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### *Prospects for Creating an AI System to Enhance Trumpet Learning*

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# Prospects for Creating an AI System to Enhance Trumpet Learning

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## **Abstract**

This article discusses the potential for artificial intelligence (AI) to be a learning resource in musical instrument pedagogy, particularly trumpet playing. The article reviews current research in this field, highlighting the need for new learning strategies and resources to address difficulties and improve learning outcomes. The methods used in this study include documentary research, participant observation, and exploratory preliminary research through interviews with experts in musical pedagogy. The article presents some results and principles that can be applied to designing new educational resources based on AI technology.

*Keywords:* AI, technology, digital learning, music learning, trumpet pedagogy.

## **Abstract (Spanish)**

El siguiente artículo analiza el potencial del uso de la inteligencia artificial (IA) como recurso de aprendizaje en la pedagogía de instrumentos musicales, particularmente en la trompeta. Se revisa el estado actual de la investigación en este campo, resaltando la necesidad de nuevas estrategias educativas y recursos para abordar dificultades y mejorar los resultados de aprendizaje. Los métodos utilizados en este estudio incluyen investigación documental, observación de participantes e investigación preliminar exploratoria a través de entrevistas con expertos en pedagogía musical. Finalmente, se presentan algunos resultados y principios que pueden aplicarse al diseño de nuevos recursos educativos basados en la tecnología de IA.

*Palabras clave:* IA, tecnología, educación digital, educación musical, pedagogía de la trompeta.

## **Introduction**

Musical teaching practices have undergone a relative transformation in the last 25 years. Although traditional methodologies prevail in teaching practice (Albert, 2023), new methodological strategies and learning resources from the basic education methodology or developments in music pedagogy research have been incorporated.

Increasingly, some researchers attempt to integrate scientific and pedagogical knowledge to achieve better learning outcomes in musical instrument students. Notably, a significant amount of research on the trumpet has been produced in our country since 2015 (Castiñeira et al., 2016; Albert, 2017). Most of this research has focused on the development of didactic strategies and learning sequences (Salmerón, 2016; Méndez 2018), specific exercises, and the design of theoretical models that describe the domain of the instrument (Albert, 2012) and expert motor performance (Albert, 2017).

Regarding learning resources (excluding practical exercises), research has been developed in the field of trumpet pedagogy from both trumpet manufacturers and pedagogues. Specifically, national research focuses on devices such as the UpSound (Castiñeira et al., 2016) and the ERpet (Albert, 2017). In musical instrument pedagogy, research has been conducted on using devices to improve study techniques, such as the traditional metronome (Bonus, 2021) and some that incorporate software that allows for tackling difficulties (Pitch shifter, n.d.).

Concerning these devices, there is also research on the use of the tuner, a digital device used to verify the tuning of an instrument (McCready, 2019), and some software that, by increasing possibilities, serves the same purpose.

The potential for an emerging artificial intelligence to contribute to music pedagogy was already explored three decades ago by Simon Holland (1989). Based on the technology available back then, he suggested using microworlds to tackle some difficulties a music student can face, especially in music composition. This approach could be rethought nowadays, considering the tremendous technological advancements in artificial intelligence, to develop a valuable digital resource for trumpet learning.

However, the field of artificial intelligence concerning music performance pedagogy still needs to be sufficiently investigated. Some resources concerning music expression and interaction (Kirke & Miranda, 2021) or deep learning sound synthesis (Huzaifah & Wyse, 2021) have been found but need more connection. A pedagogical model could organize these elements to serve the main objectives of trumpet learning, but it has not been found in the current research.

This topic is experiencing a significant increase in attention, particularly in the fields of cognition and language (Yang, 2022; Bozkurt, 2023), having great results in generating texts and graphic elements. A similar revolution is about to come in the field of music (Yu & others, 2022). If something similar happens to the area of graphic arts, these developments usually aim at generating their own audiovisual content and creations rather than building tools for human learning use.

The exploration of new learning strategies and resources continues to be necessary not only to update educational institutions with current technological resources but also due to the high dropout rate of students between professional and higher degrees (Lorenzo & Escandell, 2003; Ibañez, 2016). This dropout occurs for two reasons: the first one is related to vocational calling or career orientation. Besides, the dropout is also due to the fact that many professional degree students have not been able to acquire the necessary skills to continue studying for higher degrees with the expected performance.

Using new learning resources based on artificial intelligence could provide tools for addressing difficulties or offering greater confidence in developing the necessary instrument mastery profiles to continue studies.

## **Methods**

This study employed documentary research to understand the current state of the issue, including an analysis of existing literature on artificial intelligence and educational processes. Additionally, it has employed participant observation in the autobiographical method. Thus, personal experience is used to analyze the possibilities of AI-related resources as a trumpet teacher and the experience of learning to play the trumpet. This analysis establishes principles that can be

applied to the construction of new educational resources based on this type of technology, as presented in this article. To examine the use of new technologies, specifically artificial intelligence, exploratory preliminary research was conducted through interviews with experts in musical pedagogy, specifically in trumpet playing.

This information was combined using data analysis and synthesis processes to present some results.

They can serve as a starting point for the design of 1) surveys that can be widely applied in music conservatories, 2) interviews that can be applied to about 70 trumpet teachers in Spain, and, if possible, 3) the design of educational resources based on software and artificial intelligence.

## **Results**

The microworld approach proposed by Holland (1989) demonstrates, first and foremost, the longstanding interest in utilizing resources based on digital elements and formulas close to artificial intelligence in music pedagogy. Although it is a very old theory, it could serve as a cornerstone to articulate an enhanced model for trumpet learning. Bearing this in mind, we could develop several independent IA-based resources that stimulate different objectives of the trumpet teaching curricula.

According to Kirke and Miranda (2021), music expression is a highly complex skill to tackle from the AI perspective. However, there has been an improvement from the first MIDI synthesizers, probably because only popular music accepted the limitations of MIDI sounds.

The literature analyzed indicates that the current specific interest in the application of artificial intelligence is closer to the interaction with musical composition or elements of musical language (Kirke and Miranda, 2021).

The field of studying expression in machines was Computer Systems for Expressive Music Performance (CSEMP), which is active nowadays. In the same chapter, Kirke and Miranda propose a framework within CSEMP called Interactive Multiple Agent Performance (IMAP). It could be applied to develop expressive human-machine interactions in performance pedagogy.

Another use for the microworld approach would be synthesizing a sound for a given composition, excerpt, or exercise. That resource, proposed by Huzaiifa and Wyse (2021), could be a partial substitution for the teacher's modeling role during the study at home. This work shows an application as a learning resource that could be applied in the trumpet classroom.

Furthermore, it is essential to highlight the extensive use of some learning resources based on digital elements, such as the digital tuner and metronome, in the personal experience of the author of this paper as a trumpet teacher. The latter resource has been used for over 200 years in music pedagogy. This demonstrates the significance of utilizing external help during the learning process of musical instruments. Although these devices are being used, the utilization of additional software or AI observed in conservatories during the author's time as a student and currently among colleagues shows that the impact of these technologies on music pedagogy is still shallow.

Another aspect observed as a teacher is a lack of data on the time the student spends practicing at home has been observed, which would be very useful in learning. Thus, resources like sound synthesis could help students improve their playing by spending more time with a good model. Another helpful tool would stimulate expressive interaction, though it had to be human-machine.

However, in interviews with Dr. Albert (Albert, 2023a; 2023b), a problem with the educational philosophy involving machines has arisen: certain elements are inherent to music learning and performing, including human expression and communication. Consequently, this should be considered when designing an AI-based trumpet learning methodology. According to Albert (2017, 2023), it is necessary to provide precise theoretical models from the experience of trumpet pedagogy professionals for the categorized design of learning strategies based on AI. The practices that artificial intelligence promotes should always consider the intra and interpersonal aspects of music learning.

## Discussion

Through the course of this research, scientific interest in the field of music and artificial intelligence has been observed. Considering the significant impact that this technology is having on our society, it is worth considering its inclusion in the music education system. However, most of it focuses on analysis, composition, synthesis, and interaction, but they rarely do on music instruments teaching. Thus, a model that integrates AI resources is needed to develop these resources in the classroom.

A well-documented trumpet learning methodology has been found in the theoretical model that describes the domain of the trumpet (Albert, 2012) and expert motor performance (Albert, 2017). One of the main ideas of trumpet learning is that it happens in society, and it would lose sense otherwise. Thus, a virtual design of the learning of trumpet performance should always encourage group playing, as well as participation in the musical activity of the local area. This participation may include performing, organizing, or attending events as an audience (Albert, 2023a).

Another aspect that should be considered essential for trumpet learning is the development of metacognition. It is the only way for the student to thoroughly understand the skill she is acquiring and integrate it into the motor system. This skill can be trained with self-regulated exercises, where detecting a proper performance is more straightforward (Albert, 2023b).

This potential virtual resource could be organized using a taxonomy model to help determine the computer's job (Avanzini et al., 2020). That would be a practical way to apply the model of the domain for trumpet performance following Holland's microworlds concept. More concrete resources, such as sound synthesis or human-machine expressive interaction, can be added once this ground structure is settled.

## References

- Albert Gargallo, J. (2012). Una estrategia para el aprendizaje de la trompeta a través del estudio de la obra musical. <http://hdl.handle.net/10251/27608>
- Albert Gargallo, J. (2017). Dificultades de aprendizaje de la práctica motriz experta en la trompeta [Doctoral thesis, Universitat Politècnica de València]. <https://doi.org/10.4995/Thesis/10251/90538>
- Albert Gargallo, J. (2023a, March 4). Aprendizaje musical como elemento sociocultural: Ética y gestión emocional [Semi-directed interview by Carles Camarasa].
- Albert Gargallo, J. (2023b, March 6). Posibilidades de virtualización del modelo de dominio de la trompeta [Semi-directed interview by Carles Camarasa].
- Avanzini, F., Ludovico, L. A., Mandanici, M., & Baratè, A. (2020). A multidimensional taxonomy of digital learning materials for music education. In *Pedagogies of Digital Learning in Higher Education* (pp. 88-103). <https://doi.org/10.4324/9781003019466-5>
- Bozkurt, A. (2023). Generative artificial intelligence (AI) powered conversational educational agents: The inevitable paradigm shift. *Asian Journal of Distance Education*.
- Bonus, A. E. (2021). Maelzel, the Metronome, and the Modern Mechanics of Musical Time. *The Oxford Handbook of Time in Music*, 303.
- Castiñeira Ibáñez, S., Esteve Rico, J. C., Rubio Michavila, C., & Vera Guarinos, J. (2016). Análisis sobre el método tradicional de estudio de la emisión tonal con la secuencia boquilla-trompeta frente a la nueva propuesta metodológica upsound®-trompeta. *EuroRegio 2016*, 1-8.
- Holland, Simon (1989). Artificial intelligence, education, and music: the use of artificial intelligence to encourage and facilitate music composition by novices. PhD thesis. The Open University.
- Huzaifah, M., & Wyse, L. (2021). Deep Generative Models for Musical Audio Synthesis. In Miranda, E. R. (Ed.), *Handbook of Music and Artificial Intelligence* (pp. 639-678). Springer Nature Switzerland.



- Ibáñez Granados, D. (2016). Motivación, autoconcepto físico, evaluación de las competencias docentes y posibles causas de abandono en las enseñanzas básicas de danza en los conservatorios profesionales de Andalucía.
- Kirke, A., & Miranda, E. R. (2021). Performance Creativity in Computer Systems for Expressive Performance of Music. In Miranda, E. R. (Ed.), *Handbook of Music and Artificial Intelligence* (pp. 521-584). Springer Nature Switzerland.
- Lorenzo, S. & Escandell, M. O. (2003). El abandono de los estudios musicales en el Conservatorio Superior de Música de Las Palmas de Gran Canaria: la opinión de los profesores del Centro. *Anuario de Filosofía, Psicología y Sociología* (No. 6) pp. 101-116. [https://acedacris.ulpgc.es/bitstream/10553/3633/1/0237190\\_02003\\_0005.pdf](https://acedacris.ulpgc.es/bitstream/10553/3633/1/0237190_02003_0005.pdf)
- McCready, L. (2019). An examination of one-to-one technology applications and pedagogical strategies in a middle school music program (Doctoral dissertation, Indiana University).
- Mendez Besil, Jorge Jose. "La enseñanza de la trompeta mediante la implementación de mediaciones pedagógicas a través del uso de las TIC." (2018).
- Pitch shifter. (n.d.). Vocal Remover. Retrieved April 16, 2023, from <https://vocalremover.org/es/pitch>
- Rivera Salmerón, G. (2020). La pedagogía "Song and Wind" aplicada a la enseñanza de la trompeta: propuesta metodológica en programación didáctica de 6º EE. PP.
- Yang, W. (2022). Artificial Intelligence education for young children: Why, what, and how in curriculum design and implementation. *Computers and Education: Artificial Intelligence*, 3, 100061.
- Yu, X., Ma, N., Zheng, L., Wang, L., & Wang, K. (2023). Developments and Applications of Artificial Intelligence in Music Education. *Technologies*, 11(2), 42.