

TECHNOLOGY AND MUSIC: THE ROLE OF AI IN INSTRUMENTAL AND COMPOSITIONAL EDUCATION

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Abstract

This study explores the transformative impact of artificial intelligence (AI) on music education, focusing on both instrumental practice and composition. It examines how applications such as Kena.AI, Yousician, Chordify, Moises, AIVA, and Amper Music personalize learning experiences and support autonomous practice through immediate feedback. Drawing from international frameworks established by the Associated Board of the Royal Schools of Music and UNESCO, the analysis assesses the pedagogical coherence of AI integration in music curricula. A systematic mapping highlights how current platforms excel in technical skills development but remain limited in fostering expressive, creative, and relational dimensions. While AI offers valuable tools for differentiated instruction, the findings emphasize that its effective implementation requires ethical guidance, critical mediation, and hybrid educational models. Ultimately, AI should be viewed not as a replacement for human teachers but as a powerful complement to enhance personalized learning, promote inclusion, and support the emotional and artistic growth of students.

Keywords: Music, artificial intelligence, pedagogy, education, innovation.

1 INTRODUCTION

Artificial intelligence (AI) is transforming music learning by offering advanced tools for analysis, performance, and composition. Applications such as Kena.AI, Yousician, Chordify, Moises, AIVA, and Amper Music allow for the high personalization of educational paths, fostering student autonomy through immediate feedback.

However, several issues may arise. First, AI cannot replace the sensitivity and empathy of a human teacher, which are essential for artistic growth [1]. Furthermore, the rapid pace of technological change raises concerns about the pedagogical stability and integration of these platforms. Critics highlight potential disadvantages such as reduced depth of learning and dependence on technology. Dzhanevizova et al. [2] emphasize the need for a careful balance between technological innovations and traditional teaching methods, alongside the development of ethical principles and regulatory frameworks to address these challenges. This approach is essential for ensuring that AI enhances rather than undermines the educational experience.

While AI can enhance personalized and adaptive instruction, its adoption necessitates careful alignment with pedagogical theories such as constructivism and connectivism. Academics' perspectives on AI vary based on their technological proficiency and institutional support, highlighting the need for a robust technical infrastructure. Ethical considerations, including data privacy and academic integrity, further complicate the integration process, necessitating a balanced approach to maximize benefits while minimizing risks [3].

This study examines the role of AI in music education in light of the international guidelines of the Associated Board of the Royal Schools of Music (ABRSM) and the United Nations Educational, Scientific and Cultural Organization (UNESCO), assessing the potential and limits of integrating new tools into music curricula without compromising creativity, expressiveness, and educational relationship.

The goal of this work is not to review the current versions of specific AI-based tools, given the rapid evolution of technologies in this field, but rather to propose a theoretical framework for critically analyzing AI applicability in the context of formal music education. The focus is primarily on secondary and tertiary (university-level) music education, where structured curricula and assessment criteria (e.g., ABRSM certifications) are commonly adopted, but the considerations may also extend to advanced non-formal training contexts such as conservatories and private academies. Within these settings, AI tools are evaluated not as replacements for teachers but as potential components of hybrid instructional models

— to be intentionally integrated into lesson plans, practice routines, and composition modules, in accordance with pedagogical values and institutional goals.

In this sense, the tools considered — Yousician, Kena.AI, Chordify, Moises, AIWA, and Amper Music — are not selected to represent the full market offering, nor are they analyzed in terms of their software updates or commercial features. Rather, they are examined as paradigmatic examples of how AI currently interacts with specific pedagogical domains (technical performance, theoretical knowledge, creative expression). Their inclusion is motivated by both their diffusion in the educational landscape [4] and their recurring treatment in the scientific literature [5,6], making them suitable for validating a broader conceptual framework.

The remainder of the paper is structured as follows: Section 2 will provide the regulatory framework, Section 3 will evaluate some relevant AI tools commonly used in music practice, Section 4 will introduce a comparative mapping between the features offered by these tools, and, finally, Section 5 will analyze the pedagogical implications due to their adoption.

2 REGULATORY FRAMEWORK ANALYSIS

Before discussing how to integrate AI into music education, we have to analyse the regulatory and pedagogical frameworks that currently guide teaching in this field. Two key international reference points are the ABRSM principles [7] and the UNESCO guidelines on arts education [8].

Founded in 1889, ABRSM is globally recognized as one of the most authoritative certifying bodies in the field of music. Its educational approach is based on a structured and progressive path, encompassing technical skills (intonation, articulation, rhythm), theoretical knowledge (music reading, harmony, history), and interpretive aspects (expression, style, communication).

ABRSM exams, from Grade 1 to Grade 8, assess both theoretical and performance skills through a highly formalized and measurable process. However, ABRSM's approach is not purely technical: alongside technical precision, musicality, namely the ability to express a coherent artistic intention, is emphasized. This focus on artistic expression poses a significant challenge for AI-based tools, which are effective in providing feedback on quantifiable elements like rhythm and pitch but still struggle with the nuanced and subjective dimensions of phrasing, emotion, and interpretation [9]. Rossi and Fedeli [10] further argue that empathy, as a relational and human-centered dimension, remains largely inaccessible to algorithmic evaluation.

In parallel, the 2010 UNESCO recommendations, especially the Seoul Agenda, propose a broader cultural vision of education that includes creativity, intercultural dialogue, and active participation in cultural life. Arts education is presented as a holistic process involving emotion, the body, the mind, and society. The student-teacher interaction is considered crucial not only for transmitting technical skills but also for developing a conscious, open, and reflective artistic identity. This model highlights inclusion, equitable access, and cultural diversity as central values. Technology is a useful but non-neutral tool: its use must be ethically and pedagogically guided to avoid reducing music education to mechanized procedures. Within this framework, the interaction between teacher and learner is seen as central, not only for the transmission of technical knowledge, but also for the formation of a conscious, open, and reflective artistic identity [11].

This approach is consistent with socio-constructivist theories of learning, such as those articulated by Vygotsky [12], which underscore the importance of social interaction and guided mediation in the development of higher psychological functions. From this perspective, the implementation of AI must be critically assessed not just in terms of technical performance, but in relation to its coherence with pedagogical values grounded in human relationships and cultural awareness.

Zysman and Nitzberg [13] emphasize the need for clear governance frameworks to define the ethical limits and possibilities of AI use in education. Their analysis highlights how technological tools, if not properly regulated, risk undermining essential values such as autonomy, inclusion, and diversity in learning environments. Furthermore, as Oh and Ahn [14] have noted, one of the main risks associated with AI adoption in the arts is the erosion of emotional and relational dimensions, which are foundational to artistic training. Chan and Tsi [5] add that technology can never fully replace the role of the educator;

its meaningful contribution arises only when AI is intentionally and pedagogically integrated into the teaching process.

A comparative analysis of the ABRSM and UNESCO frameworks demonstrates that AI can benefit music education only when embedded in a coherent and value-based educational structure that centers on human creativity, expression, and emotion.

3 EVALUATION OF MUSIC-ORIENTED AI TOOLS

The ecosystem of AI-based applications for music education is rapidly expanding, offering an increasingly diverse range of tools designed to support instrumental practice, theoretical learning, performance analysis, and musical composition. Among the most widely used and established platforms are Yousician, Kena.AI, Chordify, Moises, AIVA, and Amper Music. The selection of these six tools is based on a triangulated methodological approach: (1) documented popularity and user base, (2) recurring citations in academic literature, and (3) representativeness of key pedagogical functionalities relevant to AI in music education.

Firstly, platforms such as Yousician and Moises are among the most downloaded music education apps globally, with millions of active users, as reported in various market analyses and app store rankings [2,4]. Their popularity reflects their accessibility, technological maturity, and broad adoption in both formal and informal educational settings. Secondly, the academic literature frequently discusses these platforms as case studies or benchmarks when exploring the impact of AI on music pedagogy [5,6]. For instance, Kena.AI has been highlighted for its neural-network-based feedback systems, which align with formative assessment models.

Moreover, while this selection inevitably carries an element of subjectivity, it has been designed to offer a paradigmatic cross-section of the functionalities that define the current landscape of AI in music education. This categorization aims to highlight key areas of innovation through the examination of representative tools and platforms. Specifically, four core AI-driven functions emerge from the literature and current educational practice: (1) real-time performance feedback (Yousician, Kena.AI), supported by the use of AI tools for interactive skill development and soft-skill training, including empathy [1,4]; (2) harmonic and analytical tools (Chordify, Moises), reflecting the integration of AI in cognitive and structural analysis of music [4,6]; (3) generative composition (AIVA, Amper Music), closely tied to recent experimental and theoretical work on AI-generated music and human expectation [6]; and (4) adaptive learning environments, as exemplified by AI-supported personalized and emotional learning systems [2,3,9]. This categorization can therefore be considered valid both from a practical and theoretical standpoint, as it reflects a functional taxonomy inspired by recent research that explores the main applications and pedagogical implications of AI in music education.

The evaluation also draws on expert analysis of each tool's technical documentation, user experience testing, and alignment with educational goals set by ABRSM and UNESCO. This approach ensures that the platforms under review are not only widely used but also pedagogically relevant, each illustrating in a distinct way how AI can reshape different domains of music learning — from skill acquisition to creative expression.

3.1 Yousician

Yousician is one of the best-known educational music services. It offers interactive exercises for guitar, piano, voice, bass, and ukulele, using real-time audio recognition and gamified learning paths. Its strength lies in simplicity and accessibility, especially for beginners. The intuitive interface provides immediate feedback on rhythm and pitch accuracy.

Yousician employs AI-driven audio recognition technology that listens to users as they play instruments or sing, providing real-time feedback on accuracy and timing. This feature helps learners identify mistakes and improve their technique effectively.

Yousician is particularly effective in promoting autonomous learning and motivating students [4]. However, the platform's pedagogical depth is limited: it lacks personalization for advanced learners and focuses primarily on technical precision, often at the expense of expressive and interpretative aspects. It also shows poor alignment with structured academic curricula such as those promoted by ABRSM, which aim for a more holistic musical development.

3.2 Kena.AI

Kena.AI, in contrast, adopts a more refined data-driven approach. It uses neural networks to analyze student performance in detail, offering highly specific feedback on elements such as pitch, articulation, rhythm, and dynamics. Its adaptability to individual learning profiles makes it a potentially powerful tool for differentiated instruction and formative assessment.

This personalized feedback model aligns with what Chan and Tsi [5] describe: AI can support tailored learning without replacing the teacher's role. However, Kena.AI requires a relatively high level of technological proficiency from both teachers and students, as well as appropriate technical infrastructure (e.g., high-fidelity microphones and a stable connection).

3.3 Chordify

Chordify provides different pedagogical value by focusing on harmony and real-time accompaniment. It automatically generates chords from any audio or video track, allowing students to explore popular and contemporary repertoires with ease.

The tool is especially useful for developing skills in functional harmony and harmonic listening. However, it is of limited relevance in academic or classical settings, where reading and writing standard musical notation are fundamental. Additionally, Chordify offers no interpretative support or performance evaluation tools. As Sánchez-Jara [4] notes, it should be seen as a creative aid for informal learning rather than a core component of a structured curriculum.

3.4 Moises

Moises stands out in performance analysis and practice support. The app allows users to isolate audio tracks (voice, bass, drums, harmony), adjust tempo and pitch, and practice with or without specific instrumental parts. These features are particularly valuable for singers and instrumentalists aiming to develop analytical listening and technical precision.

Moises aligns well with UNESCO's "Responding" standard, which promotes critical analysis and evaluation of music. However, it does not provide automated performance assessments and, without careful instructional guidance, risks promoting a mechanical approach to practice. As noted by Chan and Tsi [5], AI tools that focus exclusively on decomposition and repetition can reduce musical experience to a purely technical exercise if not mediated by human intervention.

3.5 AIVA

AIVA (Artificial Intelligence Virtual Artist) introduces a compositional dimension to music education with AI. It generates original pieces in different musical styles, customizable by instrument, mood, and structure. AIVA is trained on large datasets of existing music, particularly classical compositions by famous composers (like J.S. Bach, L. van Beethoven, and W.A. Mozart) as well as contemporary music styles. It uses deep learning techniques, especially recurrent neural networks (RNNs) and transformers, to learn musical patterns, structures, harmonies, and styles.

AIVA is especially useful in composition and orchestration courses, where students can explore harmonic and formal possibilities in a creative environment. However, it also has significant limitations: the music often bears the "algorithmic signature" of the model, making it stylistically homogeneous. Furthermore, it does not provide pedagogical feedback on student-generated content. Tools like AIVA are better suited to exploration than formal instruction, serving more as prompts for metacognitive reflection on musical structure [6].

3.6 Amper Music

Amper Music provides a streamlined interface for quickly generating and editing musical tracks. It allows users to select atmosphere, intensity, and instruments, making it ideal for introductory experiences in digital music production. Amper's AI is trained on a comprehensive dataset of musical patterns, structures, and styles. This training enables the AI to understand and replicate various musical elements, allowing it to compose music that resonates with human listeners. By analyzing user inputs and preferences, the AI generates compositions that are both unique and contextually appropriate.

Amper Music's practicality encourages a "hands-on" approach to musical creation. However, it offers limited control over microstructural musical choices and lacks a solid theoretical foundation to support

advanced musical understanding. Consequently, it may be less appropriate for academic training paths focused on live performance or theoretical depth.

4 SYSTEMATIC COMPETENCY MAPPING

Taken together, the platforms mentioned in Section 3 demonstrate the growing potential of AI in enhancing music education. Each responds to different pedagogical needs: from basic skills development to autonomous practice, from creative exploration to analytical listening. However, none can replace the complexity and depth of the teacher's role. Their integration into structured educational programs must be carefully evaluated, ensuring consistency with technical objectives, expressive outcomes, and curricular standards. As emphasized in the literature [4,5,9], the goal is not to replace traditional instruction but to use AI as an intelligent and flexible extension of pedagogical practice.

To better assess the actual contribution of AI platforms to music education, a comparative mapping was conducted between the functionalities offered by each tool and the pedagogical competencies outlined in internationally recognized frameworks, particularly those of ABRSM [7]. From this analysis, three overarching competency domains were identified, reflecting the core dimensions of music learning and cutting across the principal pedagogical models:

1. **Technical and Performance Skills** (encompassing competencies related to instrumental mastery and precision)
 - Instrumental technique
 - Music notation reading
 - Rhythmic and pitch accuracy
 - Automated performance analysis
2. **Theoretical and Analytical Skills** (aimed at developing cognitive understanding of musical language and structure)
 - Music theory and harmony
 - Understanding musical structure
 - Ear training
3. **Expressive and Creative Skills** (focusing on interpretative, inventive, and culturally responsive dimensions of musicianship)
 - Creative composition
 - Expressive interpretation
 - Improvisation
 - Cultural and stylistic sensitivity

The mapping is shown in Figure 1. The attribution of each competency marker in the mapping was based on a triangulated analysis combining official documentation of the platforms, evidence from peer-reviewed literature [4,6], direct user experience of music educators, and information drawn from expert discussions in technology-oriented music education communities. Although not based on Likert-scale assessments by a panel of raters, the chart reflects informed qualitative judgments about the pedagogical affordances of each application.

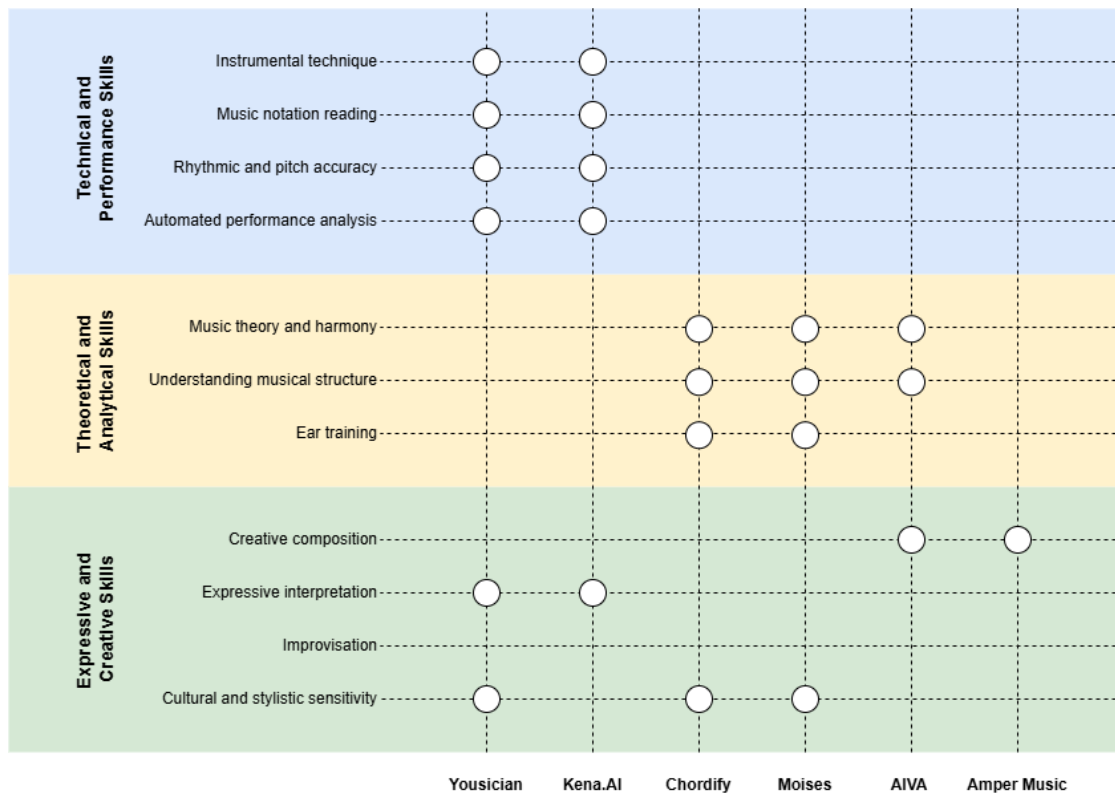


Figure 1. Mapping between AI-based platforms and competency domains and areas.

The mapping showed some interesting results. Platforms like Kena.AI and Yousician adequately cover the first domain, excelling in automated performance analysis and technical-error correction. Chordify and Moises offer solid support in the second domain, facilitating understanding of chords, harmonic structures, and ear training. The third domain, which includes expressive and creative skills, is still partially uncovered: tools like AIVA and Amper Music support automated composition but are not able to promote real critical thinking or autonomous artistic awareness. It is worth noting that improvisation competency is not addressed by any of the considered platforms.

In conclusion, a “gradient of effectiveness” was observed in AI platforms: very high effectiveness in basic technical skills, medium effectiveness in theoretical competencies, but still limited coverage of expressive and interpretative dimensions, which require human interaction and direct teacher-student engagement.

5 PEDAGOGICAL IMPLICATIONS AND CONCLUSIONS

The integration of AI in music education represents a promising yet complex turning point. Platforms such as Yousician, Kena.AI, Moises, Chordify, AIVA, and Amper Music clearly demonstrate how AI can support the teaching process through immediate feedback, personalized learning, creative content generation, and advanced music analysis. These tools have already shown, in various contexts, their ability to enhance student motivation, strengthen individual practice autonomy, and increase access to music learning, even in environments without constant in-person [11].

However, a critical analysis reveals that this technological promise is accompanied by several limitations. Among the main strengths, we can include the immediacy and personalization of feedback, the ability to adapt learning paths to students’ progress, and greater accessibility thanks to time- and location-independent learning environments. At the same time, we must acknowledge some key weaknesses: AI tools struggle with in-depth qualitative evaluation (such as emotional expressiveness or interpretive coherence), depend heavily on the quality and diversity of their training datasets, and risk encouraging passive, gamified learning experiences. The fast pace of technological obsolescence further complicates the sustainability of implementation, and, most importantly, the lack of human

interaction can strip away the dialogic and relational dimension that is foundational to musical and artistic growth [9,10].

From a curricular perspective, the structured adoption of these technologies raises important questions regarding long-term pedagogical robustness and alignment with existing educational frameworks. For example, the ABRSM model promotes a layered vision of musical development, integrating technical mastery, theoretical understanding, and expressive interpretation in a sequenced and measurable pathway. While platforms like Kena.AI show compatibility with this framework, especially in their capacity for granular performance feedback; others, such as AIVA or Amper Music, risk generating outputs that are musically coherent but disconnected from the student's internalized understanding of form and style [13].

UNESCO's educational vision reminds us that artistic learning cannot be reduced to mere accurate execution or creative productivity. It requires human relationships, cultural understanding, dialogue, and exchange. As Oh and Ahn [14] emphasize, AI still has major limitations in the socio-emotional dimension of teaching: it cannot recognize complex emotions or provide the empathy that often guides an expert teacher's interpretative decisions. In this sense, AI should not replace the teacher, but amplify their educational action, freeing them from repetitive tasks and supporting the analysis and documentation of student progress.

The evolving role of the teacher is therefore central. As highlighted by Chan and Tsi [5], educators in AI-enhanced environments shift from content transmitters to mediators and curators of learning experiences. This transition is particularly critical in music education, where the human element made of embodied knowledge, intuition, and interpretation is irreplaceable. An algorithm may correct intonation, but it cannot explain the expressive function of a silence, or the emotional weight of a crescendo. As Vygotsky [12] reminds us, the zone of proximal development is built in relationship, not in automation.

In light of these reflections, it becomes essential to establish a series of best practices for AI. Given these considerations, it is essential to develop a series of best practices to guide the introduction of AI in music curricula. First, teachers must gain advanced digital literacy to critically select and effectively use the most appropriate tools. Second, hybrid curricula should be promoted, combining AI use with traditional lessons, group improvisation, and critical reflection. Finally, it is fundamental to foster an ongoing dialogue on the role of technology in music learning, involving students, teachers, and institutions in an open and inclusive pedagogical conversation.

In conclusion, AI can become a valuable ally in music education, but only if integrated critically, responsibly, and with a deeply human perspective. The challenge is not simply adopting new technologies but rethinking educational processes so that tradition and innovation can coexist, enriching each other. On this path, the teacher remains the irreplaceable centre of the educational experience, the guardian of not only technical skills but also a vision of music as living art, relationship, and transformation.

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