Per Musi

eISSN 2317-6377

Music education and digital culture: interaction of integrative thinking and creative technologies

Educação musical e cultura digital: interação do pensamento integrador e das tecnologias criativas

Olha Shcholokova[1] ***Alla Skopych***[1] ***Nataliia Zhurska***[1]
olha_shcholokova@edu-iosa.org

Leonid Khomenko[2] ***Tetiana Rastruba***[3]

[1] Dragomanov Ukrainian State University, Department of Piano Performance and Art Pedagogy, Kyiv, Ukraine
[2] Ukrainian National Tchaikovsky Academy of Music, Department of Theory and History of Culture, Kyiv, Ukraine
[3] Nizhyn Mykola Gogol State University, Department of Vocal and Choral Skills, Nizhyn, Chernihiv Region, Ukraine

SCIENTIFIC ARTICLE
Section Editor: Fernando Chaib
Layout Editor: Fernando Chaib
License: "CC by 4.0"

Submitted date: 30 apr 2025
Final approval date: 19 may 2025
Publication date: 05 jun 2025
DOI: https://doi.org/10.35699/2317-6377.2025.58891

ABSTRACT: The aim of the study is to analyze the impact of a digital learning environment on students' motivation, engagement, and creativity in music education, focusing on the implementation of digital tools in music education. The research methodology includes a survey of 100 music teachers, five focus group interviews and an experimental study with 81 students divided into three groups using of interactive, project-oriented, and blended learning models. The results show that the use of digital platforms increase student motivation, digital competence, and music performance. The study offers methodological recommendations for integrating digital technologies into music education.
KEYWORDS: Music education; Digital culture; Integrative thinking; Creativity; Pedagogical innovations.

RESUMO: O objetivo do estudo é analisar o impacto de um ambiente de aprendizagem digital na motivação, envolvimento e criatividade dos alunos no ensino da música, centrando-se na implementação de ferramentas digitais no ensino da música. A metodologia de investigação inclui um inquérito a 100 professores de música, cinco entrevistas a grupos de discussão e um estudo experimental com 81 alunos divididos em três grupos, utilizando modelos de aprendizagem interactiva, orientada para projectos e mista. Os resultados mostram que a utilização de plataformas digitais aumenta a motivação dos alunos, a competência digital e o desempenho musical. O estudo oferece recomendações metodológicas para a integração das tecnologias digitais no ensino da música.
PALAVRAS-CHAVE: Educação musical; Cultura digital; Pensamento integrador; Criatividade; Inovações pedagógicas.

1. Introduction

In the twenty-first century, digital technologies are a determining factor in socio-cultural development, changing communication, learning, work, and creativity. Digitalization has affected almost all spheres of human life, including music education (Karanfiloğlu and Akın Bulut 2025). On the one hand, the digital environment opens up new opportunities for the integration of knowledge, the realization of the creative potential of the individual, and the development of creative thinking (Sinaga 2025). On the other hand, it gives rise to numerous risks associated with the transformation of human essence, the replacement of creativity with imitation, and the development of digital thinking, which is not always humanistically oriented (Vargas-Murillo *et al.* 2025). In this regard, there is a need to understand the interaction of music education and digital culture as a complex, multidimensional, and dynamic process.

As a form of spiritual and aesthetic activity, music is a unique phenomenon that accumulates emotional and value meanings, interprets cultural heritage, and projects the ideals of the future (Zicari and Biasutti 2025). Therefore, in the context of digitalization, music education seeks to preserve and transmit the emotional, sensual, and spiritual components of culture. In this sense, music education facilitates integrating traditional and innovative, rational and sensual, individual and collective elements. Modern music education is undergoing a period of profound transformation driven by the rapid development of digital technologies and the formation of a new digital culture. These changes open up opportunities for creative self-realization, personalized learning, visualization of complex musical concepts, development of remote interaction, creation of interactive content, implementation of project-oriented forms of work, and modelling of professional environments. Novel digital platforms and online services (for example, Google Classroom, Microsoft Teams, Soundtrap, MuseScore, Flat.io, Moodle, etc.) provide organizational and methodological support for music teachers.

Thus, the effective integration of technological tools into the traditional music education system requires an interdisciplinary approach that combines pedagogy, creativity psychology, and digital technologies (Richardson and Milovidov 2019). They help visualize music and develop students' cognitive and communication skills. These digital platforms diversify teaching methods, increase student motivation, and make education more accessible. Despite the obvious advantages of digital transformation, the integration of information technologies into music education is associated with a number of challenges. One of the key problems is the gradual desensitization of creativity, including the loss of the sense of real sound, live communication, and emotional empathy. Moreover, the introduction of artificial intelligence into the educational and artistic process that can imitate human creative activity, for example, composing music, creating arrangements, and even performing works. In this context, a number of questions arise: what is a true creative act? Can an algorithm replace an artist? Where is the line between inspiration and simulation?

In this context, studying the phenomenon of integrative thinking as a key cognitive ability that ensures the synthesis of heterogeneous experience, a combination of emotional and rational, figurative and abstract, individual and collective in the process of creativity is particularly relevant. As a cognitive strategy, this type of thinking is a basis for flexibility, adaptability, ability to express and interpret ideas in a changing digital context (Burke *et al.* 2025). Consequently, there is an increasing academic focus on the multifaceted and reciprocal relationship between music education and digital culture. Its comprehension requires an interdisciplinary approach, a combination of pedagogy, cultural studies, philosophy, art history, and technology. This article discusses the opportunities, challenges, and prospects of integrative thinking and

creative technologies in music education, taking into account the needs of forming a modern musician as a thinking, creative and adaptive personality.

The relevance of the study is stipulated by the need for a systematic analysis of current trends in digital music education in the context of the transformation of educational practices based on the interaction of traditional and innovative approaches. In this regard, it important to consider the impact of a digital learning environment on the development of students' musical thinking, creativity, and independence, as well as on improving the learning efficiency. The aim of this article is to study the impact of digital technologies on music education in the context of digital culture. Accordingly, the following research objectives are set: to study the specifics of cultivating students' integrative thinking via digital educational platforms; to identify effective practices and methodological solutions; and to justify the feasibility of using the latest tools in the pedagogy of creative activity.

To achieve the aim and objectives, the article adopts a comprehensive approach that combines the analysis of academic sources and a survey of art school teachers' experience working with digital platforms. An emphasis is placed on the study of digital platforms used to create music by students. Thus, the study contributes to establish a methodological basis for the effective implementation of digital technologies and support the development of pedagogical strategies aimed at cultivating students' integrative thinking and creativity. The practical significance of the study is that it offers specific tools for updating music education to the requirements of modern digital society. This study focuses on the context of Ukrainian music education institutions and covers the period from September 2023 to May 2024. This timeframe encompasses the introduction and evaluation of digital tools in music teaching in contemporary educational settings. By delimiting the geographical and temporal coverage, this study offers a clearer picture of the digital transformation in music education that is specific to the Ukrainian educational and cultural landscape.

2. Literature Review

Contemporary music education is at the crossroads of traditional pedagogical approaches and digital innovations, which creates new opportunities and challenges for researchers and teachers. Modern research in music education focus on the transformative impact of digital technologies on educational strategies and students' creative development in terms of developing civic, creative and interdisciplinary competences. Thus, Vargas-Murillo *et al.* (2024) analyze educational approaches and digital tools used over the past decade to develop key skills of the 21st century. Ma and Wang (2025) point out the growing interest of researchers in the intersection between music, education, and digital transformation, as well as the need for a theoretical systematization of pedagogical models in music education. Burke *et al.* (2025) argue that combining traditional pedagogy with digital innovation fosters creative self-realization, though they lack a clear framework for measuring competence growth. However, these works focus on institutional readiness without addressing disparities in digital literacy across socio-economic or geographic contexts.

Furthermore, some scholars study digital competences of teachers and students. Martzoukou *et al.* (2020) identify an alarming trend - only 30% of music teachers have sufficient skills to use specialized platforms effectively. Ovcharuk *et al.* (2020) emphasize the importance of systematic teacher training, but their findings are limited to the experience of European countries, which significantly limits their applicability in regions with limited access to technology. It is also important to note that Richardson and Milovidov (2019)

concentrate on subjective surveys that do not take into account cultural and socioeconomic factors that significantly affect the process of adopting digital tools.

The integration of gamified elements into music education has been analyzed by Tejada et al (2024). Authors argue that the integration of electroacoustic music and digital competences into the educational process stipulates the development of future teachers' creativity. They emphasizes the importance of creating a pedagogical space where digital media and creativity become a means of personal and professional growth. Similar ideas are developed by Saether *et al.* (2018), who underline the importance of media education in establishing a new model of musical thinking based on the integration of sound, technology, and cultural reflection.

King and Himonides (2016) focus on the technical aspects of using digital technologies in music education, including digital image, sound processing, visualizing musical structures, and creating new forms of artistic thinking. At the same time, Revenko (2021) outlines Web 2.0 as a musical culture environment where learning takes the form of flexible dynamic interaction. The researcher explains that Web 2.0 technologies (for example, social media and blogs) not only enable communication, collaboration and co-creation but also sharing of music content in a social-media-driven space. As a result, learning in this context is no longer static; rather, it is participatory and evolves through shared experiences. Apart from that, Guzmán (2021) and Zhang (2022) emphasize the connection between music, technology, science, and innovation. They assert that the integration of information technology into school music education stimulates the development of students' creative thinking and supports their ability to express their emotions in the digital space. However, empirical methods in these studies are often limited to self-report data, with little triangulation or longitudinal validation.

The historical and pedagogical context is studied by Swanwick (2008) and Teachout (2014), who analyze changes in the content and methods of training future music teachers. They prove that a balance between the traditional performing school, and modern digital practices is fundamental in the context of an educational paradigm shift in the teacher's professional identity. Furthermore, Pranay (2025) explores the current state of music education and creative technologies within the regional aspect, focusing on adapting global technological trends to local educational realities.

However, the analysis of the literature reveals significant gaps, namely: insufficient research of the long-term impact of digital technologies, the lack of unified criteria for evaluating effectiveness, and the insufficient attention to age characteristics and the cultural context of technology integration. Therefore, while the existing literature supports the transformative potential of digital technologies in music education, it remains fragmented. In this regard, there is a lack of standardized metrics to assess the effectiveness of digital tools in music education. Studies often rely on short-term interventions and unsystematized data, leading to questions about long-term impact. Moreover, the accessibility for students with special educational needs or the integration of neuroscientific approaches is also undeveloped. Structured categorization and critical synthesis, as applied here, are essential to advance an integrated theoretical and practical understanding. Future research should aim to develop comprehensive models that take into account the emotional, cognitive, and technological dimensions of music learning. Therefore, the article highlights promising areas for further research such as the development of integrated models that combine cognitive, emotional, and technical aspects; the study of the impact of AI on creativity; the adaptation of

technologies for students with special needs; and the integration of neuroscientific methods into the study of creativity in the digital environment.

3. Methodological Framework

In this study, integrative thinking is regarded as a cognitive ability to synthesize knowledge from different fields (music, digital technologies, cultural studies) in creativity. Accordingly, the following five indicators were used to measure it: 1) the quality of interdisciplinary student projects, assessed by the criteria of originality, integrity, digital skills, and theoretical soundness; 2) the success of creative tasks completion that involved a combination of musical and non-musical elements 3) students' self-assessment of their ability to integrate different knowledge and experience; 4) standardized teachers' observations during classes to assess interdisciplinary thinking; 5) the analysis of the dynamics of the questionnaire results before and after the experiment. This multi-level approach helps define the development of integrative thinking as an educational outcome of music education in the digital environment.

The study of the interaction between music education and digital culture with a focus on integrative thinking and creative activity technologies was based on an interdisciplinary approach that combines pedagogical, cultural, historical, art, and technological perspectives. The methodological basis of the study was a synthesis of qualitative and analytical methods, as well as elements of comparative analysis of modern educational practices.

The application of this methodology allowed for a deep and comprehensive study of the interaction between music education and digital culture in terms of integrative thinking in creative technologies. The theoretical basis of the study consisted of digital pedagogy, methods of integrating technology into art education, and using gamification in music education. Moreover, a systematic review of academic literature was conducted, including articles, monographs and conference proceedings dwelling upon integrative thinking in art and education. The empirical basis of the study was the integrated approach that combines theoretical analysis of academic literature with empirical study of using digital technologies in music education. The reliability and validity of the study was ensured by the use of validated data collection tools, such as a survey, and data triangulation. When studying the methodological features of using the digital learning environment in music education, an experimental test of digital platforms usage in teaching art was carried out.

The survey was aimed to establish how different organizational approaches to integrating digital resources into music education affect students' motivation, engagement, performance and development of digital competencies. It was also used to define the role of digital tools as a means of cultivating students' integrative thinking and creative potential. All participants of the study provided informed consent to participate in accordance with the ethical standards of research. The survey involved 81 students aged 13 to 17. These students were divided into three experimental groups (27 students in each), each of them corresponding to a different learning model: interactive, project-based, and blended learning. This age range corresponds to secondary and upper secondary music education.

The first group worked by an interactive learning model that involved the use of online platforms, including Google Classroom, Kahoot!, and Soundtrap. Participants completed interactive exercises, took tests, participated in quizzes, and solved creative tasks. The main goal of the interactive approach was to ensure a high level of student engagement in the learning process through instant feedback and emotionally charged

interaction with the learning content. The second group functioned as part of project-based learning. Students completed creative tasks in the format of projects such as creating digital arrangements, visualizing sound images, and preparing presentations that integrated knowledge of music history, cultural studies, and technology. Digital tools such as Flat.io, Canva, Trello, and MuseScore were used by this group. The third group studied under a blended learning model that combined traditional forms of teaching with the use of digital educational resources. In the learning process, e-textbooks, multimedia presentations, remote assignments on the Google Classroom platform, video analysis of educational material, and individual work with digital notes were used.

A mixed-methods design was implemented to evaluate the effectiveness of different learning platforms and strategies. Quantitative data were obtained from pre- and post-experiment surveys, descriptive statistics, and comparative assessment of students' learning outcomes. Qualitative findings were derived from focus group interviews and teachers' observations. The experiment lasted for six weeks and involved recording the dynamics of the following parameters: the level of success and mastery of music theory; the evolution of digital skills (working with a music editor, audio processing, and presentation of a creative product); students' activity and involvement during classes; students' attitudes towards digital learning in a musical context; motivation to further use digital tools in creative activities. Before the experiment began, a baseline survey was conducted to determine the basic level of digital awareness, attitudes towards music education in the digital environment, and experience of using specialized platforms. The students' learning activities were monitored, their achievements were recorded, and the dynamics of their progress were analyzed. At the end of the cycle of lessons, a final survey and comparative analysis of the results were conducted.

The information base was comprised of the results of an online survey of 100 music teachers from art schools and higher education institutions of Ukraine, selected according to the criteria of professional experience (5 years or more) and experience with digital tools (at least 2 years). Semi-structured interviews with teachers were conducted to explore the specifics of teaching music with digital tools. The survey was conducted between September 2023 and May 2024. This combination of methods facilitated obtaining statistically significant data. The obtained data were processed, using descriptive statistics, correlation and regression analyses. The online survey included a 5-point scale assessment of the effectiveness of various digital platforms, identification of difficulties in their use, and analysis of professional development needs. For an in-depth study of the issue, 5 focus group interviews were conducted (8-10 participants each) to identify the subjective experiences of teachers, analyze specific cases of technology use, and receive practical recommendations.

In addition, general scientific methods of logical analysis, induction, deduction, generalization, and systematization were applied. All ethical principles of the study, including voluntary participation, anonymity and confidentiality, were strictly observed. The proposed methodological approach helps obtain representative data that combines quantitative indicators with a qualitative interpretation of pedagogical practices in the context of digitalization of music education.

4. Results

4.1. Digital platforms in music education: strategies and effectiveness

Digital learning environments have gradually become a key component of the music educational ecosystem where the combination of traditional performance, theory, and composition with innovative tools enriches teaching methods (Martzoukou *et al.* 2020). Given the music specifics, the effective implementation of digital technologies requires a rethinking of pedagogical approaches that would ensure a high level of learning and develop students' creative potential. In the context of digitalization, the combination of individualized and project-based learning, in which the digital learning environment plays the role of an integrative platform for practice, reflection and artistic experimentation, becomes especially relevant (Ovcharuk *et al.* 2020).

As a result of the survey conducted among art teachers and students, the effectiveness of using various digital platforms in music education was assessed. The focus was on such aspects as the usability of the platforms, the impact of digital environments on students' motivation, their involvement in the creative process, and their music perception level. Respondents were asked to rate a number of platforms adapted for the educational process (Google Classroom, Microsoft Teams, Moodle), specialized music platforms (Soundtrap, Flat.io, MuseScore), interactive tools (Kahoot, Quizizz), and messengers (Telegram, Viber, WhatsApp) as elements of a modern digital environment for music education on a five-point scale, where 1 means "unsatisfactory" and 5 means "excellent". The assessment was carried out both by teachers (in terms of organizational and functional characteristics) and by students in the context of their motivation and music perception level. The data was collected through a questionnaire for music teachers and focus group interviews with art school students, which allowed for a comprehensive assessment of the impact of digital tools on learning.

The results showed a significant relationship between the availability of digital content, the level of interface convenience of the platforms, and the level of emotional and cognitive engagement of students in learning. It was observed that digital technologies improved communication between students and teachers, promoted independent work and critical reflection on musical material, and cultivated interdisciplinary skills necessary in the context of modern digital culture. The study results indicated a significant role of digital platforms in organizing learning and developing creative skills and integrative thinking. The analysis of the responses of music teachers identified the main areas of digital platforms use in music teaching. Thus, 74% of respondents indicated that they used platforms for the structured presentation of material, 58% of teachers applied them for knowledge control and assessment, while 46% participants resorted to digital tools for project work, for example, the creation of digital musical compositions, score analysis, and interaction in online groups.

Music teachers highly rated Google Classroom (average score – 4,5), emphasizing its intuitiveness, speed of uploading materials (sheet music, audio files, performance videos), the ability to communicate with students, and integration with other Google products. The students who used Google Classroom in their music classes rated their motivation at an average of 4,6 points and their understanding of the material at 4,5 points. They noted that convenient access to learning materials and the opportunity to interact with teachers and peers helped increase their interest in creative activities. Despite its functionality, the Moodle platform received a lower score of 3,8. According to respondents, the main disadvantages of this platform

are the complexity of navigation, the need for additional training, and the time required for setup. This, in turn, affected students' motivation, with the average level of motivation being 3.9. Students' also indicated difficulties in navigating the learning blocks, which made it difficult to complete tasks and master the material, particularly when learning complex musical forms and analyzing harmonic structures.

The experience of using Edmodo was interesting, with an average score of 4,0. The platform proved useful for messaging and document sharing, but limited features for assessing and managing music projects reduced its overall effectiveness. Students highly appreciated the ability to communicate (motivation – 4,2; understanding of the material – 4,1) but noted that the lack of multimedia and interactive elements reduced their interest in completing tasks. Microsoft Teams was recognized as an effective tool for creating a learning space with advanced collaboration features. The average rating for the platform is 4,4. It was noted that it was convenient for conducting online classes, sharing music and videos, and working together on music projects through integration with OneNote, Excel, and Word. At the same time, some teachers noted the difficulty of mastering the interface for users without prior training.

Furthermore, interactive platforms with gamification elements, such as Kahoot and Quizizz, were praised for their ability to stimulate learning motivation, especially in the context of theoretical subjects (solfege, music literacy, music history). Kahoot received a 4,5 rating because this platform proved to be effective in creating quizzes that diversified lessons and promoted emotional engagement of students in learning. However, some respondents noted that its functionality was limited in terms of analyzing learning outcomes. Having an average score of 4,3, Quizizz allowed students to work at their pace, ensuring a personalized approach to learning. Teachers noted the usefulness of the detailed statistics for lesson planning although some of them faced technical difficulties. In addition, the Zoom platform was used to give video classes, receiving an average score of 4,0. Despite high-quality video broadcasting and the function to record classes, the platform was less effective in interactive interaction as it required additional integration with other digital resources to implement music projects or creative tasks.

In addition to general-purpose platforms for managing the educational process, an important component of the study was to examine the effectiveness of specialized digital music tools focused on the creative activities of students. The analysis of the survey results on the use of Soundtrap, Flat.io, and MuseScore platforms revealed the key advantages and challenges of their use in music education. Thus, the Soundtrap platform, which functions to create, record, and edit music in the cloud, was used as part of a project-oriented approach. Students created musical compositions and experimented with arrangements, electronic instruments and effects independently or in small groups. According to the survey, the average level of satisfaction with the functionality of Soundtrap was 4,6 points, the motivation of students for creative work was 4,7, and the level of assimilation of digital recording techniques and basic composition techniques was 4,5. Teachers noted that this platform stimulated the development of interdisciplinary thinking as it combined the elements of music theory, sound engineering, technological literacy, and team work.

Flat.io is an online service for creating musical scores, which allows students to edit musical works in real time with a teacher or classmates. The platform was highly appreciated in terms of forming notes recording skills and understanding a piece of music structure. The average performance rating by the criterion of educational value was 4,4, while by the convenience of the interface it was 4,2. The students noted that the possibility of instant listening to the written fragment facilitates understanding harmony and rhythmic structure. Teachers, in turn, pointed to the potential of Flat.io in the integrative thinking formation through

the involvement of students in the analysis and editing of classical and modern works. MuseScore is another popular free software for creating notes. It has more functionality compared to Flat.io, including importing and exporting files in various formats, adding dynamics and articulation, etc. MuseScore received an average rating of 4,5 from the surveyed teachers, while students rated usability at 4,3 points. At the same time, about 20% of participants pointed out the complexity of the platform use. However, after training, most students showed significant improvement in understanding musical language and in creating scores of different levels of complexity.

A visual overview of the platform evaluations is provided in Figure 1. It shows the average scores given by teachers (for usability and pedagogical effectiveness) and students (for motivation and understanding). It is notable that Soundtrap and Google Classroom received the highest scores for student engagement and teacher approval, while Moodle received relatively lower scores across the board.

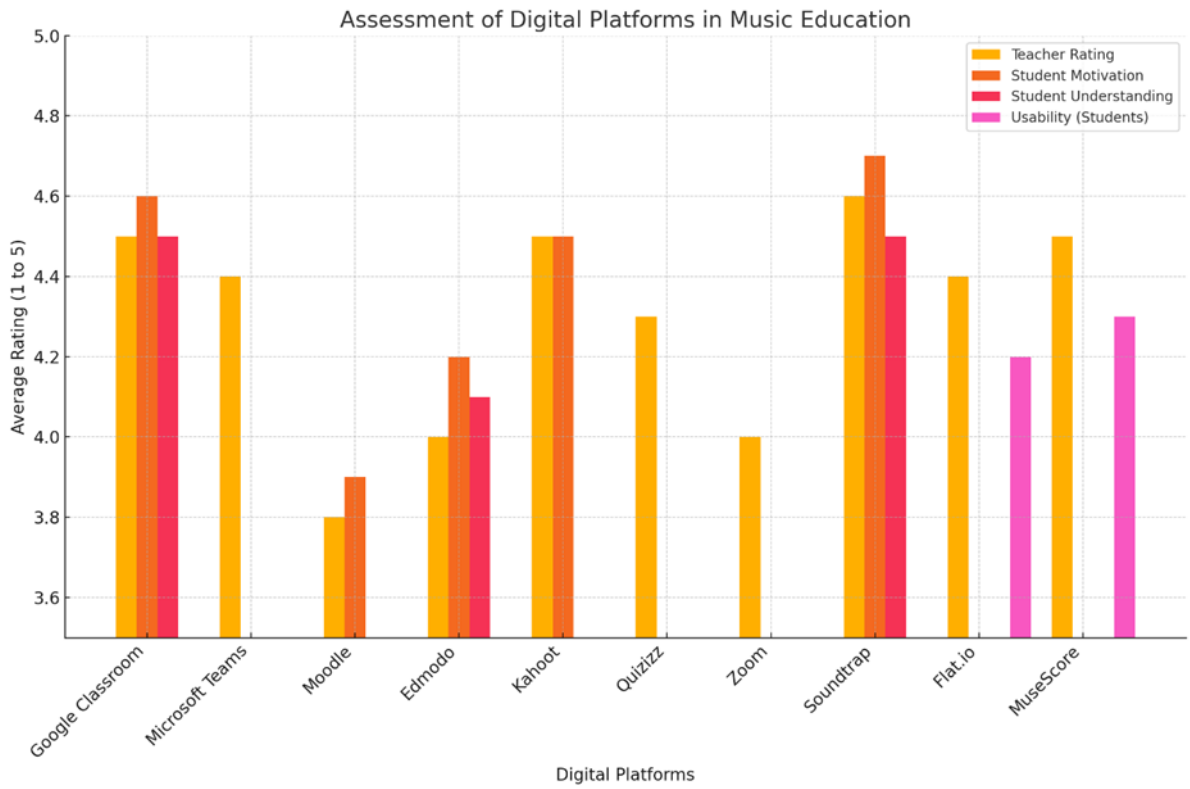

Figure 1 – Assessment of digital platforms used in music education
Reference: authors

Hence, in addition to improving technical skills in digital music, these platforms have a powerful motivational effect. In this regard, students noted that the ability to create their music, store it, share it with others, and receive instant feedback from the teacher or classmates was an important factor in emotional involvement in music learning. Within the integrative paradigm of modern education, these platforms implement the principle of learning through creativity, which is key for the development of competencies of the 21st century.

The study results indicate that the effectiveness of digital platforms in music education depends on the balance between functionality, accessibility, interface convenience, and the possibility of organizing interactive creative activities. The most positive results were observed when using platforms that combined technical simplicity with the ability to host multi-component multimedia content such as notes, audio, video, tasks and feedback. Meanwhile, specialized digital musical tools provide flexibility, personalization and

creativity in the educational process. In addition, they create conditions for the development of students' innovative thinking in a digital culture.

4.2. Organizational conditions for the effectiveness of the digital learning environment in music education

Regarding the impact of digital technologies on music education, the analysis of organizational conditions ensuring the effective implementation of interactive, project-oriented, and blended learning models is important. As part of the experimental implementation of the digital learning environment in art teaching, three approaches to the educational process organization based on specialized platforms (Soundtrap, MuseScore, Flat.io) and general digital tools (Google Classroom, Moodle, Canva, Google Slides) were tested (Figure 2).

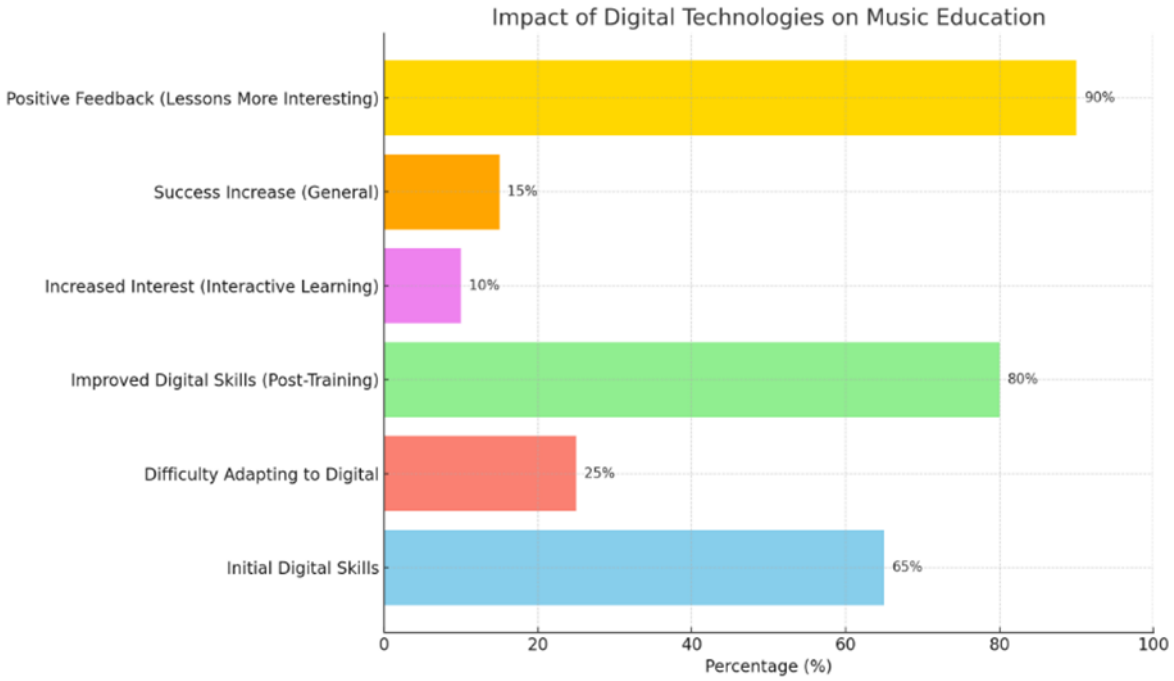

Figure 2 – Impact of digital technologies on music education
Reference: authors

The initial survey showed that only 65% of students had a basic level of digital skills, while 25% had difficulty adapting to work in a digital environment. This necessitated the phased introduction of digital platforms and a differentiated approach to learning. The group working by the interactive learning model showed a 10% increase in interest due to the use of quizzes, visualizations, online tests, and creative exercises on digital platforms. Students noted that digital tasks made learning theoretical concepts more visual and dynamic. In contrast, the project-based learning group demonstrated the growth of independence, creativity, and critical thinking through the creation of digital music (presentations, scores, and arrangements). This group achieved the highest results in the visualization of musical ideas and team interaction. The blended learning group was characterized by a high level of adaptability. In other words, combining traditional teaching with digital content improved the preparation of students and increasing their motivation.

All three groups showed an increase in digital literacy. Thus, after completing the class cycle, more than 80% of students rated their digital skills as medium or high. There was also an increase in success by 10-15%, which indicated the effectiveness of combining digital platforms with artistic content. There was an increase in the ability to use digital tools to implement creative ideas. For example, students actively used Soundtrap to create electronic compositions, MuseScore to notate, and Flat.io to collaborate on scores.

Organisational conditions that were introduced within the experiment ensured the consistency and transparency of learning. Students received access to educational materials, schedules, instructions and feedback from teachers via Google Classroom. Moodle acted as a hub for hosting theoretical resources, while Canva, Trello, and Google Slides became mediums for cross-subject music projects. Such an environment made it possible to manage learning, organise teamwork, and provide feedback. It is important that the digital learning environment was formed taking into account the age characteristics and creative potential of students. The creation of individual and group projects using digital tools cultivated self-study skills, creativity, and visual literacy. Students expressed a desire to continue using digital platforms for music creativity. Meanwhile, 90% of respondents noted that digital technologies made lessons more interesting, understandable, and emotionally rich.

Thus, the experiment confirmed that the organisational conditions of the digital transformation of music education should be based on innovative approaches to teaching, flexible digital infrastructure and a holistic pedagogical strategy that combines traditional and technological elements. This increases the effectiveness of training and creates conditions for the realisation of the creative potential of students in a digital culture.

4.3. The effectiveness of digital tools in music education: an analysis of the teachers' experience

The study analyzed the experience of music 100 teachers who introduce digital technologies into learning in art schools. The survey goal was to identify the key factors affecting the effectiveness of the use of the digital learning environment in music education and identify the obstacles and needs faced by teachers during digital transformation (Figure 3).

Figure 3 displays that a significant proportion of teachers (over 75%) stressed the importance of the availability of digital tools and their ability to ensure interactive learning. Platforms with a simple and logical interface that support multimedia content (notes, audio, video) facilitate a more effective organisation of lessons in music and theoretical disciplines, solfeggio, composition, and music history. It was also found that a significant proportion of students (according to the answers of teachers) respond positively to interactive elements, such as video fragments of concert performances, built-in surveys, creative forums that stimulate students' interest and increase the assimilation level of the material.

Special attention was paid to the use of instant messengers (Telegram, Viber, WhatsApp) for extracurricular work. The highest efficiency in musical learning was shown by Telegram, which, according to respondents, provides the possibility to create structured channels, joint chats for discussing works, exchanging notes and recordings, and conducting surveys on repertoire or tasks. Viber and WhatsApp were believed to be inferior in the convenience of organising an educational space and the speed of access to materials. The use of instant messengers in teaching and learning y improves communication and forms a responsible attitude towards the independent work of students.

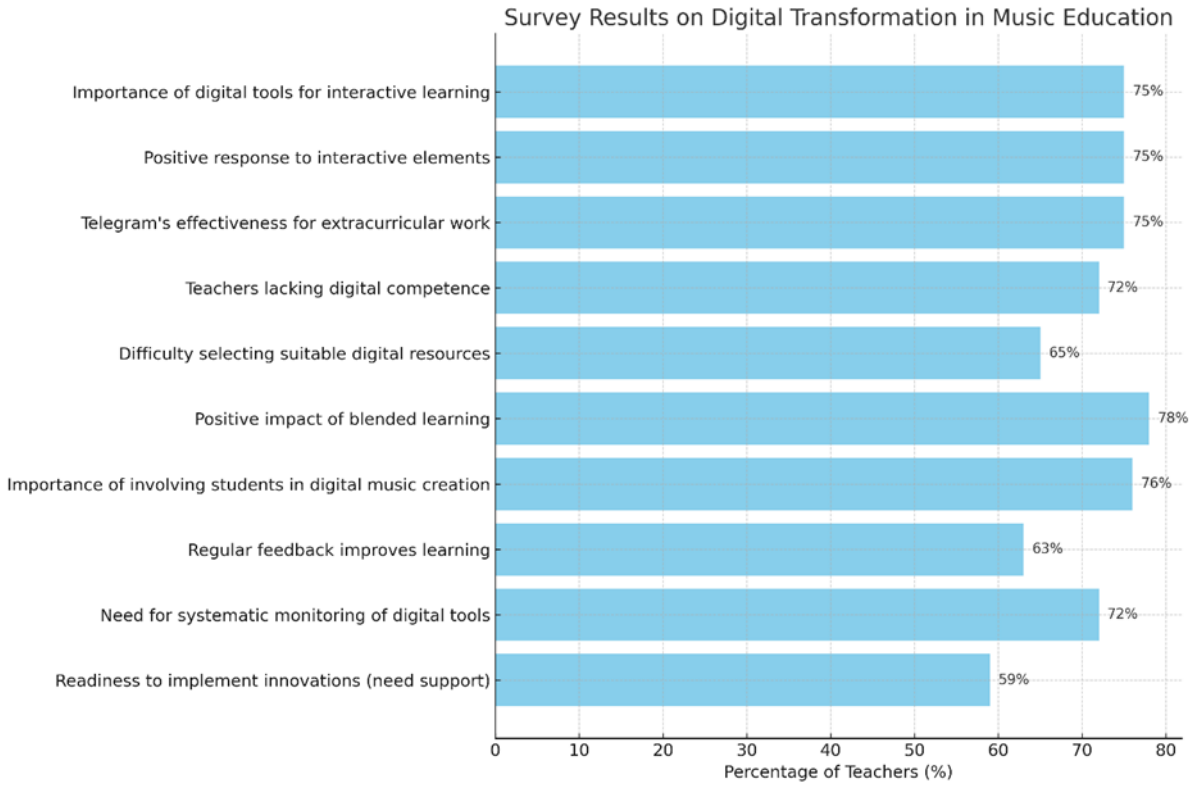

Figure 3 – Survey results on digital transformation in music education
Reference: authors

The survey results also showed the urgent need to increase teachers' digital competence. 72% of teachers indicated that they lacked the knowledge of digital technologies necessary for effective teaching using Soundtrap, Flat.io, MuseScore, Google Classroom, Microsoft Teams platforms, etc. In this regard, it is essential to organise trainings, seminars and webinars on mastering the tools of digital pedagogy. Enhancing teachers' digital literacy will improve the learning quality and activate students' creative potential through the use of digital means. An important challenge for teachers was also choosing suitable digital resources. 65% of respondents faced difficulties in selecting high-quality, pedagogically relevant content for working with music. The creation of a national or institutional catalogue of reliable resources for music education was proposed, covering at least 50 platforms and services classified by genre, activity (performance, listening, theory, composition), difficulty levels, and age groups.

The survey data confirmed the effectiveness of blended learning model, which combines traditional and digital approaches. In this regard, 78% of teachers indicated its positive impact on motivation, student involvement level, and learning quality. Respondents recommend using at least 3-4 digital tools in each lesson, such as educational process management platforms and programs for editing notes or sound recording. 76% of teachers stressed the importance of involving students in the creation of music in digital format, for example, in performing and recording works, creating arrangements, improvisations, and multimedia presentations. To achieve this goal, group creative tasks, digital projects, and discussions were effective. According to their estimates, such activation increased students' motivation by 15-20%. Moreover, 63% of teachers believed that regular feedback improved music learning effectiveness.

Hence, it is recommended to use digital forms of reflection (surveys, Google forms, interactive magazines in LMS) after every second lesson. This helps identify educational gaps, students' interests, and optimise the

teaching methodology. 72% of teachers indicated the need for systematic monitoring of digital tools effectiveness. It is suggested to evaluate digital platforms effectiveness in terms of material assimilation, participation level, creative products every two weeks to adjust the pedagogical strategy timely. Finally, 59% of respondents expressed their readiness to introduce innovative digital methods but noted the need for support from the administration of educational institutions. Therefore, it is necessary to create a digital platform or online community for sharing best practices, lesson templates, and digital exercises, which will increase the innovativeness of music training by at least 10-15%. Thus, the survey results demonstrate the high potential of digital technologies in music education under the condition of an integrated approach, namely: advanced training of teachers, the creation of methodological materials, the integration of innovative platforms, and regular monitoring of learning efficiency. The combination of digital tools with traditional forms of music teaching creates a new quality of educational environment, i.e., dynamic, interactive, and focused on the development of creative personality in the era of digital culture.

5. Discussion

When studying the effectiveness of digital technologies in music education based on empirical results and analysis of modern educational practices, a set of methodological recommendations for music teachers was developed in order to cultivate integrative thinking and enhance students' creative activity (Tab. 1). They are based on the adaptation of principles tested in computer science to music education specifics.

As the analysis showed, digital platforms in music education increased learning effectiveness and stimulated creative thinking, communication skills, and the ability to learn independently. Digital tools proved to be suitable for the project-based approach to ensure the integration of knowledge and practice. They also permit to work effectively in different educational models: classroom, distance, and hybrid. Hence, these methodological recommendations facilitate the formation of a holistic approach to teaching music within digital culture. It concerns adapting technical tools and shifting the educational paradigm from transferring knowledge to creating a space for creativity, experimentation, and self-realization. This approach meets the modern challenges of education focused on the development of innovative, critical, and integrative thinking. Therefore, the effective implementation of digital music education requires that teachers focus on creating an interactive digital environment that provides convenient access to learning materials, organized communication, and feedback. Using platforms such as Google Classroom, Microsoft Teams or Moodle structures the learning process, distribute scores, audio and video files, and organize remote assignments.

Within the project-based learning model, teachers can ask students to create electronic compositions in Soundtrap or BandLab, edit sheet music in Flat.io or MuseScore, prepare multimedia presentations in Canva or Google Slides, record music podcasts or reviews, create videos of performances or arrangements of works. Such projects should be judged on the criteria of creativity, technical implementation, music literacy, and interdisciplinarity. Moreover, digital tools for formative assessment can be used to support student motivation and improve assessment. Online quizzes (e.g. Kahoot or Quizizz), electronic surveys in Google Forms, e-portfolios, and reflection forums stimulate students to engage in self-assessment, track their progress, and discuss creative outcomes. In addition, the development of digital literacy of teachers is also noteworthy. In this regard, it is recommended to hold trainings, seminars and workshops on working with digital platforms, sound recording, editing music, legal and ethical aspects of using digital content. It is also advisable to encourage the participation of teachers in massive online courses (Coursera, FutureLearn, Prometheus) dedicated to digital pedagogy, modern composition or STEAM education.

Tab. 1 – Methodological recommendations for the effective use of digital technologies in music education

Recommendation	Description	Examples
Integrating digital platforms into the learning process	Systematic use of digital platforms for organizing music education	Google Classroom, Microsoft Teams, Moodle can be used for sharing sheet music, audio, and assignments; Soundtrap, MuseScore, Flat.io can be used for creating music compositions
Blended learning	A combination of traditional music-making and theory classes with online components	Online music theory assignments; digital note analysis in Flat.io; live performances followed by discussion in Teams
Increasing motivation through gamification	Using game elements to keep students interested	Kahoot/Quizizz can be used to test music literacy knowledge; gamified tasks with a hierarchy of levels in solfege
Regular updates of training materials	Considering the latest music trends and digital formats	Adding modern music examples; using cloud libraries with scores and audio archives
Professional development of teachers through online platforms	Professional development through courses, trainings, online seminars	Coursera/Prometheus courses on digital music, contemporary composition, pedagogy in the digital environment
Supporting students in their learning process	Individual support and adaptation of digital tools to students' needs	Online consultations, discussions of student-created pieces, personalised music assignments
Digital ethics and security	Developing skills of safe behaviour online	Classes on copyright ethics, digital reputation, confidentiality when publishing your own music
Evaluating the effectiveness of digital methods	Regular monitoring of learning outcomes using digital tools	Electronic portfolios; student self-assessment; analysis of the dynamics of participation in digital projects

In order to ensure inclusiveness and personalization of learning, it is necessary to adapt digital tasks to meet the needs of students with special educational needs. It is important to create a supportive environment in which each student has the opportunity for self-expression in music. An effective strategy is to create practical communities for teachers. These can be intra-school or regional online platforms for sharing methodological developments, task templates, video lessons, and recommendations on digital tools. It is recommended to organize online competitions, digital creativity festivals or open lessons to facilitate the exchange of experience and improve the quality of digital music education.

In developing countries, integrating digital technologies into music education faces a set of interrelated challenges that may limit the potential for digitalization of education. The most acute problem is limited access to basic technological infrastructure. Many educational institutions, especially in rural areas, do not have a stable internet connection, making it impossible to use modern cloud platforms and online resources. Moreover, financial constraints lead to a lack of necessary technical equipment such as computers, tablets, and digital musical instruments, which are often outdated. This situation is exacerbated by the lack of centralized funding to upgrade the technical base of educational institutions. The second major obstacle is the insufficient level of teachers' digital competence. The in-service training system for music teachers often

does not take into account the need to develop digital skills, and existing trainings are inaccessible due to financial or logistical barriers. Many teachers, especially those of the older generation, lack confidence in the use of digital technologies, which leads to a passive perception of innovation. The lack of systematic methodological support for the integration of digital tools into the traditional learning process further complicates the situation.

An important problem is the shortage of adapted teaching materials and software. Most modern digital platforms for music education do not have localization into national languages, which creates additional difficulties for their use. In addition, existing digital resources often do not take into account local musical traditions and cultural characteristics, which limits their pedagogical value. Furthermore, financial constraints pose a separate set of problems. The high costs of purchasing licensed software, maintaining technical infrastructure, and updating equipment often exceed the budgetary capacity of educational institutions. Thus, the lack of targeted funding for the digitalization of music education hinders the implementation of innovative projects. Organizational difficulties also slow down digitalization. The lack of a clear state policy on the integration of digital technologies into music education leads to fragmented efforts. Many administrations of educational institutions do not see the need to support digital initiatives, preferring traditional teaching methods. The need to adapt curricula to the requirements of digital learning is often met with resistance from conservative educational leaders.

To overcome these problems, a comprehensive approach is needed that takes into account the specifics of developing countries. The primary task is to create support programs for music teachers, including free online courses, masterclasses, and practice communities. Such initiatives could be implemented with the support of international organizations and in cooperation with local pedagogical universities. It is also necessary to create open digital resources adapted to local conditions, such as national languages, musical traditions, and technical capabilities.

To solve the problem of technical support, it is proposed to consider models of resource sharing between educational institutions and the introduction of mobile computer classes. In this connection, the blended learning model is useful because it combines traditional methods with limited digital capabilities. This will allow for the gradual integration of technology into music educational without radical changes and significant financial costs. At the state level, it is necessary to develop targeted programs of financial support for the digitalization of music education, such as tax incentives for companies investing in educational technology. Finally, the creation of regional methodological support centers would provide teachers with the necessary resources and advice. To overcome cultural barriers, it is proposed to develop a series of pilot projects that would demonstrate the effectiveness of digital technologies in combination with traditional teaching methods.

6. Conclusions

Digital technologies are an integral part of modern music education, transforming traditional pedagogical approaches and opening up new opportunities for students' creative self-realization. The analysis of empirical data and educational practices showed that the integration of digital tools contributed to the cultivation of integrative thinking, increased students' motivation and activated their cognitive activities. The analysis of the teachers' experience demonstrated that digital platforms fulfilled their potential within the integrated approach. It is noteworthy that the positive impact of interactive tools on the formation of

integrative thinking was observed because students were able to master theoretical knowledge, practical skills, and develop artistic taste simultaneously. In addition, the identification of optimal conditions for the implementation of blended learning in music education was an important outcome of the study.

It was also established that the combination of traditional forms of work with innovative digital means created a dynamic learning space where each student could find the best way for self-expression. At the same time, the professional training of teachers who should be fluent in musical competencies and digital skills was found to be important. The methodological recommendations developed during the study suggested specific solutions to overcome existing challenges through systematic training of teachers and the creation of communities for the exchange of experience. During the experiment, three approaches to the organization of music education in the digital learning environment were tested, namely: an interactive learning, project-based learning, and a blended learning model. The highest results were achieved by the students who studied by the blended and project-based learning models. The blended learning combined traditional methods (live music-making, analysis of music, and individual classes) with digital components (online tasks, creation of electronic portfolios, and digital analysis of compositions). The project-based approach facilitated the independent creation of music, the use of digital audio editors, and strengthening students' creative potential.

Therefore, the integration of digital technologies into musical learning was highly relevant. Digital platforms created prerequisites for the personalization of education, expanded opportunities for creative expression, promoted the development of interdisciplinary skills, and increased learning motivation. However, digital technologies did not replace traditional methods, but complemented and expanded them, creating new conditions for the harmonious development of personality in a digital culture. Thus, the study proved the need for a comprehensive approach to introducing digital technologies in music education, involving systematic teachers' training, the curricula adaptation, the interactive content creation, and the establishment of digital infrastructure in art educational institutions. In this way, it is possible to combine the creative technologies with the formation of integrative thinking effectively, which is the basis of modern music and the learning environment. The introduction of the recommended approaches will facilitate the formation of a new generation of musicians capable of creatively self-realization in a digital era.

Finally, it is worth noting certain limitations of the study, including the selective nature of the data, the subjectivity of the assessments, and the influence of external factors. However, they do not reduce the value of the results for understanding current trends in music education. In this connection, further research can be focused on the impact of artificial intelligence and virtual reality on music education. It is also possible to consider the development of adaptive learning systems that can take into account each student's individual characteristics.

However, this study has a number of limitations. First, the empirical data was collected from a relatively limited sample. While this sample is representative of the Ukrainian educational context, it does not reflect the full diversity of experiences in other countries or educational systems. Second, the study dwells upon only Ukrainian educational institutions between September 2023 and May 2024, which limits the interpretation of the results to a specific cultural, institutional, and temporal context. Such a framework may reduce the applicability of the findings to countries with different digital infrastructures, pedagogical traditions or educational policies.

Given the identified limitations, it is advisable to conduct future research aimed at expanding the empirical base and deepening the understanding of the impact of digital technologies on music education. In particular, it is promising to conduct longitudinal studies that would assess the long-term impact of the use of digital instruments on the development of students' musical, cognitive, and creative competences. Further studies could include monitoring changes in students' academic achievements, emotional engagement, and professional orientation over several academic years. Moreover, it is possible to explore the possibilities of integrating artificial intelligence into teaching music, including the use of adaptive systems for analyzing musical works, generating compositions, providing personalized feedback, and improving instrumental training. Another promising area for future research is the use of virtual and augmented reality technologies to simulate stage experiences, visualize musical structures, develop ensemble performance skills, or interact with historical and cultural contexts of music. It is also worth expanding the geographical scope of research to include different educational models, countries, and socio-cultural contexts, which will allow for more informed generalizations about the effectiveness of digital technologies in music education. Finally, interdisciplinary approaches that combine musicology, pedagogy, digital humanities, psychology, and neuroscience are important to create a comprehensive picture of the digital transformation of music education.

7. References

Burke, Paul F., Sandy Schuck, Kevin Burden, and Matthew Kearney. 2025. "Mediating learning with mobile devices through pedagogical innovation: Teachers' perceptions of K-12 students' learning experiences." *Computers & Education* 227: article number 105226. doi:10.1016/j.compedu.2024.105226.

Guzmán, Jorge. 2021. "The Music Education and Its Relations with the Science, Technology, Society and Innovation." *Mendive. Revista De Educación* 19 (2): 659-672.

Karanfiloğlu, Mehmet, and Mehmet Akın Bulut. 2025. "Techno-Pedagogical Communication, Ed-Tech and Media Professionals: Crossroads for Enhancing Instructional Quality." *Interactive Learning Environments*, 1-25. doi:10.1080/10494820.2025.2459180.

King, Andrew, and Evangelos Himonides. 2016. *Music, Technology, and Education: Critical Perspectives.* London: Routledge. doi:10.4324/9781315596945.

Ma, Yidi, and Chengliang Wang. 2025. "Empowering Music Education with Technology: A Bibliometric Perspective." *Humanities and Social Sciences Communications* 12: article number 345. doi:10.1057/s41599-025-04616-2.

Martzoukou, Konstantina, Crystal Fulton, Petros Kostagiolas, and Charilaos Lavranos. 2020. "A Study of Higher Education Students' Self-Perceived Digital Competences for Learning and Everyday Life Online Participation." *Journal of Documentation* 76 (6): 1413-1458. doi:10.1108/JD-03-2020-0041.

Ovcharuk, Oksana, Iryna Ivaniuk, Nataliia Soroko, Olena Gritsenchuk, and Oksana Kravchyna. 2020. "The Use of Digital Learning Tools in the Teachers' Professional Activities to Ensure Sustainable Development and Democratization of Education in European Countries." *E3S Web of Conferences. The International Conference on Sustainable Futures: Environmental, Technological, Social and Economic Matters (ICSF 2020)* 166: 1-6. doi:10.1051/e3sconf/202016610019.

Pranay, Pandey. 2025. "Role of Digital Technology for Advancing STEAM Learning." In *Transformative approaches to STEAM integration in modern education*, edited by Santosh Kumar Behera, Ali

Sorayyaei Azar, Samantha Curle, and Jeanette Gaoat Dials, 159-181. New York: IGI Global Scientific Publishing. doi:10.4018/979-8-3693-7408-5.ch007.

Revenko, Vira. 2021. "Education and Music Culture in the Context of Web 2.0." *International Journal of Emerging Technologies in Learning* 16 (10): 96-107. doi:10.3991/ijet.v16i10.19693.

Richardson, Janice, and Elizabeth Milovidov. 2019. *Digital Citizenship Education Handbook: Being Online, Well-Being Online, and Rights Online.* Strasbourg: Council of Europe.

Saether, Eva, Alagi Mbye, and Reza Shayesteh. 2018. Intercultural Tensions and Creativity in Music. In *Creativities, Technologies, and Media in Music Learning and Teaching: An Oxford Handbook of Music Education*, edited by Gary .E. McPherson and Graham F. Welch, 52-68. Oxford: Oxford University Press.

Sinaga, Dameria. 2025. "Innovative Instructional Models: Leveraging Independent Study in Online Information Ecosystems." *Journal of Information Systems Engineering and Management* 10 (9): 170-187. doi:10.52783/jisem.v10i9s.1177.

Swanwick, Keith. 2008. "The 'Good-Enough' Music Teacher." *British Journal of Music Education* 25 (1): 9-22. doi:10.1017/S0265051707007693.

Teachout, David J. 2004. "Preservice Teachers' Opinions of Music Education Methods Course Content." *Contributions to Music Education* 31 (1): 71-88.

Tejada, Jesús, Adolf Murillo, and Borja Mateu-Luján. 2024. "'It Blew My Mind'. Creating Spaces for Integrating Creativity, Electroacoustic Music and Digital Competencies for Student Teachers." *British Journal of Music Education* 41 (2): 182-194. doi:10.1017/S0265051723000384.

Vargas-Murillo, Alfonso Renato, Ilda Nadia Monica de la Asuncion Pari-Bedoya, and Shirley Mabel Gordillo Bedoya. 2025. "Digital Education Strategies and Tools in Developing Citizenship Skills: A Literature Review Based on Scopus (2014-2024)." In *ESET 2024 - Conference Proceedings of the 2024 8th International Conference on E-Society, E-Education and E-Technology*, 50-55. New York: Association for Computing Machinery, Inc. doi:10.1145/3704217.3704237.

Zhang, Lanting. 2022. "Integration of Information Technology into Music Education to Cultivate Creative Thinking among Middle School Students." *Journal of Contemporary Educational Research* 6 (1): 93-98. doi:10.26689/jcer.v6i1.2931.

Zicari, Massimo, and Michele Biasutti. 2025. "Early Twentieth-Century Recordings in Higher Music Education: A Preliminary Analysis of the Students' Views." *British Journal of Music Education* 42 (1): 30-45. doi:10.1017/S0265051724000378.