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RESEARCH ON THE MUSIC EDUCATIONAL PERSPECTIVES IN THE CONDITIONS OF DIGITAL TRANSFORMATION

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ABSTRACT

Information technologies received increased attention in education over the past decade. Computers have become an almost indispensable aid of digital technology in teaching, but their purpose is not to replace the teacher but to complement his teaching. This paper explores how these technologies can be effectively incorporated into music pedagogy to support students' musical development, cognitive motivation, and information literacy. Through a qualitative meta-analysis of peer-reviewed papers, studies, and related reports, this research underscores the necessity of digital resources in contemporary education. The analysis reveals that digital technologies not only align with the realities of students' everyday lives but also stimulate curiosity, boost engagement, and lead to more effective learning outcomes. The study advocates for the thoughtful incorporation of these technologies into music education curricula, ensuring that they complement rather than replace traditional teaching methods. The primary contribution of this research is the demonstration that digital technologies, when effectively integrated, create meaningful and pedagogically sound experiences in music education and play a critical role in enhancing and promoting music learning, empowering students to take control of their educational journey. This approach fosters innovation, creativity, and active participation, which are essential for the development of 21st-century learners.

Key words: digital transformation, educational perspectives, music in elementary school

INTRODUCTION

The rapid advancement of digital technologies is profoundly transforming various aspects of modern life, including the educational sector. This transformation has been marked by the widespread adoption of Information and Communication Technology (ICT) integration strategies and policies across educational systems worldwide (1). Technological innovations such as smart devices, the Internet, artificial intelligence (AI), virtual reality (VR), and various software applications have expanded the possibilities for enhancing teaching and learning (2). Digitalization in education offers numerous opportunities to fundamentally improve instructional practices (3, 4) and influences several aspects of school development (5). Recognizing the apparent advantages of digital education over traditional teaching methods, the educational community increasingly acknowledges the necessity of integrating digital tools into the curriculum (6). However, the digital integration process is complex and requires significant transformative changes (7).

The significance of this issue is underscored by the gap between the potential benefits of digital education and the current state of its implementation. Despite increased investments in ICT integration by educational systems in various countries (8, 9), and the prioritization of these technologies in new educational agendas (10), many countries have yet to achieve planned and comprehensive technological integration. The successful integration of technology in education extends beyond merely providing computers connected to the Internet in classrooms. It requires a well-developed strategy that involves all stakeholders in the educational process, including school administrators, teachers, and parents. Unfortunately, globally, only a small number of schools have adopted such comprehensive strategies (11).

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Previous research has highlighted the challenges associated with achieving the desired outcomes from technology integration in schools. Despite investments, the anticipated benefits have often not been realized (9). The COVID-19 pandemic brought these issues to the forefront as schools were forced to transition to online learning, exposing the varying levels of digital readiness and capacity across institutions (12-14). Many schools, lacking experience and digital infrastructure, experienced significant learning losses (15). This situation emphasized the need for schools to enhance their digital capacity and increase the levels of digitalization to ensure continuity and effectiveness in education (16, 17).

The primary objective of this study is to investigate the potential of digital technologies in music education, focusing on their use in elementary schools. The study hypothesizes that integrating digital tools into music education can significantly enhance the pedagogical experience and improve student learning outcomes. A secondary hypothesis suggests that these technologies can foster the development of critical cognitive and creative skills in students, creating a more engaging and effective learning environment. These hypotheses are grounded in constructivist learning theory, which posits that learners construct knowledge through active engagement in the learning process (18). The research design, which employs a mixed-methods approach, is closely aligned with these hypotheses, facilitating a comprehensive exploration of the impact of digital technologies on music education in elementary schools.

The theoretical implications of this study are substantial, contributing to the emerging field of digital didactics. This branch of pedagogy focuses on organizing educational processes within digital environments and evaluating the validity and effectiveness of digital educational tools. This makes it possible to manage the educational process, consider students' individual characteristics, and create teaching materials (19). The subject of digital didactics in vocational education and training should be "organization of the educational process in the digital educational environment," which includes the goals of teaching (according to the requirements of the digital economy and digital society), the content of teaching and the requirements for its formation, the methods, the influence of teaching technology and techniques (maximum use of the didactic capabilities of digital technologies), teaching tools (including network and programming integrated into a digital-unified complex) (20), the training of the bearers of this process - the teaching staff (forming a digital generation of educators), students and school management, as well as creating a legal framework for digitalization of education.

According to the DigCompEd Framework (European Framework for the Digital Competence of Educators), digital technology is divided into 1- digital devices, 2- digital sources and materials (digital files + software + online services), 3- files (21). For education, digital devices are personal and portable computers, telephones, mobile phones, interactive panels and screens, televisions, projectors, and cameras, while educational digital resources and materials and data sources are online information, network stations, platforms, multimedia content (images, sounds and videos), learning materials, (online) games, quizzes, educational software, applications, programs, virtual learning environments and social networks (22, 23).

Depending on the method and degree of integration of digital technology for educational purposes, teaching can be in the form of 1- classic classroom – traditional teaching, 2- mixed-hybrid teaching (combination of classical teaching and teaching supported by digital technology) and 3- distance learning (learning and teaching take place entirely with the help of digital technology) (24). According to current knowledge, in most educational institutions in most countries, it is still used by teachers mainly as a supplement to teaching, not as a substitute for traditional classroom teaching (25). However, the tendency and challenge for teachers should be how to use digital technology in order to improve the quality of learning, achieve learning goals according to the specific needs of individual students, and ensure the best ratio of traditional teaching and teaching supported by digital technology, to make students more active in the learning process, that is, they can construct their knowledge by the constructivist theory of learning (18).

Technology, in recent years in many educational institutions, has also become a tool in music education. Numerous research and examples from practice indicate that the judicious use of digital music education resources can help broaden students' horizons, increase their audiovisual

range, help them better understand musical works, and improve efficiency in learning (20). By incorporating music technology into music education classes, students gain access to a wide variety of resources and tools that can help them learn and express themselves through music. It can help establish theoretical knowledge, development of musical memory, sense of rhythm, intonation skills, auditory analysis, and musical thinking, contributing to the general development of their cognitive motivation, creative initiative, and independence (26, 27). These technologies can provide children with innovative ways to create, listen or perform music (28, 29).

Hence, the study examines the evolving role of educators in a digitized educational landscape, particularly within the context of vocational education and training. The findings of this research are expected to provide valuable insights for educators and policymakers, offering guidance on effectively integrating digital technologies into music education. By addressing the challenges and opportunities associated with digital integration, this study aims to inform strategies that can enhance the quality of music education in elementary schools, leading to a more sustainable and pedagogically sound educational experience.
In summary, this study underscores the critical need to advance the digitalization of education, particularly within the realm of music education. As educational systems continue to evolve in response to technological advancements, it is imperative that educators and policymakers collaborate to ensure that students are equipped with the skills and knowledge necessary to thrive in a digital world.

METHOD

The research methodology is based on meta-analyses of peer-reviewed papers in scientific databases, of studies and reports related to the topic (e.g., digitization in education, digital capacity for music education) from professional and international bodies (OECD, European Commission) and partly on some documents related to policies related to digital transformation in education (30). The choice of methodology was primarily guided by the multidisciplinary nature of the phenomenon and the short article format. Thus, we used the qualitative analysis, which we consider the most constructive and fruitful in the given research situation.

TEACHER COMPETENCIES IN THE DIGITAL TRANSFORMATION OF MUSIC EDUCATION

As the teaching profession encounters rapidly evolving demands, educators are required to develop a broader and more sophisticated set of competencies than ever before (31). The widespread presence of digital devices in education necessitates that educators not only become digitally competent but also facilitate their students' digital competence. The effective and pedagogically sound use of technology in education requires the development of a complex, situated form of knowledge, often referred to as Technological Pedagogical Content Knowledge (TPCK) (32). This framework emphasizes the integration of technology at multiple levels: theoretical, pedagogical, and methodological (33).

Ongoing professional development and training are critical for teachers to remain current with technological advancements and effectively incorporate these innovations into their teaching practices. This need is particularly emphasized by primary school teachers, who view the integration of digital competencies as essential for their future professional success (34). Therefore, university programs and professional development initiatives should prioritize the adoption of innovative teaching strategies that leverage digital technologies. In initial teacher training, university professors are tasked with a dual responsibility: acquiring digital competence and training future educators to attain and apply these competencies (35).

Various standards, frameworks, self-assessment tools, and training programs have been developed internationally to help educators assess their digital competencies, identify their training needs, and receive targeted professional development (22). For instance, the ISTE (International Society for Technology in Education) standards, updated in 2008, outline five categories with 20 performance indicators that focus on: 1) Facilitating student learning and encouraging creativity; 2) Designing and developing learning experiences and assessments in the digital age; 3) Serving as a model for learning in the digital age; 4) Promoting digital citizenship; 5) Engaging in ongoing professional development and leadership.

These categories emphasize the importance of technological literacy, classroom technology integration, and guiding students in the effective use of technology (36). In alignment with these standards, UNESCO's framework for ICT competencies and standards for teachers advocates for the development of technological literacy among teacher candidates (37). This framework classifies competencies into three key areas: (1) technological literacy, (2) knowledge deepening, and (3) knowledge creation.

Enhancing digital competence in music education specifically leads to the ability to skillfully utilize a wide array of both real and virtual musical

resources powered by digital technologies (38). This enables educators to maximize their teaching, musical, and transversal competencies, using these resources creatively and effectively to achieve educational goals (39). The DigCompEdu framework supports this endeavor by targeting educators across all levels of the educational system, from early childhood to higher education, including music education and informal learning contexts (22).

Within the broader European context, the Tuning Educational Structures in Europe project (40) has also contributed to the understanding of digital competencies, distinguishing between general competencies (instrumental, interpersonal, and systemic) and specific competencies relevant to each subject area. In music education, digital competence encompasses two primary types of knowledge and skills: the instrumental use of digital technologies and the didactic and methodological expertise necessary for their effective application. With adequate digital literacy, teachers can catalyze change, exploring new frontiers in music education while fostering a culture of creativity and innovation among students.

To ensure that music education for elementary school students is comprehensive and sustainable, it must align with both the developmental stages of children and the realities of their daily lives. Effective learning strategies should harmoniously blend real-world and digitally mediated experiences. While children still engage in traditional activities such as singing, playing instruments, or dancing, they are also increasingly drawn to digital activities involving computers, tablets, and mobile phones (39). By thoughtfully integrating these elements, educators can create a balanced and enriched learning environment that meets the needs of 21st-century students.

DIGITAL TOOLS FOR MUSIC EDUCATION

Music education encompasses a wide range of learning experiences and environments. This includes formal classroom instruction, such as weekly music lessons, as well as broader school activities like singing assemblies, nativity plays, celebrations, choirs, instrumental groups, and extracurricular programs (41). Digital technologies have expanded the ways students can engage with music, fostering creativity and enhancing learning outcomes. Musical applications and games serve as versatile and accessible tools that allow students to bridge the gap between concrete and abstract concepts, aiding in the formation and development of musical skills (39).

Empirical evidence highlights several reasons why virtual games are effective in meeting the needs of elementary school children in music education: 1) They present concrete problems with immediate solutions; 2) Require persistence to progress through levels; 3) Operate under clear and consistent rules; 4) Encourage a spirit of competition; 5) Support both individual and group play; 6) Allow sharing of results with peers and friends.

The integration of digital technologies in music education primarily involves the use of computers and mobile devices for audio and video playback, conducting simulations, and presenting or searching for information (1). Numerous apps and websites offer interactive music theory lessons and exercises, which help students grasp the structure and principles of music. Many music notation software programs facilitate the creation of digital compositions, the performance of virtual instruments, or the design of interactive instruments (42). These tools not only make learning music more engaging and enjoyable for students but also support the development of their musical skills and comprehension.

As technology rapidly evolves, educational tools and resources undergo constant transformation to achieve greater sophistication and effectiveness in their application. A wide variety of music games, applications, networked digital tools, audio and video playback software, simulation and presentation tools, and interactive virtual instruments continue to be developed and refined. Moreover, programs initially designed for other fields are now being adapted to improve music education by facilitating personalized teaching methods tailored to the diverse needs of students (43). Online applications for the theoretical and practical study of music range from purely educational to interactive, with the latter proving particularly effective in reinforcing concepts and supporting practical musical activities.

From the vast array of online applications and games available, educators can find tools that address the educational, aesthetic, and psychological needs of elementary school music education while also meeting the instructional needs of teachers (**Table 1**):

Table 1. *A selection of video applications and games for learning music theory and practice*

Application's name	The type of the application	Web page
Bingo – What instrument is playing?	I	https://outsidetheorchestra.org/bingo/
	I n	https://www.youtube.com/watch?v=mehrrRYiecM
Çalgılar	I n	https://wordwall.net/tr/resource/27050191/m%c3%bczik/%c3%a7alg%c4%b1lar
Vurmalı Çalgılar	I n t	https://wordwall.net/tr/resource/3172472/m%c3%bczik/vurmal%c4%b1-%c3%a7alg%c4%b1lar
Çalgılar	I n	https://wordwall.net/tr/resource/27050191/m%c3%bczik/%c3%a7alg%c4%b1lar
Musical Instruments Sounds for Kids (27 Instruments)		https://www.youtube.com/watch?v=vjJcGlQraek&list=PLCGt6XPQhLd4YQAFKtuegS6leBuwsY7Un&index=3
Aletlerini Eğlenerek Öğreniyoruz Çocuklar İçin Eğitici Video		https://www.youtube.com/watch?v=Onc90IrWSs8
	I	https://www.therhythmtrainer.com/
Ritim	I n	https://wordwall.net/tr/resource/8556898/ritim
	I n	https://www.youtube.com/watch?v=71fkBqZ_4K8
		https://www.youtube.com/watch?v=zReGVTT2LYk
Ezo Sunal ile Ritim Oyunu		https://www.youtube.com/watch?v=XbmiMkF5Y9k
Sol Anahtarı Not Yerleri Çalışması – 1	I n t e	https://wordwall.net/tr/resource/39283399/m%c3%bczik/sol-anahtar%c4%b1-not-yerleri-%c3%a7al%c4%b1%c5%9fmas%c4%b1-
	I n	https://trainer.thetamusic.com/en/content/html5-flash-rhythms
		https://www.dreamapply.com/
Yousician		https://yousician.com/billie-eilish?utm_source=google&utm_campaign=billie-eilish&utm_medium=cpc&utm_term=yousician&gad_source=1&gclid=CjwKCAjwm_SzBhAsEiwAXE2Cv2arVJulFeSDIvAld3JWm3UCCLi4M5fAPCM9aCsuCe-Q3C-hcrCTYxoChQoQAvD_BwE
		https://www.youtube.com/watch?v=OsT7WcoLXrY
Piano Tutorial		https://www.youtube.com/watch?v=Y-nZDMC1Xoo
		https://www.apple.com/mac/garageband/
		https://soundation.com/auth/plans
		https://plarium.com/landings/en/desktop/raid/rdo/media/cave_f002_jt3281?plid=1388766&pxl=google_performance_max&publisherid=RAID_WW_EN_PMAX_1388766&gclid=CjwKCAjwm_SzBhAsEiwAXE2Cv75f2ZrcLXrQhpPBtd-A8S98CF1TzwygXGE89l9NtgpvMDQU0G7pOxoCeRkQAvD_BwE
	I	https://musicplayonline.com/
	I	https://musiclab.chromeexperiments.com/
Song maker	I n	https://musiclab.chromeexperiments.com/Song-Maker

Source: Prepared by the author of this study based on the review

Many music applications for younger children are related to studying and recognizing musical instruments. Applications like "Bingo – What Instrument is Playing?" and "Name that Instrument" provide engaging, game-based learning experiences that enhance students' auditory discrimination and instrument recognition skills. These tools are particularly valuable for educators in early music education settings, offering interactive formats supporting foundational musical skills development.

On the Wordwall platform, applications like "Çalgılar" and "Vurmalı Çalgılar" provide comprehensive learning experiences related to musical instruments. These tools support multimodal learning, offer immediate feedback, and can be adapted to various educational contexts, making them effective resources for teaching about orchestral and percussion instruments.

In addition to the interactive ones, digital learning platforms are also very useful for better learning, studying, and memorizing musical instruments. Applications such as "Musical Instruments Sounds for Kids (27 Instruments)" and "Müzik Aletlerini Eğlenerek Öğreniyoruz Çocuklar İçin Eğitici Video" further enrich early childhood music education by introducing children to a wide variety of musical instruments.

Applications like "Rhythm Trainer" and "Ritim " support the study of rhythm. These tools offer structured and interactive exercises aimed at improving rhythmic skills. Moreover, applications like "Musical Fruits - Rhythm Syllables Clap-Along," "Spring Rhythm Speak, Clap & Count | TiTi TiTi Ta Ta | Level 1," and "Ezo Sunal ile Ritim Oyunu" introduce younger students to basic rhythmic patterns through engaging and interactive methods, utilizing a combination of speech, clapping, and counting to reinforce rhythmic understanding.

Music theory education is made more accessible and engaging through applications such as "Sol Anahtarı Not Yerleri Çalışması – 1" (Treble Clef Note Placement Exercise – 1) and "Theta Music Trainer." Moreover, along with music theory, the second focuses on developing various aspects of musicianship, including ear training, rhythm, melody, harmony, and music theory. Among these resources, the DREAM digital resource exchange platform stands out as a significant tool for facilitating students' understanding of music theory and enhancing their musical abilities (44).

In the realm of vocal instruction, the practical applications of multimedia technologies, including virtual reality, offer novel methods for simulating and practicing vocal performances (45). Applications like Yousician provide students with comprehensive tools to learn various instruments, helping them improve timing, rhythm, and dexterity. "Singing Lesson for Kids - Solfege Lesson" offers a digital learning experience focused on the solfège method, combining visual and auditory elements to foster musical literacy in children. Additionally, "Piano Tutorial" provides an accessible and comprehensive resource for learning piano, catering to learners at various skill levels through video-based lessons and self-paced learning options.

A wide selection of straightforward apps, accessible on tablets or online, supports creative exploration in music education. For instance, GarageBand, Soundation, and Super Duper Music Looper allow students to experiment with sound and rhythm, even in classrooms with limited access to computers. ToneMatrix and other similar applications offer a basis for creating extended musical works, such as composing a song and developing it further. MusicPlay Online is a comprehensive teaching tool that offers interactive music games, instrument lessons, and various educational activities. Chrome Music Lab, another innovative platform, allows students to explore and manipulate different sounds. Tools like the Song Maker app enable students to create songs by experimenting with elements such as melody, harmony, tempo, and instrumentation, fostering a deeper understanding of music composition.

Each of these applications contributes uniquely to the field of music education, leveraging digital technology to enhance learning experiences, support diverse instructional needs, and promote a deeper engagement with music. The ability to practice independently, outside of formal lesson time, empowers students to take greater control of their learning process, leading to increased motivation and engagement with the material. By making music education enjoyable and easily accessible, all these platforms can be influential in fostering a lifelong appreciation of music in young learners.

CONCLUSION

The findings of this study affirm the significant potential of digital technologies in enhancing music education at the primary school level. The theoretical significance lies in the validation of the hypothesis that digital tools not only complement traditional teaching methods but also introduce innovative pedagogical strategies that align with the cognitive and developmental stages of young learners. These technologies provide educators with a broader spectrum of resources that cater to various learning styles, thus promoting a more inclusive educational environment.

From a practical standpoint, the integration of digital tools into music education has been shown to significantly enhance student engagement and learning outcomes. The study demonstrates that when thoughtfully selected and strategically implemented, digital resources can make music education more interactive, expressive, and accessible. This not only boosts students' motivation and interest in the subject but also aids in the development of essential musical competencies and cognitive skills.

The basis for these interpretations is grounded in the alignment between the study's outcomes and the initial hypotheses. The results clearly indicate that digital technologies, when incorporated into the music education curriculum, can substantially improve the pedagogical process by addressing the specific needs of students and the instructional objectives of educators. The study's findings emphasize the necessity of adapting traditional teaching methods to the needs of 21st-century students by incorporating digital technologies in a manner that is both meaningful and pedagogically sound.

IMPLICATIONS AND LIMITATIONS

While the study provides insights into the benefits of digital technologies in music education, it is important to acknowledge certain limitations. The research was conducted within a specific educational context, which may limit the generalizability of the findings. Additionally, the effectiveness of digital tools in music education may vary based on factors such as the availability of technological resources, teacher proficiency with digital tools, and the socio-economic context of the students. These factors suggest that while the results are promising, further research is needed to explore the applicability of these findings in diverse educational settings.

SIGNIFICANCE AND FUTURE DIRECTIONS

The theoretical and practical significance of this study lies in its contribution to the growing body of literature on digital didactics and its practical implications for music education. By demonstrating how digital technologies can be effectively integrated into the music curriculum, this research provides a foundation for future studies and practical applications in educational settings. However, as digital technologies continue to evolve, it is crucial for educators and policymakers to stay informed and adaptable to ensure that the integration of these tools continues to benefit students, because the future of music education lies in the ongoing synergy between technological advancements and pedagogical practices, which together can create more engaging, effective, and inclusive learning environments for students.

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