- Cognitive shift: student feedback moved from “I feel” to “I see, I measure.”

These empirical findings demonstrate that digital tools can quantitatively diagnose vocal problems and form a replicable teaching closed loop. However, this loop remains incomplete, and it is precisely this incompleteness that we address next

## **3. Boundaries of Current Two - Dimensional Digital Tools: Three Scene Dimensions**

### **That Cannot Be Provided**

Although digital tools such as DingTalk, Praat, and AAID can provide a teaching platform, accurate acoustic diagnosis, and affective feedback, they are limited by the two-dimensional screen. The student always faces a flat interface. The following three dimensions of “scene deprivation” cannot be resolved by current tools:

### **3.1. Lack of stage visual scenes**

Students in under-resourced regions have never stood on a real stage. They practice in practice rooms and sing arias in classrooms, but they have never felt the warmth of a spotlight on their face, never seen a dark auditorium full of audience, never experienced what it feels like to stand in the center of the stage of the Mariinsky Theatre or the St. Petersburg Philharmonia. Performance videos on a two-dimensional screen only allow them to “watch,” not to “be there.”

### **3.2. Lack of acoustic environments**

Bel canto singing requires adaptation to different acoustic spaces. The long reverberation of a cathedral, the warm sound of a chamber hall, the specific sound field of an opera house – each environment demands that the singer adjust her resonance and sound projection. But students in remote areas can only practice in ordinary practice rooms with poor acoustics and cramped spaces. They have never heard how their own voice reflects and diffuses in a real concert hall. Audio playback on a two-dimensional screen cannot simulate the auditory experience of different spaces.

### **3.3. Lack of performance-related psychological situations**

Singing without an audience is completely different from singing in front of an audience. Many students have solid technique, but as soon as they step onto a stage, their heart races and both voice and body become tense, leading to underperformance. They have never practiced amidst applause, under the gaze of judges and audience, or in the pressure situation of a stage. A two-dimensional screen cannot create a psychological

environment “with an audience.” Students cannot prepare in advance for stage anxiety, nor can they repeatedly practice how to control nervousness in a safe environment.

These three deprivations – stage visual environment, acoustic environment, and performance psychological situation – are not problems of technical diagnosis but problems of situational perception. Two- dimensional digital tools leave students’ ability at the level of “seeing” and “hearing” but cannot give them an “immersive” experience. This is precisely the area where virtual reality (VR) and augmented reality (AR) need to intervene.”

#### **4. VR/AR as a Supplement and Extension: Filling These Three Scenes**

Based on the three deprivations above, we argue that VR and AR technologies should and can be introduced into vocal teaching as a supplement and extension of digital pedagogy. Specifically, VR/AR can bring about changes in the following three dimensions.

##### **4.1. Bringing stage visual scenes: from “watching” to “being there”**

VR can instantly place a student on the stage of a world- class concert hall. Suppose a student from Guizhou puts on a VR headset and selects the “Mariinsky Theatre” or “La Scala Opera House.” She looks around – crystal chandeliers, tier upon tier of audience seats, dark red curtains, the stage floor beneath her feet – all presented before her eyes. She sings an aria, can walk a few steps forward, and turn to look at the wings. This is not watching a video; this is being there. The value of such immersive visual scenes lies in the fact that the student has already rehearsed in a virtual environment before a real performance. She knows from which direction the spotlight comes, and how far away the audience is. Although this cannot fully replace a real performance, it can help reduce the sense of strangeness and fear when stepping onto a real stage for the first time.

##### **4.2. Bringing acoustic environment simulation: from “sound in the practice room” to “sound in the concert hall”**

VR/AR can simulate the auditory feedback of different acoustic spaces. We envision: multiple acoustic modes are built into the VR/AR system. With a simple button press, the student switches to “cathedral” mode – the voice returns with a long reverberation; another button switches to “chamber hall” – the voice becomes warm and focused; yet another button switches to “grand opera house” – the voice is enhanced at specific frequencies. While singing the same piece, the student immediately hears how her voice changes in different spaces. This helps her learn to adjust actively: when reverberation is long, enunciation must be clearer; when the space is small, the sound needs to be more three- dimensional; when the space is large, the vocal placement must be more concentrated. Students in remote areas do not need to pay for access to different venues; a single VR setup can provide low- cost training in multiple acoustic environments.

##### **4.3. Bringing audience and psychological situations: from “practicing alone” to “facing stage pressure”**

VR can simulate the presence of an audience. We imagine: the student selects the “audience” mode. The virtual auditorium is full; in the first row even sit several virtual judges. As she begins to sing, she hears slight coughs, the rustling of programmes, and after she finishes, applause. She can choose the level of “tension” – from “small recital” to “international competition.”

Such simulation is not intended to create psychological pressure but to allow advance adaptation and rehearsal. Furthermore, the virtual space of VR lowers the threshold for students to step onto top- level stages: they do not need to become professional singers first to experience the atmosphere of world- class theatres in a virtual environment. This can help stimulate students’ learning motivation and let them immerse themselves in the unique charm of the stage. In a virtual environment without real risk, students repeatedly practice how to control their heartbeat, how to face an audience, and how to maintain vocal stability under pressure. This can become part of performance- psychology training and help students build stage confidence.

Of course, VR/AR cannot replace the professional guidance of a teacher, nor can they replace real performance experience. But they can fill the three scene dimensions that current two-dimensional digital tools cannot provide, offering a promising extension path for vocal education in under-resourced regions.

## 5. Conclusion

The empirical results of the 11-week Guizhou experiment show that a digital pedagogy centered on Praat acoustic analysis, AAID affective feedback, and the DingTalk platform can effectively construct a “diagnosis-intervention-evaluation” teaching closed loop. The experimental data validate significant improvements in vocal range expansion, dialect correction, and theoretical knowledge, and also confirm the applicability of quantitative diagnostic tools in under-resourced regions.

However, this closed loop has a fundamental limitation. Two-dimensional digital tools cannot provide immersive experiences of stage visual scenes, acoustic environment simulations, or performance-related psychological situations. The data feedback obtained by students in a practice room cannot be translated into bodily experience in real performance venues such as theatres and concert halls. This lack of “scene perception” limits the possibility of transforming digital pedagogy from skill training into complete performance ability.

Based on the above limitation, we propose an approach: VR and AR can serve as a supplement and extension of digital pedagogy, filling the gaps in scene dimensions that two-dimensional tools leave empty, especially by offering an economically feasible, multi-dimensional teaching enhancement for under-resourced regions.

Building on our earlier experiment, we have identified the problem of scene deprivation in current digital pedagogy and put forward a theoretical path that uses VR/AR as a solution. By integrating existing digital tools with VR and linking two-dimensional data with three-dimensional scenes, we form an extended closed loop: “Digital diagnosis (Praat/AAID) → Virtual scene training (VR/AR) → Evaluation (AAID).” This provides a testable model for future research.

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Dr., Full University Professor, Chief Researcher of the Education and Methods Laboratory *Music Computer Technologies* at the Herzen State Pedagogical University of Russia, St. Petersburg; hold the degree of Honorary Worker of Higher Professional Education of the Russian Federation.

Work experience; 1990 – 2010 - Associate Professor, Professor of the Department of Music and Department of Information Technology of the Herzen State Pedagogical University of Russia, St. Petersburg; 2010 - present - Full Professor of the Department of Information Technology, Institute of Computer Science and Technological Education of the Herzen State Pedagogical University of Russia, St. Petersburg; 2002 – present - Chief Researcher of the Research and Methods Laboratory *Music Computer Technologies* at the Herzen State Pedagogical University of Russia, St. Petersburg. She was on a number of business trips abroad, among them: working trips to the USA; lecturing and giving research and practice seminars in; business trips to the UK; working trips to Greece, Germany, Ireland (Dublin) – many times.

Prof. Dr. Gorbunova has developed first ever course in higher music education in Russia *Music Computer Technologies*, which has been offered under the Bachelors of Arts and Sciences (BASc), which in 2004 carried out student recruitment in different regions and educational institutions of Russia and she also leads post-graduate courses *Music Computer Technologies in Education* available under the MA in Music Education, since 2006; then, under the leadership of I. B. Gorbunova, the Bachelor's degree program in Information Technology in Music and Sound Design (2023) and the Master's degree program in Digital Technology in Music and Sound Design (2022) were developed and implemented in the educational process of the Russian Federation. Prof. Dr. Irina B. Gorbunova has more than 550 scientific publications. There are more than 15 monographs among them: *Music Computer Technologies: Historical-Theoretical*, *The Concept of Music Computer Pedagogical Education*, *Musical Instruments of the Digital Age*, *Voice and Computer and the Practical Aspects and Music Computer Technologies: The Problem of Modeling the Process of Musical Creativity*; a lot of course books: *Information Technology in Music*, vol. 1 – 4: vol. 1: *Architectonics of Musical Sound*, vol. 2: *Musical Synthesizers*, vol. 3: *Musical Computer*, vol. 4: *Music, Mathematics and Computer Science* (compiled with participation of Mikhail S. Zalivadny); *Musical Sound Engineering* and many others, as well as a variety of educational resources and programs (more than 100) developed for educational purposes, including those hosted in specialized distance education systems such as Moodle, Coursera.

Her research activities include such directions as:

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MCT in general musical education (as one of the means of education);

MCT as a means of rehabilitation of people with disabilities;

MCT as the new direction in preparation of specialists of humanitarian and technological profile;

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MCT in information technology, psychoacoustics and musical acoustics; system of training arrangements and the art of performing skills on electronic musical instruments.

Her circle of interests also includes the problems of interrelation of natural and technical sciences and humanities, as well as the possibilities of applying the results of such interrelation for the purposes of music education and upbringing.

She also takes part in working out the specialized software for computer music devices and in application of this software in pedagogical processes.

Her developments and researches also belong to the field of musical pedagogics and musicology, musical informatics, computer modeling of processes of musical creativity, timbre programming, art of performing skills and arrangement on electronic musical instruments, creative work in the field of computer music, mathematical methods in musicology.

Prof. Dr. Gorbunova is a Chairperson of the annual International Research and Practical Conference *Contemporary Musical Education: Creative Work, Research, Technology*, held since 2002; Chairperson of the annual International Research and Practical Conference *Music Computer Technologies in the System of Contemporary Education*, held since 2007; International Research Conference *Music of the 21st Century*, held since 2017; Chairperson of the annual Intra-University Scientific Congress Higher School. Scientific Research. We are in Science: Physics.pro, Chemistry.lab, Bio&Geo.field, Math.com, IT.park; Chairperson of the annual International Research Conference *Interdisciplinary East-West Discourse: The 21st Century. Creative Work. Research. Technology. Education*, held since 2020 (St. Petersburg, Russia – Baku, Azerbaijan); member of the organizing committees of many Russian and foreign conferences.

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Awards and honors: 3 Gold medals of the all-Russian Exhibition Centre (former VDNKh); Silver medal of the all-Russian Exhibition Centre (former VDNKh); Diploma of the winner in the nomination «New Educational Technologies in ICT Environment» of the all-Russian creative contest of scientific-technical solutions, educational products and services in the field of Informatization of the innovative-educational complex «Music Computer Technologies in the System of Modern Education»; Grand Prix of International Congress-exhibition «Global Education - Education Without Borders»; Diploma of the 11th all-Russian forum «Educational environment» for the project «Digital educational resources «Music Computer Technologies in

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Currently, the main focus is on postgraduate studies - PhD Program (starting in 2024) at the Herzen State Pedagogical University of Russia, St. Petersburg under the scientific supervision of Professor I. B. Gorbunova (to study for a doctorate in music education). The topic of the dissertation work is Vocal Teaching in the Professional Musical Educational System in China. Specialty: music pedagogy (music education). Attention is also currently being paid to continuing vocal training in order to develop skills and improve professional performance: a scientific internship as an assistant (starting in 2025) at the St. Petersburg Rimsky-Korsakov State Conservatory. Specialty: vocal performance.

She has participated in numerous study tours, including the New York International Choral Festival (USA) (2014) and the Urbania International Song Competition (Italy) (2017).

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Ji Yuchi won the Gold Medal at the New York International Choral Festival (USA) (2014), Third Prize in Opera and Art Song at the 7th Urbania International Song Competition (Italy) (2017), Third Prize in the Hong Kong International Vocal Open (2019), and First Prize in the V.O. Kochur Competition of the Ministry of Culture of Ukraine (2021).