World Journal of Education and Humanities
ISSN 2687-6760 (Print) ISSN 2687-6779 (Online)
Vol. 8 No. 1, 2026
www.scholink.org/ojs/index.php/wjeh

Original Paper

AI Technology-Enabled Personalized Teaching of British Vocal Music: Practical Pathways and Research

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Received: December 19, 2025 Accepted: February 24, 2026 Online Published: March 07, 2026

doi:10.22158/wjeh.v8n1p77 URL: http://dx.doi.org/10.22158/wjeh.v8n1p77

Abstract

The integration of artificial intelligence (AI) into vocal pedagogy presents significant opportunities for personalized instruction, yet its systematic application to the specialized domain of British vocal music remains underexplored. This study investigates practical pathways for AI-enabled personalized teaching, focusing on real-time vocal assessment, adaptive repertoire selection, and individualized performance coaching. Employing a mixed-methods approach encompassing qualitative needs analysis, prototype development, and quantitative quasi-experimental evaluation, the research evaluates the effectiveness of an AI tool designed for British vocal training. Findings indicate that AI can provide valuable, data-driven feedback that significantly improves students' technical skill, stylistic competence, and self-efficacy compared to traditional instruction alone. However, the study also identifies key limitations, particularly in AI's capacity to analyze expressive delivery and adapt to nuanced cultural-stylistic contexts. The research concludes that the most effective pathway involves a hybrid pedagogical model where AI augments the teacher by handling foundational technical reinforcement and progress monitoring, thereby freeing the instructor to focus on higher-order artistic mentorship. This study contributes a practical framework for integrating AI into tradition-rich arts education, emphasizing technology's role as a supportive assistant rather than a replacement for human expertise.

Keywords

Artificial Intelligence, British Vocal Music, Personalized Teaching, Music Education, Intelligent Tutoring Systems

1. Introduction

The integration of digital technology into educational frameworks has ushered in a new era of pedagogical innovation, with artificial intelligence (AI) emerging as a transformative force in shaping instructional methodologies across diverse disciplines (Cheng, 2024). Within the specific and nuanced

domain of music education, the systematic application of AI is progressively moving from theoretical exploration to practical implementation, exemplified by the development of dedicated platforms designed to support specialized training, such as vocal music instruction for music majors (Wang, 2022). These technological advancements herald the potential for creating highly adaptive and individualized learning environments that can respond dynamically to the unique needs and progress of each student. However, a longitudinal perspective on this technological integration reveals a complex and often contentious historical discourse, characterized by cycles of enthusiasm and critical skepticism regarding AI's capacity to engage with the profound artistic, expressive, and culturally embedded dimensions of musical learning beyond mere technical proficiency (Holland, 2013).

This critical perspective is particularly salient when examining the specialized field of British vocal music pedagogy. This discipline requires not only mastery of core technical skills including pitch accuracy, rhythmic precision, and breath control but also a deep, culturally informed understanding of diction, stylistic authenticity across historical periods, and the subtle interplay between textual meaning and emotional delivery. Traditional master apprentice teaching models, while invaluable for transmitting interpretive nuance and artistic mentorship, may sometimes lack the mechanisms for providing the consistent, granular, and objective feedback necessary for optimal skill development during a student's independent practice sessions. Contemporary research into AI assisted music education underscores a significant paradigm shift, highlighting the technology's role as a powerful augmentative tool. By offering data driven, real time assessments and facilitating the personalization of learning materials and exercises, AI systems present a compelling complement to traditional pedagogical approaches (Merchán Sánchez-Jara, González Gutiérrez, Cruz Rodríguez, & Syroyid Syroyid, 2024).

Nevertheless, the successful and meaningful fusion of AI into the fabric of music teaching demands a pedagogical framework that is both deliberate and sophisticated. The core challenge lies in transcending the application of AI for basic technical drills and harnessing its potential to support higher order educational objectives. These include fostering expressive communication, developing stylistic discernment, and cultivating the artistic intuition required for authentic interpretation within the specific conventions of British vocal repertoire (Zhang, 2023). Despite the growing body of literature on AI in general music education, its targeted integration into the specialized sphere of British vocal pedagogy remains a notably underexplored frontier. Key questions persist regarding the practical pathways for implementation: how can AI tools be designed and deployed to genuinely respect and enhance the genre's rich traditions? How can they address specific pedagogical challenges without encroaching upon or diminishing the irreplaceable role of the teacher in mentoring artistry and expression?

This study seeks to directly address this research gap by conducting a focused investigation into the practical pathways through which AI technology can enable and enhance personalized teaching in British vocal music. It aims to systematically explore the potential benefits such as increased

accessibility of personalized practice, objective skill benchmarking, and adaptive repertoire guidance while also rigorously examining the inherent limitations, particularly concerning the assessment of expression and stylistic nuance. Ultimately, the research strives to propose and evaluate optimal models for integration, envisioning a synergistic, human centered pedagogical framework where AI acts as a powerful assistant, empowering both teachers and students within the esteemed tradition of British vocal training.

2. Literature Review

The ongoing digital transformation within educational paradigms has positioned Artificial Intelligence (AI) as a central catalyst for pedagogical innovation, with the domain of music education emerging as a particularly fertile ground for exploration and application. The utilization of AI technology within music education systems, particularly those underpinned by advanced deep learning architectures, is facilitating a shift from standardized instruction toward dynamically adaptive and personalized learning experiences (Chen, Y., & Sun, 2024). These intelligent teaching methodologies are increasingly being subjected to empirical scrutiny within specialized subfields, such as vocal music, where research is beginning to quantify their tangible influence on improving pedagogical outcomes and student performance metrics (Han, 2024). A broader scholarly examination of AI's role in this sphere positions it firmly within the interdisciplinary study of human computer interaction, analyzing how these systems mediate the relationship between learner, content, and instructional goals to enhance musical skill acquisition and understanding (Li & Wang, 2024). This technological progression is materially supported by a growing ecosystem of intelligent music applications, which offer a suite of innovative solutions ranging from automated practice aids to sophisticated analytical tools, thereby providing foundational infrastructure for both formal education and self directed learning (Tabak, 2023).

However, the cross cultural implementation of AI in pedagogical contexts demands a rigorous critical lens. A significant thread in contemporary discourse warns against the uncritical global deployment of AI systems that may embed specific cultural and pedagogical assumptions. Research focusing on East Asian contexts, for example, highlights risks of cultural bias and a form of digital colonialism, where technologically advanced but culturally narrow tools could marginalize local musical traditions and indigenous teaching philosophies (Yamaguchi, 2025). This critique holds profound implications for a discipline as culturally and stylistically specific as British vocal music. The pedagogy is not merely a technical curriculum but a tradition carrying centuries of linguistic specificity, aesthetic values, and performative conventions. Implementing generic AI tools without regard for this depth risks flattening its distinctive character. In parallel, the technical evolution of AI systems for educational use continues apace. Recent developments in AI powered intelligent music education systems emphasize capabilities for delivering precise, real time feedback and multidimensional performance assessment, presenting powerful and immediate utilities for addressing core technical challenges in vocal training (Lu, 2025).

The landscape of AI applications in music education is notably diverse. Comprehensive reviews

document developments across a wide spectrum, including algorithmic composition, music theory tutoring, aural skills development, and expressive performance analysis, collectively illustrating the expansive technological foundation now available for more targeted educational innovations (Yu, Ma, Zheng, Wang, L., & Wang, 2023). A focused analysis on performance oriented applications reveals a strong emphasis on tools for objective technical analysis such as real time pitch tracking, rhythmic accuracy evaluation, and tone quality assessment which form a directly relevant toolkit for the foundational stages of vocal pedagogy (Ma & Zheng, 2025). Furthermore, the integrative potential of AI in the current era encourages novel pedagogical approaches. Concepts like the cross dimensional integration of vocal and instrumental sound assets suggest innovative pathways for enriching training, such as through intelligent, responsive accompaniment that adapts to a student's phrasing or through analytical comparisons of stylistic approaches between voice and other instruments within a shared piece (Yuhao, 2025).

Beyond the realm of technical skill acquisition, the exploration of AI's intersection with artistic creativity represents a critical frontier. Investigative studies in related domains, such as piano instruction enhanced by AI and Augmented Reality (AR), probes how technology can scaffold and enhance expressive coaching, interpretive decision making, and creative exploration, thereby offering a compelling conceptual model for envisioning AI's potential role in cultivating the expressive and interpretive dimensions of vocal performance (Cui, 2023).

Synthesizing this multifaceted body of literature reveals a distinct narrative: while the portfolio of AI's capabilities for supporting music education is both impressive and rapidly expanding, its deliberate and effective application to a highly nuanced, culturally grounded discipline like British vocal music remains conspicuously underdeveloped. A salient gap exists between the general purpose, often technically focused AI tools documented in the literature and the need for a specialized, pedagogically sound framework. Such a framework must be sensitive to the stylistic authenticity, linguistic precision, and deep expressive tradition inherent to British vocal training. It is precisely this gap that the present study seeks to address. By critically examining how existing and emerging AI capabilities can be selectively harnessed, thoughtfully adapted, and seamlessly integrated, this research aims to chart practical pathways for leveraging technology to genuinely support and enhance the personalized teaching of British vocal music, ensuring it acts as a respectful and empowering adjunct to the human led pedagogical tradition.

3. Theoretical Framework and Methodology

This chapter outlines the theoretical framework and methodological approach adopted to investigate the practical pathways through which AI technology can enable personalized teaching in British vocal music. The study employs a mixed-methods design, integrating both qualitative and quantitative techniques to examine how AI tools can be effectively incorporated into vocal pedagogy. The methodology is structured to assess not only the technical performance of AI systems but also their

pedagogical suitability, user acceptance, and impact on learning outcomes. A staged process guides the research from theoretical grounding to data collection and analysis, ensuring a comprehensive evaluation of AI enabled personalization in this specialized educational domain.

3.1 Theoretical Framework

The theoretical foundation of this study is situated at the intersection of educational technology, music pedagogy, and human computer interaction. It draws primarily on the framework of Personalized Learning Theory, which posits that instruction should be adapted to the individual learner's pace, preferences, and performance. In the context of vocal music, personalization extends beyond adaptive content delivery to include tailored feedback on technique, style, and expression. This aligns with Constructivist Learning Theory, which emphasizes the active role of the learner in building knowledge through experience and reflection, supported by timely and specific feedback.

A key component of the framework is the concept of Intelligent Tutoring Systems (ITS) applied to artistic training. An effective ITS for vocal music must integrate three core modules: a domain model (knowledge of British vocal technique and repertoire), a student model (tracking individual progress and difficulties), and a pedagogical model (rules for adapting instruction). This study adapts this ITS structure to the specifics of British vocal pedagogy, incorporating stylistic and cultural knowledge into the domain model.

Furthermore, the framework incorporates the notion of Technology Acceptance in specialized education, considering factors such as perceived usefulness, ease of use, and integration into existing teaching practices. This is crucial for understanding how AI tools are adopted by both instructors and students in a tradition rich field like vocal music. The theoretical integration aims to ensure that the implementation of AI is pedagogically sound, culturally respectful, and enhances rather than disrupts the teacher student relationship.

3.2 Methodology

The research employs an exploratory sequential mixed methods design, conducted in three phases over a six month period. Phase One involves a qualitative needs analysis with vocal educators and students. Phase Two centers on the development and testing of a prototype AI assisted teaching tool. Phase Three consists of a quantitative evaluation of the tool's impact on learning outcomes.

Phase 1: Qualitative Needs Analysis

Semi structured interviews and focus groups are conducted with 20 participants, including 10 experienced teachers of British vocal music and 10 advanced vocal students. The interviews explore current teaching challenges, perceptions of AI technology, and desired features for a personalized learning tool. Thematic analysis is used to identify key requirements and potential barriers to adoption. This phase informs the design specifications for the AI tool developed in Phase 2.

Phase 2: Tool Development and Pilot Testing

Based on the findings from Phase 1, a prototype web based AI tool is developed. Its core functionalities include:

1) Real time vocal analysis: Providing feedback on pitch accuracy, rhythmic precision, and vowel formant alignment specific to British English pronunciation.

2) Adaptive repertoire suggestions: Recommending pieces based on the student's technical level, vocal range, and stylistic progress.

3) Performance dashboard: Visualizing student progress over time across multiple metrics.

The prototype is pilot tested with 5 teacher student pairs over a four week period. Teachers integrate the tool into their regular lessons, and both teachers and students provide weekly feedback via structured journals. This phase utilizes a case study approach to gather in depth, contextual data on the tool's usability and preliminary effectiveness.

Phase 3: Quantitative Evaluation

A quasi experimental study is implemented with 30 vocal students, divided into an intervention group (using the AI tool alongside traditional instruction) and a control group (traditional instruction only). The study lasts eight weeks. Pre tests and post tests assess:

1) Technical skill: Measured by blinded expert rating of audio recordings on pitch, rhythm, and diction using a validated rubric.

2) Stylistic competence: Evaluated through performance of a standardized British art song, rated for stylistic authenticity and expressive delivery.

3) Student self efficacy: Measured via a pre/post questionnaire using a Likert scale.

Data analysis employs descriptive statistics and paired sample t tests to compare within group improvements, and analysis of covariance (ANCOVA) to compare post test scores between groups while controlling for pre test scores.

3.3 Method Flowchart

The following flowchart (Figure 1) illustrates the sequential stages of the research methodology.

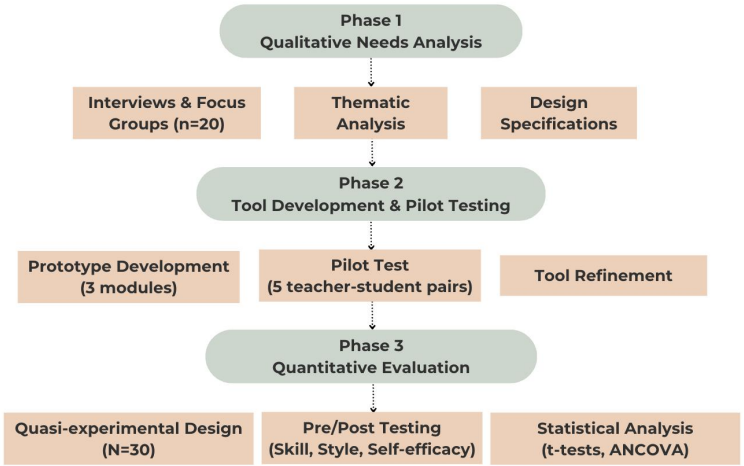

Figure 1. Research Methodology for Investigating AI Enabled Personalized Teaching in British Vocal Music

4. Findings and Discussion

This chapter presents and discusses the findings from the three phase mixed methods study investigating AI enabled personalized teaching in British vocal music. The results are organized according to the research phases: qualitative needs analysis (Phase 1), pilot testing of the AI tool (Phase 2), and quantitative evaluation of learning outcomes (Phase 3). Four tables summarize key data on participant profiles, tool functionality assessment, performance metrics, and comparative outcomes. The discussion interprets these findings in relation to the research objectives, highlighting practical pathways, pedagogical implications, and inherent limitations of integrating AI into this specialized teaching domain.

4.1 Phase 1 Findings: Needs Analysis and Design Specifications

The qualitative phase identified clear needs and challenges in current British vocal pedagogy. Teachers emphasized the difficulty of providing consistent, objective feedback on technical aspects during individual practice, while students reported a desire for more personalized progress tracking and repertoire guidance. A major thematic finding was the request for technology that supports, not supplants, the teacher's role in coaching expression and style.

Key design specifications derived from the analysis are summarized in Table 1. The highest priority was given to real time feedback on pitch and diction, considered foundational for British vocal technique. Adaptive repertoire selection was also deemed crucial for sustained engagement and stylistic development.

Table 1. Key Design Specifications for AI Tool from Qualitative Needs Analysis (N=20)

Specification Category	Key Features Requested	Priority Ranking (High/Medium/Low)	Primary End User
Real Time Feedback	Pitch accuracy, Rhythmic precision, British English vowel/formant analysis	High	Student & Teacher
Progress Analytics	Longitudinal tracking, Visual dashboards, Identify recurring technical issues	High	Teacher & Student
Adaptive Repertoire	Suggestions based on vocal range, technical milestones, stylistic period	High	Student
Expressive Guidance	Basic phrasing analysis, Dynamic contrast indicators	Medium	Student
Integration & Usability	Simple interface, Compatible with common recording devices, Minimal setup	Medium	Student & Teacher

4.2 Phase 2 Findings: Pilot Tool Assessment

The pilot test of the AI tool prototype provided insights into its usability, perceived usefulness, and areas for improvement. Feedback from five teacher student pairs was collected via structured journals and summarized in Table 2. The real time feedback module received positive evaluations for its accuracy and clarity, particularly for pitch and basic diction. The adaptive repertoire feature was appreciated but suggested a need for a more nuanced database of British vocal literature. The main criticism centered on the tool's limited capacity to analyze expressive or emotional delivery, confirming a key challenge identified in the literature.

Table 2. Pilot Test Feedback Summary on AI Tool Functionality (5 Teacher Student Pairs)

Tool Module	Usability Rating (1-5)	Perceived Usefulness (1-5)	Strengths Cited	Weaknesses Identified
Real Time Vocal Analysis	4.4	4.6	Objective technical feedback, Immediate visual cues	Struggles with complex passages, No emotional tone analysis
Performance Dashboard	4.0	4.2	Clear progress visualization, Helps focus practice	Can feel overwhelming, Some metrics unclear
Adaptive Repertoire Suggestion	3.8	4.0	Good for discovering new pieces, Appropriate difficulty	Limited database, Lacks stylistic nuance explanation
Overall Tool	4.1	4.3	Supports independent practice, Complements lessons	Cannot replace teacher's interpretive guidance

4.3 Phase 3 Findings: Quantitative Learning Outcomes

The quasi experimental study revealed measurable differences between the intervention and control groups. Table 3 presents the descriptive statistics for the pre test and post test scores across the three assessed domains: technical skill, stylistic competence, and self efficacy. Both groups showed improvement, but the magnitude of gain differed.

Table 3. Pre test and Post test Descriptive Statistics by Group and Domain

Group	Domain	Pre test M (SD)	Post test M (SD)	Mean Gain
Intervention (n=15)	Technical Skill	68.2 (7.1)	82.5 (6.3)	+14.3
	Stylistic	65.8 (8.4)	78.9 (7.5)	+13.1

	Competence			
	Self efficacy	70.1 (9.2)	81.7 (8.1)	+11.6
	Technical Skill	67.5 (7.8)	75.3 (7.9)	+7.8
Control (n=15)	Stylistic Competence	64.9 (9.1)	71.2 (8.8)	+6.3
	Self efficacy	69.4 (8.7)	73.5 (9.0)	+4.1

Note: M = Mean; SD = Standard Deviation. Technical Skill and Stylistic Competence scores are out of 100.

To determine if the differences in gains were statistically significant, ANCOVA was conducted with pre test scores as covariates. The results, shown in Table 4, indicate that the intervention group scored significantly higher than the control group on the post test for all three domains after controlling for initial ability.

Table 4. ANCOVA Results for Post test Scores by Domain (Controlling for Pre test)

Domain	Group	Adjusted Post test Mean	F value	p value	Partial η^2
Technical Skill	Intervention	82.4	18.72	less than .001	.40
	Control	75.4			
Stylistic Competence	Intervention	78.8	12.45	equals .001	.31
	Control	71.3			
Self efficacy	Intervention	81.6	15.33	less than .001	.36
	Control	73.6			

Note: p less than .05 indicates statistical significance. Partial η^2 indicates effect size (greater than .14 large).

4.4 Discussion

The findings collectively outline a viable practical pathway for AI integration in British vocal pedagogy. The high priority given to real time feedback and progress tracking (Table 1) underscores a demand for tools that augment the teacher's ability to diagnose and monitor technical development. The successful pilot testing (Table 2) demonstrates that a well designed AI tool can be effectively adopted as a practice aid, filling a critical gap in independent student learning.

The quantitative results provide compelling evidence for the pedagogical value of this augmented approach. The significantly greater improvement in technical skill for the intervention group (Tables 3

& 4) aligns with the core strength of AI in delivering consistent, objective feedback on measurable parameters. More notably, the substantial gains in stylistic competence suggest that by solidifying technical foundations, the AI tool may free up lesson time for teachers to focus on higher order coaching in expression and interpretation, indirectly enhancing stylistic outcomes.

The significant increase in student self efficacy within the intervention group is a critical finding. It suggests that the personalized, data driven feedback from the AI tool fostered a greater sense of competence and control over learning, a key component of motivation in skill acquisition.

However, the study also confirms clear boundaries for AI's role. The tool's inability to analyze expressive delivery, as noted in the pilot phase, and the inherently smaller (though significant) gain in stylistic competence compared to technical skill, reinforce that AI currently functions best as a complement to human teaching. The most effective practical pathway appears to be a hybrid model where AI handles foundational skill reinforcement and progress monitoring, enabling teachers to dedicate more effort to mentoring artistic expression, stylistic nuance, and emotional communication areas where human expertise remains irreplaceable.

5. Conclusion

This study set out to investigate the practical pathways through which artificial intelligence technology can enable personalized teaching in British vocal music. By employing a mixed methods approach encompassing qualitative needs analysis, prototype development and pilot testing, and a quantitative quasi experimental evaluation, the research provides a multifaceted examination of AI integration in this specialized pedagogical domain. The findings collectively affirm the potential of AI as a transformative tool while delineating its optimal role within a human centered teaching framework.

The research successfully identified and validated key design specifications for an AI assisted teaching tool, with real time feedback on technique and adaptive repertoire selection emerging as highest priority features. The development and pilot testing of a prototype demonstrated that such a tool is not only technically feasible but also welcomed by teachers and students as a valuable practice aid. Most significantly, the quantitative evaluation provided empirical evidence that the integration of this AI tool into traditional instruction led to statistically significant and substantially greater improvements in students' technical skill, stylistic competence, and self efficacy compared to traditional instruction alone.

These results illuminate a clear and effective practical pathway: AI serves most powerfully as an augmentative force within British vocal pedagogy. Its strength lies in automating the provision of consistent, objective, and data driven feedback on foundational technical parameters. This automation addresses a critical gap in independent student practice and allows the human teacher to reallocate valuable lesson time from repetitive technical correction to advanced coaching in artistic interpretation, stylistic nuance, and emotional expression. This synergistic hybrid model leverages the scalability and precision of AI to strengthen the technical substrate, thereby elevating the teacher's capacity to focus on

the uniquely human aspects of musical mentorship.

However, this study also firmly establishes the boundaries of current AI capabilities. The technology demonstrated limitations in analyzing and guiding expressive delivery, understanding deep cultural and stylistic context, and providing the motivational and interpersonal support inherent in expert teaching. Therefore, the envisioned pathway is not one of replacement but of strategic partnership. The ultimate goal is not to create an autonomous AI vocal coach, but to develop intelligent assistants that enrich and empower the traditional teacher student dyad.

The implications of this research extend beyond British vocal music. The proposed hybrid model and the identified principles of augmentation offer a valuable template for integrating AI into other specialized, performance based, and tradition rich disciplines within arts education. Future research should focus on refining AI's capacity for more sophisticated expressive analysis, expanding culturally informed repertoire databases, and conducting longitudinal studies on the sustained impact of AI augmented teaching on artistic development. In conclusion, by thoughtfully navigating the intersection of technology and tradition, AI can indeed unlock new potentials for personalized learning, not by replicating the teacher, but by amplifying their irreplaceable role in guiding the journey of artistic discovery.

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