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Abstract

This paper addresses the ethics of the use of artificial intelligence in both trumpet pedagogy and research in this field. It investigates how AI can improve educational processes, observing the potentialities and risks, noting, in particular, the importance of ensuring that the introduction of this technology maintains the human and collective experience of music. Regarding research, the different opportunities offered by AI are observed, as well as the importance of preserving the integrity of authorship.

Keywords: AI in Music Education, Trumpet Teaching, Ethical AI Use, Personalized Learning, Human Interaction, Trumpet Learning.

Introduction

In recent years, artificial intelligence (AI) has been transforming various areas of society, including music education (Amin, 2024) and academic research (Nature, 2023). These technologies offer advanced tools that allow us to analyze learning patterns, thus offering more personalized educational experiences. Education research could also involve a paradigm shift, such as optimizing the wording of the text to improve clarity. This would be of particular interest to authors who publish in a language other than their mother tongue, as in the case of this article.

The pedagogy of the trumpet, including its academic research side, still seems to be a wasteland in the world of AI. For this reason, it has been considered appropriate to carry out this preliminary bibliographic review. The implementation of this new technology raises, however, several ethical questions. In this article, we will try to expose these conflicting points and the

solutions that seem to be taking shape to ensure responsible use, respecting the essential elements of the educational process, such as human interaction and artistic creativity.

One of the problems encountered by a first reflection on the use of AI in trumpet pedagogy is the problem of the de-individualization of educational processes. The debate is not new; several decades before the appearance of AI, John Dewey (1938), for example, stressed the social experience of education and the importance of interactions between participants in a learning situation. At that time, Dewey warned that any technology that reduced human interactions could limit the human learning process. On the other hand, Paulo Freire (1999) criticized approaches that understood the student as a passive recipient. He advocated a liberating education through which individuals develop critical thinking. Also, with the appearance of the first technologies applied to education, Ivan Illich (1971), a critic of institutionalized education, devised systems based on learning networks through communication technologies (of the time). The concerns and the opportunities projected for technologies by these pedagogues are especially relevant in the current context. Although the circumstances are highly distant 80 years after Dewey, it seems essential to consider the challenges faced in the history of education with the introduction of technologies.

AI can improve music education and significantly increase the number of people who learn music. At the same time that music teaching could be extended, AI seems able to individualize learning processes.

For example, in the field of music pedagogy, AI has proven to be a powerful tool for personalization, providing exercises adapted to each student's level and learning style, especially when integrated into learning environments such as Web 3.0. (Bamigbola, 2021). However, AI may also have the tendency to automate crucial aspects that currently require human interaction and guidance.

For example, in the case of the trumpet, AI's automation of assessment processes could limit the learner's ability to analyze technical progress and dynamically adjust (Camarasa Botella, 2023).

Some tools have facilitated the creation of individualized exercises that allow students and professionals to work with specific elements, such as tonality, tempo, and dynamics, without

needing prior advanced experience (Ye, 2020). However, this level of personalization must be carefully balanced with the preservation of expressiveness and creativity, essential elements in musical performance (Gouzouasis & Bakan, 2011).

This work also addresses the use of AI in musical research. Machine learning tools make it possible to quickly process large volumes of data, for example, by analyzing performance patterns from recordings (Lupker & Turkel, 2021). In some research, AI has been used to model musical perception, offering new insights into human perception. However, the use of these tools requires transparency in their application. This makes it essential that the ethical debate reaches both committees and participants. Only in this way can a clear understanding of the limitations and risks of such applications be proposed and unrealistic expectations avoided (Kirke & Miranda, 2021).

In terms of ethics, it is essential that clear limits and frameworks for the use of AI can be established to ensure that these technologies do not compromise the fundamental values of music teaching or music research. Some studies have pointed out that the integration of AI should focus on enhancing, and not replacing, human capabilities and promoting creativity and social interaction (Avanzini et al., 2020; Ye, 2020). AI can act as a complementary tool that enriches technical and artistic learning. However, it is the responsibility of educators to ensure that these tools maintain essential elements of the educational experience. Therefore, this article preliminarily explores a part of the scientific literature that allows us to observe the ethical implications of using AI in trumpet research and teaching.

Methodology

The methodology from which the analysis is based is documentary research. With it, a first approach is made to the scientific corpus related to the ethical and pedagogical implications of the use of artificial intelligence (AI) in trumpet teaching and research. The work seeks to establish a theoretical and conceptual basis for framing key debates and guiding future research developments.

This work has an informative nature. The initial approach identifies key concepts, trends, and tensions at the intersection between AI, musical pedagogy, and educational ethics. This review

will serve to implement a systematized bibliographic research methodology in later phases of the doctoral project and, in turn, to design trumpet teaching applications based on AI.

To carry out the analysis, the following axes were delimited:

- Ethics in the implementation of AI in educational processes.
- AI in the personalization of learning and its impact on instrumental pedagogy.
- Musical expressiveness and creativity in technology-mediated contexts.

A preliminary search was conducted in academic databases, selecting key publications in music pedagogy, applied artificial intelligence, and educational ethics. Peer-reviewed texts in these fields were prioritized.

The sources collected were critically analyzed to identify patterns, gaps in knowledge, and points of tension between technological automation and the core values of music education.

Grammarly is an online service that has been used for text correction as well as optimization to improve clarity in written communication.

Ethics of AI in trumpet teaching

We can understand by ethics, both in education and research, the principles and norms guiding actions and decisions within each context. In the educational field, ethics is related to respect for students as individuals, the teacher's professional responsibility, and the search for a fair and equitable learning environment. In research, ethics implies the integrity of the process of seeking knowledge, the quality of scientific communication, and the guarantee that the methodologies used are fair, transparent, and respectful of the rights of all parties involved.

From the perspective of contemporary educational philosophy, the concept of ethics remains a central pillar in the definition of pedagogical practices. According to recent research by (Bozkurt et al., 2023), new technologies in education, such as AI, should be employed to respect student autonomy and encourage active and critical learning. Regarding the teaching and learning

of the trumpet, this could mean that the use of AI should be aimed at enhancing the student's creative abilities, making sure not to impose limitations on their artistic development.

Avanzini et al. (2020), meanwhile, comment that any educational technology, including AI, must focus on preserving the relational nature of learning. This would imply that trumpet teaching should not depend solely on technological tools but continue to promote an environment where artistic expression and personal interaction remain fundamental. Thus, technology is prevented from automating learning processes that, at this time, require human emotional and artistic guidance.

Dehumanization of the educational process

In the field of trumpet, one of the most significant challenges of using AI is the risk of dehumanizing educational and artistic processes. Unlike human-to-human interactions, machines lack the empathy, intuition, and emotional adaptability that characterize music teaching. In trumpet teaching, expression and interpretation are crucial elements; therefore, relying excessively on AI could undermine the relationship between the teacher and the student (Camarasa Botella, 2023).

On the other hand, the risk of dehumanization is also reflected in the way AI could assess students' progress. Current AI algorithms focus on objective metrics, such as rhythmic accuracy or tuning. Therefore, they could overlook more subjective aspects of musical performance, such as expressiveness and creativity. These aspects seem too complex to be evaluated by an AI, and when it has to be done, it must necessarily establish clear parameters.

Another essential advantage of AI in assessment is its ability to offer continuous and dynamic feedback (Ye, 2020). This contrasts with traditional assessment methods, often limited to specific times such as exams or periodic reviews. With AI, students can receive assessments after each practice session, allowing them to adjust their performance more nimbly. By integrating AI into the assessment process, teachers can optimize the time spent on feedback, focusing on the areas where students need the most personal support. However, AI could offer assessments that do not conform to elements other than those stipulated, including the limitations discussed in the previous paragraph.

Therefore, AI must be potentially used in teaching the trumpet and, in general, music in a balanced way, complementing, but not replacing, human interaction.

Adaptation to teacher needs

AI's current ability to adapt to each teacher's individual needs is one of its most valuable characteristics in the educational field. AI could be used to develop personalized resources within each teacher's approach that fit these teaching styles. For example, AI can create sequences of exercises based on teacher preferences or suggest variations of the same exercise to adapt to the different skills of students (Rivera Salmerón, 2020).

However, this also poses significant challenges. The teacher must maintain control over the content and pedagogical approach. Teachers could lose some of their autonomy in creating educational materials by relying too much on AI. Teachers should use AI as a complementary resource rather than as a replacement for their teaching creativity.

For example, trumpet teaching usually uses diagrams to explain the correct embouchure and the tongue movements or the diaphragm. If these graphs are generated by AI without the supervision of a teacher, for example, in a delegated self-learning situation outside of class hours, errors could be introduced that would confuse students.

An example of positive use could be its use in the design of customized rubrics and evaluation criteria. AI could help teachers develop rubrics that align with the specific objectives of each course and each student's circumstances (Bozkurt et al., 2023). However, for all the above, the teacher should review this work to ensure that it includes other elements such as creativity, interpretation, etc.

Potential use of AI in the trumpet teaching process

Currently, the potential AI application within the trumpet class is minimal. Although we can imagine that it could be helpful in educational planning and even in the execution of classes and individual study, several limitations prevent its adoption in the musical learning environment.

Among these problems, we can highlight the lack of models that adequately integrate musical expressiveness and creativity (Bozkurt, 2023). Likewise, models capable of adapting AI to the individual variations and nuances that characterize musical performance have yet to be found.

We can describe some of the potentialities that an AI model specifically designed for trumpet teaching could have if some current gaps were addressed.

Artificial intelligence could enable comprehensive personalization of learning. It could adapt exercises to the needs and skills of each student in a reactive and almost immediate way. AI should be able to analyze student progress and adjust the content of lessons in the near future, providing activities and challenges that align with their level and learning style.

For example, the detailed audio analysis could allow both students and teachers to improve the quality of educational processes since the analysis of a class recording could allow evaluation of aspects that are not perceptible to the first ear during the class in real time.

These objective and quantifiable data could be helpful to complement teacher assessments if used correctly. In this way, the history of this data could help create individualized strategies for the student or even allow the learning of AI for other situations with other students.

This could contribute to students progressing at an appropriate, extremely personal pace. Thus, each student's progress could be much more fluid without stagnating in skills they already mastered or facing exercises that are too complex for their current level. All this could contribute to more efficient and motivating learning for the student.

As a complementary tool, AI could offer teachers a more personalized methodology, better ideas, and solutions to specific difficulties.

Using AI in the research process

Researchers from different fields highlight the importance of researchers being transparent about the use of AI in their studies (Bozkurt, 2023; Casal & Kessler, 2023; Friederich & Symons, 2023; Nature, 2023). It also urges researchers to ensure that the technology does not distort or oversimplify data or results.

That is why it may be interesting for a researcher attracted to the use of AI to reflect on the practical and ethical aspects of its use, its potential, and its limitations.

AI in research planning: objectives, questions, and methods

Artificial intelligence can be used in research planning. AI can help researchers define objectives, raise research questions, and suggest methods for addressing study problems.

On the other hand, using advanced AI models allows for the rapid analysis of large volumes of data and academic literature. All this facilitates the identification of existing gaps and the generation of new research questions. In terms of research objectives, AI tools can analyze patterns in historical data or trends in the literature (Friederich & Symons, 2023). This could help researchers refine and fine-tune their goals more precisely.

Despite this, using AI in research planning raises some ethical issues that must be considered. One of the main challenges, which also arises in other areas, is the lack of originality in the research objectives and questions generated by AI.

Learning AI and using existing data could lead researchers to ask research questions that simply repeat previous studies rather than bring genuine innovations.

Another problem could be the analysis of data that contributes to planning. Although AI models can analyze large volumes of data, they cannot understand cultural, historical, or social subtleties. These subtleties are often transcended to formulate relevant research questions and devise appropriate methods.

Once again, the concern about the possible dehumanization of the investigative process lies in AI's development of research questions. According to Kirke and Miranda (2021), this type of

automation could limit researchers' ability to think innovatively or question the underlying premises in a field of study.

Use during research

AI appears to be a valuable tool in the research's data collection and processing phase (Bozkurt, 2023). Advanced AI models, such as OpenAI's Whisper model, make it easy to accurately and quickly transcribe interviews.

By employing AI to transcribe interviews, researchers save valuable time and can focus on analyzing the data. However, it is essential that an exhaustive review of said transcripts be carried out to ensure that accuracy is maintained and that no errors are introduced (Casal & Kessler, 2023).

On the other hand, it is essential to consider using AI language models, known as LLMs (Large Language Models), to format transcripts. These models can help organize and format transcripts efficiently. They should also only be used under strict human supervision to prevent them from altering the original content.

Researchers should be aware of the current limitations of AI-based technologies in maintaining the quality of the data and its future analysis. Machine transcription can help, but the interpretation and final analysis of the data should be in the hands of the human researcher as they can understand the cultural and linguistic context of the responses. AI should not replace the critical judgment and attention to detail that qualitative research demands.

Use during drafting

This is one of the most controversial sections of the use of AI. Many researchers use AI-assisted writing today. It seems to allow for the optimization of time and the improvement of the coherence of texts. Tools based on language models can generate drafts that can speed up the writing process. However, there is an obvious ethical problem when these tools generate content that is not entirely original.

The basic problem, as in data analysis or questioning, is that AI cannot understand contextual subtleties during analysis, which could lead to misconceptions. In the same sense, the

great problem of using AI is addressed: the authorship of the generated content. Even if AI only assists in the writing to "guarantee" the quality of the text, it intervenes in the oral expression of the communicator and, therefore, interferes in a certain sense in the process. This interference affects both the intellectual merit and the responsibility of the arguments presented since the human researcher can assume forms of expression that are not his own and, therefore, do not emanate from the analysis itself.

Therefore, researchers must take full responsibility for the published content. According to Avanzini et al. (2020), AI cannot be considered a reliable source of information since it cannot understand a topic's full context or discern between different theoretical interpretations. Therefore, at least for now, its use should be limited to supporting tasks, such as spell-checking and assessing clarity. However, it should always remain the investigator's critical judgment.

Grammarly is one of the best-known tools that AI uses and is relatively accepted in the scientific community. These types of AI applications allow, as is the case in this paper, to improve the writing or translations of people who are not native speakers of the language of communication (Casal & Kessler, 2023).

Generation of images and graphics

Creating graphics and images through AI is an increasingly accessible option in research. However, the precision in the graphical representation could generate some problems in the complex diagrams required by the music.

Additionally, AI could generate images that do not reflect a particular research piece's cultural context or communication style. Instead of relying on AI to create graphics, it is preferable to use conventional methods that allow greater control over the accuracy of the content (Huzaifah & Wyse, 2021).

Search for solutions to limitations.

Chain-of-thought (CoT) thinking models are one of the significant innovations in the use of AI. These allow complex problems to be solved. Through it, it becomes feasible for AI to break down a problem into smaller, easier-to-manage steps. This facilitates the identification of problems

and their solutions. In trumpet research, especially in the study of trumpet teaching and learning strategies, breaking down a problem into multiple layers can help analyze, for example, technical difficulties or identify areas in which students need to improve (Kirke & Miranda, 2021).

In the relatively near future, CoT models could accompany researchers and teachers to better structure pedagogical problems. They could identify patterns in learning difficulties (among other aspects) and their solutions. This is due to AI's data analysis capability and data storage. For example, AI could store and analyze large amounts of data on students' motor skills or instrument proficiency (Albert Gargallo, 2017). With this, personalized exercises and strategies could be suggested in a specific area,

Even so, it should be noted that these models may have some limitations. AI could probably identify problems and suggest solutions, but human intervention will still be crucial to interpret the results correctly, apply the solutions, and evaluate the outcome. It is important to remember that music is a social activity and that this necessarily implies the development of social, inter, and intrapersonal skills (Albert Gargallo, 2017).

For all these reasons, AI should be seen as a complementary tool that will support research, in this case, pedagogical, but which cannot and should not replace either the researcher or the teacher.

Conclusions

The advent of AI has changed virtually all fields of human knowledge and experience, presenting many opportunities and significant challenges. Trumpet teaching and research in this field are not exempt from them.

Currently, AI can act as a support resource to facilitate the drafting processes, offer some ideas, provide structuring and coherence, etc. However, authorship can be compromised in the very essence of the relationship between knowledge and researcher. Therefore, this affects the structures of this knowledge and how it is communicated. It consequently presents an epistemological problem that, insofar as it can change the practical reality of education, for example, generates an ontological conflict of its own.

For example, excessive written communication mediated by AI could generate excessively unitary, not to raise criticism. It could tend to dilute the personality of the researchers and, with it, dehumanize their own knowledge. When these processes are carried out in educational research, for example, with the social and human characteristics of the object of research (trumpet learning), an unethical application of AI will lead us to modify the results of said research substantially.

On the other hand, in the future, models such as Chain-of-thought can improve the optimization and personalization of learning. This will help teachers identify complex problems, which may contribute to offering new solutions and improve attention to learning difficulties in some aspects. However, it will be essential to consider the ethical implications at all times and, once again, maintain the social and human experience of music learning.

That is probably the most considerable risk: the dehumanization of the educational process. In an educational field where human expression is so essential, AI should not replace a human teacher's emotional and artistic guidance. Therefore, finding the balance between the potential use of technology and human interaction will be essential to preserve the quality and richness of musical learning.

Therefore, it is recommended that both researchers in the trumpet field and teachers develop their own ethical criteria around the use of AI and that the trumpeter collective carry out, as discussed in this text, a collective discussion on the subject.

The authors of this paper are currently working on designing AI educational applications using the criteria expressed in this document.

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