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Educational AI, Public Pedagogy, and the 2026 European Guidelines: The Strummin' Gym Approach to Music Education

Marco Pennese [1], Lara Corbacchini [2]

[1] Conservatory of Music "A. Steffani", Castelfranco Veneto, Italy; marco.pennese@steffani.it
[2] Conservatory of Music "F. A. Bonporti", Trento, Italy lara.corbacchini@conservatorio.tn.it

Abstract: The 2026 European Guidelines on the ethical use of artificial intelligence in teaching and learning provide a vital framework for navigating the nexus of cognition, learning, and technological mediation. This paper argues that the educational legitimacy of AI depends not on technical efficiency, but on its capacity to enrich the "cognitive ecology" of the classroom by supporting pedagogical judgment. By examining the structure of the Guidelines, the study shows how they contextualize the AI Act within the institutional ecology of schooling, advocating for domain-sensitive design grounded in embodiment and teacher mediation. Music education serves as a primary illustration, revealing non-binary and interpretative dimensions of learning – such as improvisation and stylistic accompaniment – that many current self-directed AI applications fail to address. In this context, the Strummin' Gym framework is presented as a case study for integrating teacher-led mediation into AI-powered tools. By keeping the educator at the center of both the neural network's training and the pedagogical relationship, the framework moves beyond rigid binary assessments toward stylistically plausible support. This approach demonstrates how AI-assisted platforms can transform musical practice into a guided, reflective, and progressively autonomous experience, reclaiming the teacher's role as the indispensable mediator of music as a living, relational art.

Keywords: educational AI; AI governance; music education; AI literacy.

1. Introduction

This paper reflects on the nexus of cognition, learning, and technological mediation. AI should be viewed not as a self-legitimating innovation, but as a cognitive tool whose value depends on its support for genuine understanding and formative experience. This is critical as AI increasingly mediates information, feedback, and creative experimentation; thus, the central challenge is ensuring AI strengthens learning rather than displacing it.

We frame this issue through perspectives of distributed and mediated cognition. In Bateson's ecological view, mind emerges through feedback circuits between organism and environment (Bateson, 1972; Bruner, 1996); similarly, Clark and Chalmers (1998) argue that tools become part of cognitive processes when reliably integrated into reasoning and action. Thus, AI's educational legitimacy depends on whether it enriches or impoverishes the "cognitive ecology" of teaching. Research on AI ethics highlights how transparency, justice, and responsibility are now central to international discourse (Jobin et al., 2019). Recent studies further clarify that AI governance involves organizational accountability and decision-making structures beyond mere technical compliance (Mäntymäki et al., 2022; Filgueiras, 2024; Batool et al., 2025). Consequently, AI cannot be evaluated by efficiency alone, but by the pedagogical relations it establishes. Public education therefore requires criteria to align AI applications with pedagogical aims rather than private agendas.

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The paper is structured as follows: Section 2 examines the 2026 Guidelines in relation to educational AI governance, providing a framework for the subsequent analysis. This leads into Section 3, which outlines the pedagogical foundations necessary for domain-sensitive educational AI design. Applying these principles to a specific field, Section 4 analyzes current AI applications within music education, while Section 5 explores the complexities of a musical AI-powered tool that exceeds binary (right/wrong) assessment. Finally, Section 6 concludes by synthesizing these insights to discuss the broader implications for public pedagogy and the future of educational AI.

2. Educational AI Governance in Light of the 2026 European Guidelines

Over the last several years, the European Union has progressively developed a coherent framework for addressing AI in ethical, educational, and regulatory terms. A first landmark was the 2019 Ethics Guidelines for Trustworthy AI, which articulated a human-centred perspective grounded in fundamental rights, transparency, accountability, fairness, and human oversight. This orientation was later connected to education through the Digital Education Action Plan 2021-2027, the first guidelines for educators, and finally Regulation (EU) 2024/1689. Within this trajectory, the 2026 Guidelines on the ethical use of artificial intelligence and data in teaching and learning for educators are particularly relevant because they translate the broader European horizon of digital rights, public responsibility, and human-centred innovation into a framework explicitly addressed to teachers, schools, and educational staff. Guidelines introduce a two-dimensional matrix based on two indices: "who" uses the AI and "when" it is used. In Figure 1 it is possible to see the synthesised matrix with operative examples.

Figure 1. 2D matrix adapted from the 2026 Guidelines, pages 12–15.

AI usage		WHO		
		teacher supporting	**student supporting**	**school supporting**
WHEN	**for preparation**	• Lesson planning; • Designing learning materials; • Supporting creative activities; • Curating digital education content; • Practising and testing instructional strategies	• Researching with generative AI; • Practicing subject knowledge; • Exploring topics independently; • Organising and drafting assignments; • Creating customised study aids	• Managing routine school operations; • Organising school records and documents; • Identifying dropout risk; • Structuring academic data and information; • Modelling budget scenarios; • Supporting enrolment planning
	for learning and teaching	• Differentiating learning; • Enabling interactive and experiential learning; • Supporting collaborative learning; • Designing immersive experiences; • Enhancing language learning; • Supporting inquiry-based learning	• Practicing problem-solving; • Developing creative expression; • Enabling simulations; • Learning foreign languages; • Visualising patterns; • Enhancing physical education	• Guiding resourcing decisions; • Automating routine communications; • Supporting early identification of learning needs; • Facilitating home-school communication; • Preparing statistical reports
	for assessment and reflection	• Designing flexible assessment; • Automating repetitive correction tasks; • Assisting written assessment; • Supporting peer assessment; • Encouraging student self-reflection; • Providing guidance services	• Conducting formative assessment and feedback; • Reviewing creative work; • Tracking progress and reporting; • Reviewing and analysing lessons; • Supporting self- and peer-reflection	• Providing guidance platform services; • Planning school professional development; • Mapping curriculum and school plans; • Auditing digital tool usage; • Monitoring school improvement goals

More specifically, this framework identifies three main actors - the student, the teacher, and the school - and relates their possible uses of AI to different moments of

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educational activity, which makes the matrix especially valuable for situated educational analysis.

Taken together, the main contribution of the Guidelines lies in three aspects:

1. they are a public and non-binding framework rather than a legal act;
2. they contextualise the AI Act within education;
3. they offer a practical matrix for situated analysis of AI uses;

Above all, they identify the school, in its most institutional sense of the term, as the privileged setting for reflection on educational AI: a setting in which school leaders, teachers, and students interact with one another and in which pedagogical judgement is embedded in shared responsibilities, organisational structures, and public aims. In this respect, the document deliberately avoids treating AI as an abstract technological object or as a decontextualised relation between device and user. Instead, it frames AI within the relational, organisational, and educational ecology of schooling (Bronfenbrenner, 1979).

3. Pedagogical Foundations for domain-sensitive Educational AI

Work on embodied and mediated cognition stresses that learning takes place within situated relations among body, environment, and artefacts (Clark & Chalmers, 1998; Gallese & Morelli, 2024; Baldassarre et al., 2025; Rita Jose Mangione et al., 2025). Research on pedagogy shows that feedback is most effective when it supports reflection, autonomy, and progressively independent action rather than simple error correction (Blackwell, 2022; McPherson et al., 2022; Dos Santos Silva et al., 2025). Studies on autonomy-supportive teaching and self-regulation (Jansen et al., 2020) further confirm that educational quality depends not only on accuracy of information, but on the extent to which teachers enable learners to act meaningfully, reflectively, and progressively on their own learning process (Bonneville-Roussy et al., 2020; McPherson & Hattie, 2022; Turhal, 2022; Zachariou & Bonneville-Roussy, 2024). These pedagogical conditions also intersect with two increasingly relevant enabling factors for educational AI, namely AI readiness (Dai et al., 2020) and AI literacy (Yang et al., 2025). Educational quality depends not only on whether advanced tools are available, but also on whether learners and teachers are prepared to engage with them critically, reflectively, and in ways consistent with broader educational aims (Wu & Qin, 2025). This point is especially relevant for instructional design, since recent work has argued that AI should be integrated into educational planning not as an external shortcut, but as part of a reflective and pedagogically grounded design process oriented toward inclusion (Gravino et al., 2025), sustainability, and embodied learning (Schiavo, Domenico et al., 2025; Schiavo et al., 2025). The need for domain-sensitive approaches to educational AI does not arise only from differences in disciplinary content. More fundamentally, it depends on the fact that technologically advanced applications, including AI-powered ones, cannot be judged only by their functionality, efficiency, or degree of innovation. Drawing upon the aforementioned literature, it is possible to synthesize several essential points regarding how learning is supported, structured, and mediated. In this respect, the following principles are especially relevant:

1. learning is not reducible to information transfer or performance optimisation, but unfolds through embodied, relational, and context-sensitive processes;

2. effective teaching depends on meaningful mediation: teacher guidance, formative feedback, and pedagogical intentionality remain central even when technological tools are introduced;
3. robust educational practice is closely linked to the development of learner autonomy and self-regulation, rather than to mere external correction or passive compliance;
4. assessment should not flatten into what is easiest to quantify, because many educationally relevant dimensions remain interpretative, developmental, and only partially formalised.

4. A Pedagogical Reading of AI Applications in Music Education

The literature on the application of new technologies in music education is constantly growing and evolving (Merchán Sánchez-Jara, 2024; Ou et al., 2025; Mazlan et al., 2026). In this context Greco et al. (2025) discuss six AI-based applications[1] – Yousician, Kena.AI, Chordify, Moises, AIVA, and Amper Music – selected through a triangulated approach combining documented popularity and user base, recurring presence in academic literature, and representativeness of pedagogically relevant AI functionalities. Their comparative analysis (Figure 2) is then organised around three didactic competency domains: technical and performance skills, theoretical and analytical skills, and expressive and creative skills. These domains are not assumed a priori; instead, they are derived from a mapping of tool functionalities against internationally recognized pedagogical frameworks – specifically those of the Associated Board of the Royal Schools of Music (ABRSM), which provides globally standardized music exams and graded teaching certifications.

Figure 2. Greco e al. (2025) mapping between AI-based platforms and competency domains and areas.

		Yousician	Kena.ai	Chordify	Moises	AIVA	Amper Music
Technical and Performance Skills	• instrumental technique • music notation reading • rhythmic and pitch accuracy • Automated analysis	o o o o	o o o o				
Theoretical and Analytical Skills	• Music theory and harmony • Understanding musical structure • ear training			o o o	o o o	o o	
Expressive and Creative Skills	• creative composition • expressive interpretation • improvisation • cultural and stylistic sensitivity	o o	o	 o	 o	o	o

Yousician and Kena.ai offer specific feedback on elements such as pitch and rhythm – dimensions that are reducible to a binary "right/wrong" logic specifically interpretable by a neural network. Despite these characteristics, Yousician "shows poor alignment with structured academic curricula such as those promoted by ABRSM, which aim for a more holistic musical development" (Greco et al., 2025). Furthermore, the mapping reveals a complete absence of applications addressing improvisation. This omission is significant, as improvisation highlights dimensions – such as real-time decision-making, embodied responsiveness, and creative situatedness – that defy standard-

[1] https://yousician.com/; https://www.kena.ai/; https://chordify.net/; https://moises.ai/it/; https://www.aiva.ai/; https://mwm.ai/it.

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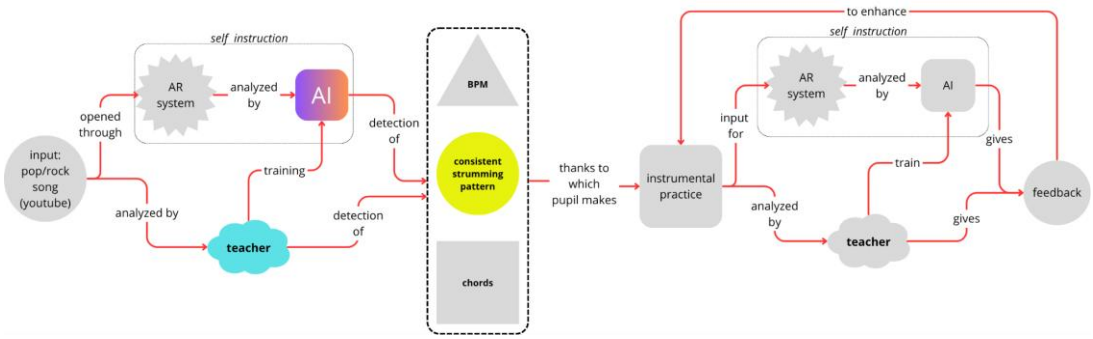
ized feedback or fixed targets. Other tools leverage AI potential to create or manipulate musical material with relative control over the creative process. Platforms like AIVA "are better suited to exploration than formal instruction", while tools focusing exclusively on decomposition and repetition, such as Moises, risk reducing the musical experience to a purely technical exercise unless mediated by human intervention. Similarly, Chordify automatically generates chords from audio or video tracks but offers no interpretative support or performance evaluation tools (Greco et al., 2025).

Read in light of the 2026 Guidelines and the pedagogical conditions outlined above, this taxonomy becomes valuable in determining whether an AI-assisted application's design logic explicitly accounts for teacher mediation and alignment with public educational aims, thereby fostering an inclusive dialogue between students, teachers, and institutional curricula.

5. Integrating Teacher-Led Mediation: The Strummin' Gym Case Study

As the Greco et al. (2025) previous mapping showed, a particularly revealing borderline case for educational AI concerns tasks that cannot be reduced to binary correctness or straightforward target matching (Wang et al., 2025). In this perspective, cases such as Strummin' Gym (Pennese et al., 2025) are especially significant. Strummin' Gym emerges as a pedagogical response to a structural gap in pop/rock guitar education: while harmonic support is widely codified, rhythmic accompaniment by the strumming hand remains fragmented, implicit, and often left to intuition as there is no single "correct" answer to the question: "which strumming pattern applies to this song?" (Freschi & Neulichedl, 2012; Baker & Green, 2013; Sellari, 2025). The Strummin' Gym project (Figure 3.) seeks to systematically and inclusively address this domain through a foundational set of three rhythmic patterns, which serve as the beginner's entry point into pop/rock performance.

Figure 3. Strummin' Gym Framework.



Within this framework, AI is leveraged to provide students with actionable suggestions regarding which of three basic/essential patterns (Perlak, 2024) is most appropriate for a given song, thereby transforming self-practice into a guided, reflective, and progressively autonomous musical learning experience. Within this learning environment, the teacher is explicitly accounted for as the figure responsible for both the pedagogical relationship and the training of the neural network. By overseeing the AI's learning process, the educator ensures that the tool's suggestions remain stylistically grounded and educationally sound. This design reaffirms the teacher as an indispensable part of the AI-powered process, transforming the technology from a standalone evaluator into a collaborative medium for musical growth. Finally we want to propose another analysis

(Figure 4) that employs a framework resulting from the overlap of the 2026 Guidelines and Greco et al.'s categories to investigate the role of the teacher within the application design: specifically, whether the teacher is explicitly integrated into the app's interaction model, or if the tool – while not accounting for the educator – remains of pedagogical interest for AI-powered instructional purposes.

Figure 4. Synthesized analytical framework overlapping Greco et al. (2025) competency domains and 2026 European Guidelines categories to assess teacher integration in music AI platforms.

			Strummin Gym		Chordify		Moises		AIVA		Amper Music		Kena.AI		Yousician	
			WHO		WHO		WHO		WHO		WHO		WHO		WHO	
	AI usage	competency domains	Teacher supporting	Student supporting	Teacher supporting	Student supporting	Teacher supporting	Student supporting	Teacher supporting	Student supporting	Teacher supporting	Student supporting	Teacher supporting	Student supporting	Teacher supporting	Student supporting
WHEN	for preparation	Technical and Performance Skills	o	o										o		o
		Theoretical and Analytical Skills	o	o	possible	o	possible	o	possible	o						
		Expressive and Creative Skills	o	o	possible	o	possible	o	possible	o	possible	o				
	for learning and teaching	Technical and Performance Skills	o	o									possible	o		o
		Theoretical and Analytical Skills	o	o	possible	o	possible	o	possible	o						
		Expressive and Creative Skills	o	o	possible	o	possible	o	possible	o	possible	o				
	for assessment and reflection	Technical and Performance Skills	possible	o									possible	o		o
		Theoretical and Analytical Skills	possible	o	possible	possible	possible	possible	possible	possible						
		Expressive and Creative Skills	possible	o	possible	possible	possible	possible	possible	possible	possible	possible				

While Greco's analysis tools show limited alignment, Strumming Gym integrates teacher-led mediation, fulfilling the European pedagogical mandate. This musical case therefore clarifies a broader point. The issue is not whether AI can support learning – as it clearly can – but whether its use remains compatible with the interpretative, embodied, and formative depth of the educational experience, within which the teacher remains the irreplaceable centre, serving as the guardian not only of technical skills but also of a vision of music as living art, relationship and transformation.

6. Conclusions

This paper has explored the nexus of cognition, learning, and technological mediation within the framework of the 2026 European Guidelines. Moving beyond the view of AI as a self-legitimating innovation, we have argued for its role as a cognitive tool that must enrich the "cognitive ecology" of the classroom rather than impoverish it. By mapping current music applications through a synthesized framework, it became evident that many tools fail to address the embodied and non-binary dimensions of learning, often prioritizing technical efficiency over deep pedagogical relations. In contrast, the Strummin' Gym case study demonstrates how AI-assisted design can support teacher-led mediation, fulfilling the requirement for human-centred innovation grounded in distributed and mediated cognition. Ultimately, ensuring that AI strengthens understanding rather than displacing it depends on the teacher remaining the irreplaceable centre of the educational experience – the guardian of music as a living, relational art. The governance of educational AI must therefore remain a matter of public pedagogical responsibility, ensuring that technological tools serve inclusive, domain-sensitive aims rather than being redefined by private agendas.

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