Evaluating the Effectiveness of Using Digital Technologies in Music Education

Flutura Gagica Rexhepi
University for Business and Technology, Kosovo
F.G.Rexhepi@outlook.com

Rreze Kryeziu Breznica
University of Pristina, Kosovo
rrezebreznica@hotmail.com

Burhan Reshat Rexhepi
University for Business and Technology, Kosovo
brhnrexhepi@gmail.com

Abstract: The relevance of the study of the effectiveness of digital technologies in music education lies in the need to adapt modern music education to the requirements of the digital world. The purpose of this study was to evaluate the effectiveness of digital technologies in music education and to determine their impact on the quality of music education. The methods used in the study were the statistical method, modelling, the method of generalising experience, as well as experimentation and theoretical analysis. The results of the study showed that the use of modern digital technologies in music education could make the learning process more effective and accessible. Students who used digital resources and tools learned music material better, expressed more interest in learning, developed better creative skills, and were involved in teamwork on music projects. The use of digital technology had also helped to optimise time and preserve music resources. In general, this is a major step in improving music education and the development of pupils and students.

Keywords: improvement of the learning process, training of students, assimilation of knowledge, creative skills, introduction of modern methods.

1. Introduction

The modern world is undergoing a digital revolution affecting all aspects of people’s lives, including education and culture. Music education is not left behind, and the question is being asked how digital technologies can improve the process of learning music, open new opportunities for self-expression and creativity, and make education more accessible to all segments of the population. The paradigm of music education is on the verge of historic change due to the introduction of digital technologies into the learning process. Opening new horizons for learning and creativity, these technologies create unique opportunities for music students and
teachers. At the same time, they raise new challenges and questions about their effectiveness and impact on music education.

This topic is relevant due to several key aspects. The absence of scientific research and methodological approaches in this field makes it challenging to objectively evaluate the impact of digital innovations on the process of music education. Inequality in access to digital resources and infrastructure also creates inequalities in learning opportunities for different educational institutions and students. Notably, the problem of determining criteria and methods for assessing the quality of music education in the context of digital technologies also remains relevant, as it requires the development of standards and methodologies for the objective measurement of results.

The integration of digital technologies into music education offers new opportunities for improving learning outcomes. However, it also raises concerns regarding implementation and efficacy. According to Iukhno (2019), establishing didactic conditions such as providing access, training teachers, and incorporating digital tools into curricula was crucial for fostering students’ information-digital competence in higher education. Solopko and Shevchuk (2022) emphasized the significance of providing professional training to teachers on the use of digital technologies. Yiping (2021) study in China revealed that collaborative projects, simulations, and multimedia were effective methods for developing digital skills among future art teachers.

According to Buleshkaj and Koren (2022), the use of digital technologies in music education allowed teachers to create individualised curricula that considered the characteristics and needs of each student in detail. Teachers can create assignments and materials that are tailored to each student’s level of proficiency. For instance, students with diverse backgrounds can receive assignments of varying difficulty, allowing each student to develop at their own level. For students with special needs or interests, teachers can create individualized curricula that can improve the learning process and make it more effective (Kenesbayev et al., 2017; Sansyzbayeva et al., 2022). According to a study by Tahirysylaj and Fazliu (2021), which was conducted among music students, students who actively used digital instruments showed a higher level of understanding of musical structures and technical skills. Specifically, the use of digital tools helped to improve arrangement and composition skills.

Salihu et al. (2019) noted in their study that graphic and visual tools in music education opened endless possibilities for visualising and illustrating musical concepts and elements. They allowed teachers to create visual diagrams, charts, graphs, and other interactive tools that could be used to explain complex musical concepts. According to the findings of Luzha (2015), the use of digital platforms in music schools contributed to the development of creativity among many students. The findings suggested that students who used digital platforms produced more original music and showed higher musical self-sufficiency. This indicate the progressive role of such technologies in music education, as the use of digital platforms allows creating a favourable environment for the development of students’ creative abilities (Marzhan et al., 2022; Tleubekova et al., 2023).

The study by Breznica (2018) investigated how the use of special software for analysing musical structures contributed to the understanding and analysis of complex musical
compositions. Within the framework of this study, students and music analysts used such applications to examine various aspects of musical works in detail, including harmony, rhythm, melody structure, instrumental distribution. The results underlined the importance of digital instruments in music education. They pointed out that such programmes and technologies not only facilitated the process of music analysis, but also helped students to uncover complex aspects of compositions that may previously have been difficult to understand. Jakupi and Muçolli-Dehiri (2018) showed how combining music with visuals and interactive components enhanced the perception of music and influence the emotional response of students. As a result, this approach to music teaching promoted a more profound understanding of musical works among students. Visuals can help to capture the emotional essence of music, which helps students to understand and feel it more easily. Interactive components also engage students in a more active learning process and stimulate their attention (Bocheliuk et al., 2022).

Researching the impact of digital technologies on music education is significant for its development, as it can not only empower students, but also make music education more accessible, effective, and engaging. The above studies mentioned vital aspects, but it is also important to investigate how the introduction of modern technologies could affect the level of learning and retention of educational material by students.

The purpose of this study is to assess the extent to which digital technologies can enhance the efficiency of the learning process compared to traditional methods. The study seeks to address gaps in understanding the effectiveness of digital tools by empirically investigating their impact on core learning outcomes such as musical knowledge, skill development, and student engagement. The objectives are:

- To compare the effectiveness of technology-enabled teaching methods versus conventional instruction for student learning and knowledge acquisition. Quantitative data will identify differences in academic achievement between groups utilizing digital tools versus traditional methods.

- To assess the role of digital technologies in student engagement, motivation, and interest in music education activities. Measurement will focus on effort, class participation, and attitudes.

- To examine the progression of musical abilities, such as technical proficiency, creativity, and musical interpretation skills, when using digital tools.

- To investigate the perceptions of teachers and students regarding the use of digital tools to enhance the teaching and learning processes in music education.

2. Materials and Methods

The main methods used to conduct this study were the statistical method, modelling, generalisation of experience, as well as experiment and theoretical analysis. The theoretical analysis was important because it offered a better insight into the scientific and pedagogical aspects of using digital technologies in music education. The analysis involved a detailed
investigation of the available scientific literature and publications on the subject matter. The key theories, approaches, and concepts related to the use of digital technologies in music education were identified. Such an analysis helped formulate a theoretical framework for the study and build hypotheses that were subsequently subjected to empirical testing. The identified theoretical foundations became the basis for the choice of research methods and for the interpretation of the results. This approach made it possible to create a scientifically sound and systematic approach to investigating the effectiveness of digital technologies in music education.

Two groups of students from the University of Pristina were selected for the experiment. The choice of this university was conditioned by the accessibility and favourable conditions for research. The experiment comprised 40 students, aged between 19 and 22 years, who were divided into two groups. The first group (20 students) used digital technologies in their studies in the “History of Performance” subject, while the second group (also 20 students) studied using conventional methods without using digital technologies. All students were distinguished by their age range and level of musical training. To ensure the objectivity of the experiment, the groups were carefully selected so that they were similar in terms of previous education and other factors.

The first group utilised digital audio workstation software, including Avid Pro Tools and Ableton Live, for multi-track recording and editing, as well as music notation software such as Finale and Sibelius. In addition, they accessed online platforms such as YouTube, Coursera, and Soundtrap for supplementary music resources. The second group relied solely on traditional teaching materials such as textbooks, sheet music, and acoustic instruments.

To evaluate learning outcomes, the researchers administered a 50-item test to the students. The test covered key course concepts and included multiple-choice, short-answer, and essay prompts. The questions were designed to assess the students’ understanding of music history and compositional techniques, based on the stated course learning objectives. The material was presented using both traditional and digital delivery methods. The test underwent validation through pilot testing with a cohort of students and review by subject-matter experts. Scoring rubrics were created to ensure consistent evaluation of open-ended responses. Test scores were used to quantitatively measure student learning outcomes.

In addition, the researchers conducted a survey to measure student engagement. The survey assessed perceptions of motivation, enjoyment, and participation using a 5-point Likert scale. It consisted of 10 items and was validated through factor analysis procedures. The survey provided a quantitative complement to test scores for evaluating the impact of digital technology.

To determine the effectiveness of the experiment, one can use the criterion of the relative effectiveness of the learned educational material, which is calculated according to the formula (1):

$$Q = \left( \frac{U1-U2}{U2} \right) * 100\%,$$  \hspace{1cm} (1)

where: $U1$ – amount of information learned through digital technologies; $U2$ – amount of information learned using traditional teaching methods; $Q$ – relative efficiency.

The statistical method of analysis was used to calculate and compare the data collected.
Evaluating the effectiveness of using digital technologies in music education

during the empirical study to objectively assess the effectiveness of the use of digital technologies in music education. Statistical analysis helped determine the statistical significance of the results and identify differences between groups of students who studied using digital tools and conventional methods. This method helped draw objective conclusions about whether digital technologies have had an impact on increasing the efficiency and effectiveness of learning, and whether improvements in the learning process have been achieved compared to conventional teaching methods. The results of the statistical analysis became the basis for determining the advantages and disadvantages of using digital technologies in music education and provided an important framework for further research.

The modelling method was a vital tool that helped create theoretical models that predicted the possible impact of digital technologies on the learning process. These models included various scenarios for implementing digital tools, defining goals and objectives that could be achieved with their use, and considering potential benefits and challenges. Models were developed that reflected the expected changes in curricula and teaching methods when digital technologies are introduced. This helped create a basic framework for further comparison of the results.

The modelling helped identify how digital technologies could affect the learning process and to establish which indicators and parameters should be measured and compared in the empirical study. As a result of this analysis, it became apparent which aspects of music education could be improved through digital technologies, as well as which shortcomings require more attention and improvement. Thus, the modelling method proved to be an essential tool for theoretical consideration of the introduction of digital technologies in music education and preparation for the practical stage of the study.

3. Results and Discussion

3.1. Digital Technologies in Music Education

The use of digital technology in music education is a revolutionary process that combines centuries-old traditions of music education with the innovative capabilities of modern electronic tools. This transformation opens new perspectives for learning, creating music, and expressing oneself, making it more accessible and interactive for students of all ages. The use of digital instruments, programmes and online resources helps to expand musical opportunities and enrich the learning process and opens the door to new ways of expression and creativity in music. In this context, the effective use of digital technologies in music education is becoming a key factor in achieving high results and developing musical talent. The use of digital technologies in music education usually involves three primary educational stages:

- The first stage is introduction and access. This involves providing students with access to the digital devices, software, and online platforms needed for digital music education such as laptops, tablets, music production software, virtual instruments, and online music resources. An essential part of this stage is training students and teachers on how to use the technology, as digital literacy skills and technical competency are crucial prerequisites to benefiting from the tools. Ensuring all students can access the required technologies is also key at this stage, regardless of socioeconomic status, in order to tackle digital divides and promote equity.
• The second stage involves integrating digital technologies into the curriculum and pedagogy. This includes incorporating digital tools into lessons, assignments, and activities across subjects. For instance, music production software can be used in music theory classes. Digital technologies can also support new teaching methods that involve online collaboration, differentiated learning, multimedia resources, and interactive exercises. Developing learning materials and assessments for digital environments is crucial. This requires rethinking content delivery and how students demonstrate knowledge.

• The third stage involves practicing and applying digital skills. This provides students with opportunities to create music, analyse compositions, and complete other learning tasks using digital tools. These technologies also promote musical experimentation, improvisation, and creative expression. Project-based learning, where students use digital tools to produce original music works and collaborations, is an impactful approach at this stage. Allowing students to explore their musical interests through digital platforms, at their own pace and direction, is also valuable.

Digital technologies can be used at all stages of education. They can become interactive partners for learners, acting as teachers, to help with practical activities, and serve as learning objects that facilitate the acquisition of knowledge (Ismail et al., 2022). The study examined a range of aspects related to teaching the history of music performance using modern digital technologies. Furthermore, the effectiveness of methods aimed at stimulating active learning of students of art educational institutions using digital technologies was assessed (see Table 1).

### Table 1

**Methods for Stimulating Active Learning in Art Educational Institutions Using Digital Technologies**

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational Process Model</td>
<td>It involves management and pedagogical components, including teachers and engineering staff skilled in digital technologies.</td>
<td>Applied in music specialization, integrating digital technologies with teaching.</td>
</tr>
<tr>
<td>Conventional Musical Information Presentation</td>
<td>Classical music compositions presented as musical scores or stored on analogue carriers, and programs for automated information technologies.</td>
<td>Used in classical music education, blending traditional and digital formats.</td>
</tr>
<tr>
<td>Organisational Aspect</td>
<td>Manages information flow from the history of performance sections, presented in either classical or digital form.</td>
<td>Adapts to curriculum sections and topics, offering flexibility in information presentation.</td>
</tr>
</tbody>
</table>

Source: Abidinovich (2021) and Ouyang (2023).

### 3.2. Assessment of Knowledge Acquisition and Analysis of Effectiveness

The consolidation of educational knowledge involves involving students in independent study and listening to various musical works of assorted styles in digital format. The assessment
of the level of knowledge acquisition is based on an independent analysis of the sound fragments of a musical piece presented by the teacher. Students should also identify the authors of musical styles, consider the historical aspects of their creation and the social factors that influenced the development of the performance style.

The study of the effectiveness of teaching music students using digital technologies was considered in the following aspects (Otaxonov, 2021):

• Analysis of the structure of the use of digital tools, including factors of organisational, emotional and motivational nature.

• Implementation of pedagogical teaching methods based on the developed models and algorithms in the educational process.

• Development and preparation of a set of training sessions for control and experimental groups.

• Statistical and pedagogical analysis of the results.

• Adjustment of the procedure for introducing digital technologies into the process of vocational training of students.

3.3. Empirical Evaluation

To evaluate the effectiveness of the educational process in educational institutions where digital technologies were used, a system of tests was introduced, in which students of the control and experimental groups took part (see Figure 1).

Figure 1

Analysis of Differences in the Level of Learning Between Students of Control and Experimental Groups

Notes: Y-axis – levels of mastery of the material determined by average scores; X-axis – sectors of students’ results in different subjects; Sector 1 – scores in “History of Performance”; Sector 2 – scores in “Music History”; Sector 3 – scores in “Ethnomusicology”.

Source: developed by the authors.
The essence of lessons using digital technologies is that a considerable part of the selected information, selected following didactic principles, is broadcast through screen monitors and played through sound speakers. The discipline “History of Performance” is chosen for consideration. The percentage of main information divided into sections can be seen in Figure 2.

**Figure 2**

*Distribution of Information Types in the “History of Performance” Discipline*

Source: developed by the authors.

To determine the effectiveness of the amount of knowledge acquired correctly, important was to clearly define the concept of knowledge (Camlin & Lisboa, 2021). Considering that \( M_\theta = 90 \) abstract units as a representation of the general information received during one 90-minute lecture on a particular topic, one could introduce coefficient indicators to analyze this information:

1. \( P_{an} \) = the amount of analytical information provided by the teacher = 0.15.

2. \( P_{vis} \) = the amount of information received by means of vision from a computer monitor = 0.3.

3. \( P_{aud} \) = amount of audio and music information = 0.55.

These coefficients were determined based on the time spent by the teacher teaching the material and watching and listening to the pieces. The time in this context was determined according to the amount of information, as this was conditioned by the specific feature of conducting such classes. Important was to adhere to a precisely defined schedule for displaying material on the monitor and playing audio fragments of musical pieces for analysis or study. Coefficients were calculated based on statistical data collected throughout the discipline during one academic year (Xu, 2022).

Accordingly, \( P_\theta = P_{an} + P_{vis} + P_{aud} \) was the total amount of information received. This study analysed the effectiveness of the educational process in artistic educational institutions, within the subject “History of Performance,” using digital technologies, as well as in comparison with...
Evaluating the effectiveness of using digital technologies in music education

conventional teaching methods. Considering a minute of class to be a unit of information that a student had learned, without considering additional factors, and then in ideal conditions, given a 90-minute duration of one session, the amount of new information would be equal to 90 units:

- \( M_{\text{an}} = 90 \times 0.15 = 13.5 \) minutes – information given by the teacher.
- \( M_{\text{vis}} = 90 \times 0.3 = 30 \) minutes – visual information presented through the monitor.
- \( M_{\text{aud}} = 90 \times 0.55 = 49.5 \) minutes – information received through hearing.

A graphical representation of the model of time spent during a music lesson using digital technologies is presented in Figure 3.

**Figure 3**

*A Model of Time Spent on Conducting a Class Using Digital Technologies*

Source: developed by the authors.

Notably, the components of the class interact with each other, forming areas of joint learning. Important is to explain the nature of these areas to the data, as well as to determine their significance coefficients (see Table 2).
Table 2

Significance Coefficients of the Model Spheres of Time Spent on Conducting the Lesson with the Use of Digital Technologies

<table>
<thead>
<tr>
<th>Sphere</th>
<th>Coefficient</th>
<th>Mgen.*, min</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sphere 1</td>
<td>X1=1</td>
<td>9</td>
<td>Covers the introductory part of the lesson, which includes the teacher’s greeting to the students, defining the topic, purpose and relevance of the lesson. This area also includes a main part, which presents historical information and explanations of the social factors that influenced the styles of music, and a concluding part, which announces the achievement of the class objectives and gives assignments for independent study.</td>
</tr>
<tr>
<td>Sphere 2</td>
<td>X2=1.2</td>
<td>18</td>
<td>Covers the display of textual information, photos, and illustrations on the monitor screen, providing students with the opportunity to independently analyse and understand the material presented.</td>
</tr>
<tr>
<td>Sphere 3</td>
<td>X3=1.3</td>
<td>27</td>
<td>Involves the process of listening to a musical composition.</td>
</tr>
<tr>
<td>Sphere 4</td>
<td>X4=1.4</td>
<td>9</td>
<td>Involves listening to fragments of a musical composition with the subsequent explanation by the teacher of the specific features of its structure and performance.</td>
</tr>
<tr>
<td>Sphere 5</td>
<td>X5=1.5</td>
<td>9</td>
<td>Involves listening to fragments of a musical composition with the subsequent explanation by the teacher of the specific features of its structure and performance.</td>
</tr>
<tr>
<td>Sphere 6</td>
<td>X6=1.6</td>
<td>9</td>
<td>Involves listening to a musical composition accompanied by simultaneous viewing of visual material.</td>
</tr>
<tr>
<td>Sphere 7</td>
<td>X7=1.7</td>
<td>9</td>
<td>Involves listening to a musical composition followed by a teacher’s explanation of the features of its structure and performance, while viewing visual material.</td>
</tr>
</tbody>
</table>

Note: * – M_{gen}=90 minutes=100%.

Source: developed by the authors.

The total amount of information obtained was calculated as a result of summing the information in the relevant sectors, considering their weighting factors by formula (2):

\[ U_1 = M_1 X_1 + M_2 X_2 + M_3 X_3 + M_4 X_4 + M_5 X_5 + M_6 X_6 + M_7 X_7. \]  

(2)

One could substitute the values of the coefficients and time into the resulting expression:

\[ U_1 = 9 + 18 \times 1.2 + 27 \times 1.3 + 9 \times 1.4 + 9 \times 1.5 + 9 \times 1.6 + 9 \times 1.7 = 121.5, \]

where: 121.5 – units of acquired knowledge.
Substituting the values of $U1$ and $U2$ into formula (1), the result was as follows:

$$Q = \left(\frac{U1 - U2}{U2}\right) \times 100\% = \left(\frac{121.5 - 90}{90}\right) \times 100\% = 35\%.$$ 

The study suggested that the introduction of digital technologies in art educational institutions made the educational process 35% more effective than conventional teaching methods. This was due to the increased efficiency and interactivity of the learning process facilitated by digital technologies. Graphics, videos, and animations could present abstract or complex concepts in a more understandable and memorable way. The use of digital technology enabled learners to actively engage with the material, solve problems, and complete practical exercises, thus promoting deeper understanding and better retention. Computer technologies also allowed for individualized learning, where students could learn at their own pace and focus on their specific needs (Schiavio et al., 2020).

In terms of specific curricular areas where digital technologies have a significant impact, the study found the greatest improvements in student outcomes for composition and music production activities. Music production software and virtual instruments enabled learners to enhance their skills in creating original musical works, arranging compositions, and manipulating musical elements. These tools allowed learners to actively experiment, iterate, and receive instant feedback, thereby increasing their flexibility and creativity.

Adhering to structured schedules for multimedia and audio components they helped learners stay focused. The segmented delivery and coordinated progression through lectures, demonstrations, immersive listening, and discussion portions maintained attentiveness and contributed to the orderly development of understanding. Allowing uncontrolled and ad hoc use of digital elements has the potential to create cognitive overload and distraction from key learning tasks. Therefore, a combination of practical creative activities, multimedia resources, and analytical discussions enhanced engagement and understanding.

When using digital instruction, music educators encounter challenges such as a lack of technical skills, difficulties monitoring student usage, and access limitations. Overcoming these challenges requires ongoing professional development, guidance on digital citizenship, and addressing resource gaps. Additionally, clear learning goals and scaffolds for using technology effectively are essential.

### 3.4. Develops Creativity and Engagement

Notably, computer software and interactive applications allow students to instantly access a wealth of learning material, including sheet music, arrangements, instructions, and sound examples. This greatly simplifies the learning process and provides faster access to the necessary resources. The use of computer technology makes it possible to create interactive learning scenarios in which students can interact with the material and even create their own music. This develops their creative skills and promotes active involvement in the learning process. In addition, digital technologies allow teachers to provide an individualized approach to teaching, considering the needs and level of training of each student, which reduces the time spent on installing technical learning tools and allows them to provide explanations and assistance to
students more effectively (Cao, 2021).

The results obtained indicate the importance of using digital technologies in music education. Using digital tools, the learning process becomes more accessible, interactive, and effective, which leads to an increase in the level of education and the development of students’ musical skills. This helps to expand opportunities for self-expression, creativity, and individualisation of learning in the field of music. Thus, the use of digital technologies in music education can be a major step towards the further development of this field and the achievement of higher learning outcomes.

3.5. Overview of Digital Technologies in Music Education

Digital technologies are becoming an integral part of modern music education, and their use in this area has a considerable impact on the learning and development of musical skills. These technologies allow students and teachers to simplify and improve the learning process in many ways. One of the key factors is the availability of a large amount of music learning material through specialized programs and resources. Digital technologies allow students to study music at any time. They can use virtual instruments to play music and improve their playing skills. Some platforms provide the opportunity to communicate and collaborate with other musicians and teachers at a distance, which expands the horizons of music education. This not only makes learning more interesting, but also develops students’ creativity and promotes their active involvement in the learning process. Therewith, digital technologies allow students instantly access a large amount of educational material, which gives them a better insight into the musical concepts and improves the quality of learning. In addition, their use simplifies the interaction between teachers and students, providing a better learning experience in general.

According to a study by Mygdanis (2023), the use of digital platforms for students to work together on music projects increased the level of collective interaction and collaboration in music lessons. Students who had the opportunity to create music together through digital tools developed communication skills and creative exchange of ideas. Analyzing the obtained findings, as well as the conclusions of the researcher, it should be noted that both studies added to the evidence of the effectiveness of digital technologies in music education. Particularly important was that the results showed a significant increase in the effectiveness of the learning process, which indicated the great potential of digital technologies to improve music education in general.

Cuervo et al. (2022) have found that students who used digital technologies retained information 30% better than those who used only conventional teaching methods. This study emphasised the importance of integrating digital tools into music education, as they contributed to the efficiency of the process of memorizing and learning music knowledge and skills. The use of interactive applications, visual materials and resources can create a more engaging learning environment that contributes to improving student outcomes in music education in general. The findings are of immense importance for music education research, but the threat of distracting students from learning through digital technologies can have a considerable impact on the quality of education. One of the main factors of distraction is the ability to access social media and other resources. Furthermore, the presence of a lot of distracting content such as videos, music, apps, can make it harder to learn the material. That is why creating strategies to control the use of
digital technologies for educational purposes is important to ensure a focus on learning.

### 3.6. Teacher Training, Preparation, and Student Engagement

When evaluating the time savings of digital technologies reported by Atabek and Burak (2020), it is important to considering the need for teacher training and professional development was important, as found in studies by Iukhno (2019) and Solopko and Shevchuk (2022). Digital tools may reduced time spent on administrative tasks, as found by Atabek and Burak (2020). However, studies by Iukhno (2019) and, Solopko and Shevchuk (2022) demonstrated that investing substantive time in developing teachers’ skills and knowledge is was also necessary to use these technologies effectively. The research highlighted the importance of comprehensive training programmes for educators to fully benefit from digitalization. These programmes should provide practical technology skills and a deeper understanding of how to integrate digital tools into pedagogy and curriculum. It is crucial to coConsidering the necessary preparation time when assessing the potential efficiencies of digital technologies in music education is important. Yiping (2021) examined teaching methods that incorporated digital technologies. These methods could also be used by music educators to enhance student engagement and improve learning outcomes.

Li (2020) found that the use of digital tools in the learning process led to a significant increase in student engagement compared to conventional methods. Students who had the opportunity to interact with music through applications and software expressed more interest in the subject and were more likely to take part in music projects and activities. This may indicate that digital instruments not only expand opportunities in music education, but also stimulate more active and high-quality music learning by students, contributing to their more complete musical development. However, not all students may have access to modern equipment and software for music education. This may be conditioned by financial constraints, technical incompetence, or other factors. Thus, it is important to consider that the introduction of digital technologies in music education may require more efforts and resources to ensure equal opportunities for all students and need more attention.

Atabek and Burak (2020) noted that digital technologies can could reduce the time spent on organising and administering music lessons by 20%. Automation of planning, journaling, and communication with students helps to optimise the time that can be spent on active learning and music practice. Despite the findings, not all teachers and students may be familiar with modern digital tools or have access to the necessary equipment and resources. It is also necessary is to invest some time in training and preparing teachers to use these technologies. Therefore, the successful implementation of such modern technologies requires planning and support from educational institutions (Volianska-Savchuk et al., 2023).

According to research by Kibici (2022), it was confirmed that digital technologies have considerably expanded the possibilities of creating and storing music materials. Using digital archives and record-keeping systems, teachers can easily create and store music resources that can be used for many school terms, which contributes to the effectiveness of lesson preparation. The findings are are important for the development of music education in general, but should consider such specifics as technical problems, dependence on electronics, data security issues, initial difficulties for those who doo not have experience with digital instruments, privacy, cost
of hardware and software, as well as copyright and licensing issues of music resources. For the successful implementation of digital technologies in music education, considering it is important to consider these aspects and developing strategies to address them, ensuring ensure accessibility and safety of learning for all participants in the learning process (Dayirbekova et al., 2019).

According to Yang (2021), the use of interactive music programmes can increase students’ independence by 30%. Students who have access to digital tools for learning music learn to solve musical problems independently, can develop their creative and analytical skills. The use of interactive music programmes and digital instruments in music education is of significant importance, as it promotes the development of students’ independence and creative skills. The findings of the researcher’s work suggested that this practice can increase the level of students’ independence by 30%. By creating the conditions for independent music learning and solving musical problems, digital instruments help to develop critical thinking, creativity, and analytical skills that are essential in the modern educational environment. This autonomy also prepares students to use their knowledge and skills more effectively in the future, making digital technology a valuable tool for successful music education.

In general, the topic of introducing digital technologies into music education is extremely important and relevant. The results of research conducted in this area show the potential of digital technologies to improve student learning and development. The use of digital platforms allows for an individualised learning process, providing students with the opportunity to study music according to their needs and learning styles. Furthermore, it increases learning efficiency by promoting better retention of information and the development of creative and analytical skills. Investigation of this topic helps to understand how digital technologies can change and improve music education and helps to develop strategies for their best use in the learning process.

4. Conclusions

The findings of this study are important and point to the need to integrate digital technologies into modern music education. The results showed that the learning process of students who used digital technologies in the learning process was 35% more effective than those who used only conventional teaching methods. This is an impressive difference that confirms the immense potential of digital technologies in music education. Digital innovations allow students to explore and learn music on their own, as well as use interactive learning tools and materials, which contributes to more effective development and learning. This creates favourable conditions for the development of musical skills and active involvement in the learning process in music education.

The practical significance of the results obtained is that they confirmed the importance of integrating digital technologies into music education in the modern world. This integration contributes to improving the quality of education, developing students’ creative abilities, increasing their level of knowledge, and making music education accessible to different social groups and regions. The study emphasised that the use of digital technologies contributed to more effective learning, which can have a far-reaching impact on the modern education system and the cultural development of society.

The principal areas for further research include a more detailed understanding of the impact
of digital technologies on learning and creativity in music education. It is also important to investigate how diverse types of digital instruments and platforms affect the development of students’ musical skills, their musical creativity, and motivation to learn. Asking how digital technologies can be optimally integrated into the learning process to achieve the best results should be explored. This may include developing innovative methods and strategies, as well as evaluating the impact of different approaches to using digital tools on student learning.

References


Xu, Y. (2022). The new media environment presents challenges and opportunities for music
Evaluating the effectiveness of using digital technologies in music education


**Acknowledgements:** empty

**Declaration Statement:** The authors declare that there is no conflict of interests.