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Miscellanea

Music Technology: A Synaesthesia for Music Education in Contemporary Societies.

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Abstract: Music technology is becoming an integral part of music education in the 21st century. It is revolutionizing the way music education is taught in contemporary society. Music technology is changing the way music students learn and do music, as such opening up new possibilities for creativity and expression of music. Thus, technology has made music education so global that students can learn from digital audio workstations (daw) to online communities for sharing music, and music ideas and patterns of applications. Technology is reshaping the field of music education. This research explores the impact of music technology on music education, and how it can enhance and enriches the learning processes; including the ways it promotes creativity, collaboration, and engagements. It also examines the challenges associated with integrating music technology in the classroom, and the opportunities it posits for the future of music education. The findings of the study suggest that music technology can be a powerful and strategic tool for promoting creativity, collaboration, and engagements in music education, and can also assist in creating a more immersive and holistic teaching and learning experience.

Keywords: Music education; music technology; didactic communication

1. Introduction

Music technology in the 21st century incorporates the use of device, mechanism, machine, or tool by musicians, composers, or music educators/instructors to boost the quality of music and accompanied sounds. In the context of this work, it involves the application of technological tools to enhance the teaching and learning

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of music. In an increasingly technological age where activities in the economy have gone digital, issues of music pedagogy are now preferably done digitally to reduce physical limitations in gaining knowledge. The evolution of music technology has brought significant positive impacts on the way's music is taught and learned in school. Obviously, the traditional analogue classroom music education, where students learn how to play instruments or sing in choirs are still important aspects of music education. However, with the introduction of new technologies, these lessons are now always supplemented with modern digital tools like music notation software, interactive learning apps, and online courses (Abril & Gault, 2016). These systems have created room for a more personalized and self-directed approach to music education, where students can learn at their own pace to explore their musical interests and talents.

Music technology has fundamentally changed the way people teach and learn music. As earlier said, from the digital sheet music to online courses and learning communities, music technology has made it easier for people to teach, learn, create, and play music (Archer & Savage, 2014). Perhaps, in the past, music education was limited to traditional methods such as reading sheet music or learning how to play an instrument; but with the invention of digital systems, people began to have access to a wide range of technological tools, and resources to help them learn how to create music in modern and innovative ways (O'Connor, 2018).One of the most significant impact of music technology on music education is the way it has democratized access and routes to music learning. In the past, music education was often reserved for people who could afford expensive lessons or had access to musical instruments (Hess, 2016). However, with the rise of online resources and digital tools, anybody with an internet connection can access a wide range of musical learning materials. This development has created enabling opportunities for people of all backgrounds-rich and poor, to engage in music, and explore their creativity. In addition, music technology has helped in breaching the gap between professional musicians and amateur enthusiasts, allowing for a more collaborative and interactive music education.

2. Music Education

Music education is a field of study associated with the teaching and learning of music. It encompasses all the learning domains such as the psychomotor domain (the development of skills), the affective domain (the learner's willingness to receive, internalize, and share what is learned), and the cognitive domain

(acquiring knowledge). Music education is a broad term that deals with many different approaches to teaching and learning music. It involves learning about music theory, history, and performance at its basic level (Mbango, 2007). However, it can also include exploring the roles of music in the society, learning about music technology, and developing creative skills through composition and improvisation. Music education can take place in a variety of settings such as schools, community centers, and private studios. The ultimate goal of music education is to help students develop a deep and lasting appreciation for music (Nwamara, 2006). Thus, music education has so many aspects, four of these aspects are briefly discussed below:

- **Music theory-** Music theory is the study of the elements and structures that make up music. It consists of topics such as melody, harmony, rhythm, and form. Learning music theory can help students to understand and appreciate the structure and meaning of music. Hess (2016) opines that music theory can help students to explore their own compositions and improvisations. Perhaps, one major factor about music theory is that it can be applied to any style of music, from classical to jazz, to rock & roll.

- **Music history-** This involves the act of studying the evolution of music over time. It includes the study of composers, genres, and trends of music. Music history can provide insights to social, political, and cultural contexts that have influenced the development of music (Rozina, 2008). It can equally help students to understand the impacts and traditions that have shaped the music they hear and those trending.

- **Music performance-** This is a key part of music education. It involves learning how to play an instrument or how to sing, as well as developing skills like stage presence and musical expression (Onwuegbuna, 2015). Music performances can also include ensemble playing, where students learn how to collaborate and communicate with other musicians. It is an important way for students to develop their own audience.

- **Music technology-** This is the use of technology to create, record, and perform music. Music technology includes tools and devices such as computers, recording software, synthesizers, and electronic instruments (Salavati, 2016). It is undebatable that music technology revolutionized the way music is made and experienced, and it has opened up new possibilities for creativity and innovation.

Finally, music technology has made it easier for people to access music-making tools and resources. Details on music technology are discussed below.

3. Music Technology

Music technology is a comprehensive aspect of music that concerns the application of science and technological tools, techniques and processes in music composition, performance, research, education, therapy, and more. Music technology comprises musical instruments technology and audio/multimedia technology. Musical technological instruments cover areas such as: designing, constructing, tuning, and repairing (Milder, 2017). Thus, music technology can be any technology such as a computer, an effect unit or a piece of software, that is used by a musician to help make music, especially the use of electronic devices and computer software to facilitate playback, recording, composition, storage, mixing, analysis, editing, and performance (Adeleke, 2008). Also, Adeleke (2011), opines that "music technology delves into sound engineering for generating tones, recording musical sounds, editing and mixing of sound". Besides, the primary aspects of music technology include the use of computer software for notation, teaching performance techniques, tone generation, and digital mixing. It also involves any form of scientific innovation to aid the creation and reproduction of musical ideas for performance, using electronic musical devices. More so, music technology is connected to both artistic and technological creativity.

However, musicians are striving to build new forms of expression through musical and physically creating new devices to enable them do so. Although, the term music technology is now commonly used in referring to modern electronic devices such as the piano and guitar, these systems are earlier used as examples of music technology. Perhaps, in the computer age the ontological range of music technology has greatly increased, and it may now be mechanical, electronic, software-based or even purely conceptual (Kimster, 2023). Music technology is being used in many modernist and contemporary experimental music situations to create new sounds possibilities. Perhaps, as technology advances, it finds its way into all sorts of musical applications. Consequently, for those who are creative and possess musical aptitude, as well as computer skills, the possibilities of exploring are endless. Whence, new sounds and styles of music are created everyday using music technology, and the wide array of options it provides. For instance, by combining a synthesizer, acoustic guitar, recording software, and a computer, a breadth of musical stylings can be created (Paraisiz, 2018).

4. Technology in the Educational System

In the early 1990s, technology started taking full pace in various aspects of human endeavours, including education. Technology-led educational development became the main focus for so many developed nations, and some developing nations with the mindset of growth were also influenced by this pace. Perhaps, the Norwegian Government amongst others made it mandatory amongst other states to adopt technology into all fields in its educational system (Cameron, 2016). The knowledge-promotion which was put in place in 2006 emphasizes that "digital literacy" must be a core competency for all students at all levels. Perhaps, after the introduction of digitization in the knowledge promotion, of which the intention was to gradually include the use of technology in all courses (Hatlevik, *etal.,* 2009). Hence, acquiring technological gadgets for all students becomes the prerequisite for technology-based education. This process may begin by acquiring individual laptops for students and teachers, and then getting instructors to teach the teachers. By engaging the teachers first on the tech training, it will help to reduce the cost of hiring manpower to train the teachers and their numerous students. By training the teachers first, the teachers can then train the students and also learn how to control them in the appropriate usage of the devices.

However, apart from the Norwegian government, many schools especially universities in Nigeria have adopted technology-based education in their curriculum. Schools like University of Port Harcourt, Rivers state University, Ignatius Ajuru University of Education are using technological systems in teaching and administrating examinations in some of their courses including music. For instance, in line with the visions of the N.P.E (2004), and towards keeping a breasts of the contemporary realities in the Nigerian and global societies, the University of Port Harcourt realigned itself as an entrepreneurial University with major focus on technology-based education, has feasible objectives of producing graduates who are not only prime assets to the corporate human resource market, but are also adequately equipped with the entrepreneurial skills domicile on technology capable of setting up businesses on of their own (Amaegbe, 2018). This means that no matter the discipline a student is undergoing in the institution, that student must undergo courses in technology to help not only in effective and efficient teaching/learning activities, but in addition, utilize technical knowledge in being able to carry out multi-resourceful tasks.

5. The Relevance of Music Technology to Music Education

Music technology has revolutionized how people teach, learn and do music. In previous times, music education was mostly limited to traditional methods like reading sheet music or playing instruments, but since the introduction of technology, people have access to a wide range of digital systems and resources that helps them create music in newly and exciting patterns. Thus, this development has been from digital sheet music to online tutorials and online communities, expanding more channels to learn and explore music. The major roles of music technology in music education are discussed in three sub-themes.

- **Music technology as a modification and complement for the traditional classroom music education:** Music technology has a significant impact on the traditional classroom music lessons. One of the most feasible ways that music technology has impacted on the traditional classroom music lessons is through the use of digital music notation software. This software allows music teachers to create and distribute digital music lectures, exams, and scores, which students can view and interact with on their own device and leisure. This process has made it easier for teachers to provide individualized instruction, and has also created forum for a more interactive and collaborative learning environment. Also, music technology has made it possible for music teachers to use a wide range of audio and video resources in the lessons. These items include recorded performances, interviews with musicians, and video tutorials. This situation has made it easier for teachers to bring the world of music into the classroom, and to connect students with real-world examples of music making (Higgins et al., 2012). Besides, it has made provisions for a more engaging and immersive learning experience, where students can see and hear how music is done in the real world.

Music technology has also made it possible for teachers to use a variety of interactive music apps in their lessons. This includes things such as virtual instruments, drum machines, and digital audio workstations. These apps allow students to experiment with different sounds and techniques, and create their own music in a fun and interactive way. Also, they allow teachers to assess students progress in a more objective way, by providing data on things such as accuracy and speed; which can be used to tailor instructions to each student's needs (Jewitt, 2011). Music technology has also made it possible for teachers to use a variety of online collaboration tools when delivering their lessons. These collaboration tools include things like Google Classroom, Soundtrap, and Microsoft Teams. These tools are capable of allowing students to work together on music projects from

different locations, and share their work with the class in real time. They can equally allow for more efficient and effective communication between students and teachers, and can be used to supplement traditional in-person instruction. This situation has made it possible for teachers to create a more collaborative and engaging learning environment. Music technology has also made it possible for teachers and students to use the AI-powered devices to assist music creation, teaching and learning activities. These activities include things as AI-generated backing tracks, virtual accompanist, and AI-powered music composition assistants. The above tools can be useful in helping students improve their musical skills, and also explore new possibilities and patterns of creating music. They can equally be used to help students with solving specific music-related problems such as composing melodies or improvising solos. This activity is a relatively new area of music technology, but is having a significant impact on music education.

- **Music technology as a democratizing force in music education:** One of the most significant ways that music technology can democratize music education is through the rise and presence of online resources and communities. Obviously, sites like YouTube, Sound Cloud, and Band camp have made possible for anyone to share their music with a global audience. This has opened up new opportunities for people to discover and learn from a wide range of musical styles and genres. This has also created a more level playing field for independent musicians and music educators, who can now reach a global audience without needing to go through traditional channels like record labels or production. Music technology has also democratized music education through the development of affordable digital tools and software. In the past, learning how to play an instrument or compose music often, required expensive equipment and lessons. Perhaps, with the rise of digital music production, software like Garage Band and Ableton Live, it's now possible to create professional-quality music on a budget. Thus, this has made diverse range of musical voices to be heard. It has also allowed for a more DIY approach to music education, where people can learn at their own pace, and in their own way. In addition to this, music education also promote efficacy in the rise of online learning platforms and courses. Platforms like Coursera, Udemy, and Khan Academy offer a wide range of music courses that are accessible to anyone with an internet connection at any place and time. These courses cover issues on music theory to music production, and they often include interactive exercises and assignments that allow students to apply what they have learnt.

Besides, many of these courses are also offered for free, or at a moderate low cost, making them accessible to people of all socioeconomic backgrounds; thereby making grounds for a more global and inclusive approach to music education. Fourthly, music technology has also promoted music education through the rise of Crowdsourced music initiatives. Projects such as the Open Music Theory and the Open Pedagogy Project aims at making music education resources freely available to everyone willing to do music. These projects are often crowdfunded or volunteer-run, and they rely on the contributions of music educators and enthusiasts from around the world. This will help to create a more collaborative and community a driven approach to music education, where people can share their knowledge and experience with others. Besides, it has also allowed for the development of new and innovative approaches to music education. Fifthly, music technology has also made it possible for learners to create and share their own online resources, which has led to the rise of "bedroom producers", who are able to create professional-quality music in their homes. This situation has opened new avenues for music education; as students can learn by doing, and by sharing their works with others. It has also made ways for a more flexible and creative approach to music education, as students can explore their interests and musical styles.

- **Music technology as a tool for expanding the horizons of music learning and creativity:** Music technology has changed the pattern that music is composed and produced. In the past, music composers and producers relied on the traditional instruments and analog recording equipment to create their music, but in recent times with the advent of digital technology, new tools like DAWs (digital audio workstations) and MIDI (musical instrument digital interface) have made it possible to create music in ways that were not possible earlier. This scenario has opened up new creative possibilities for composers and producers, and has led to a more diverse and dynamic musical landscape. An example of this is through the use of DAWs in the classroom. DAWs are software programs that allow students to compose, record, and produce their own music. They can be useful in creating multi-track recordings, manipulate sounds with effects, and music in varieties of ways. Thus, this has made it possible for students to learn about the creative processes and the technical aspects of music production in a more participative and interactive manners. It has also opened up new opportunities for learners to collaborate, and foster a more creative and innovative activities (Nahid et al., 2019).

Secondly, music technology has changed the pattern of teaching and assessing students in music. Basically, traditional methods of music education focused on

learning music notation and sight reading, but with the advent of music technology, there are now new ways to teach and assess music students. For instance, instead of simply listening to students playing a piece of music, teachers can use technology to analyze students' performance in real time act. This may allow for a more nuanced assessment of the students' performance, and can help to identify areas for improvements. It may also allow for a more personalized and individualized approach to music education. Music technology has also changed the pattern of interaction with music by students outside the classroom. With the rise of streaming services and social media, students have unprecedented access to a wide range of music (Ming-Hung et al., 2016). Having access to these, they can discover new music from all over the world, and can also interact with musicians and others and other music fans in a variety of ways. This circumstance has helped to foster a sense of community and connections around the music world, and has given students more active roles in shaping the musical landscape.

Music technology has also led to the development of new ways for students to express themselves creatively through engaging in musical acts (Brown & Liedholm, 2002). For instance, before now students who wanted to share their music would have to rely on physical media like CDs or cassettes, but now, students can use various platforms such as Sound Cloud or Band camp to share their music with the global audience. They may also use social media platforms such as Instagram or TikTok to connect with other musicians and fans. However, with the rise of streaming platforms such as Twitch, students can perform their music live for the audience, from the comfort of their homes. Perhaps, these new forms of interactions have led to more diverse and vibrant musical landscape. Music technology has also changed the way music is performed and experienced (Sen, 2023). Previously, live music performances were limited to specific time and place, but with the advent of new music technology, music performances can now be experienced in a variety of ways; such that with virtual reality technology, it is possible to experience a live concert from anywhere in the world. This has paved way for a more immersive and interactive experience for music fans, and has also made it possible for musicians to reach a wider audience. It has also led to the development of new forms of musical performance like streaming and virtual concerts.

The concept of "immersive music education", which is the type of education that uses technology to create an immersive and interactive learning experience (Biagi & Loi, 2013). For instance, there are now virtual reality platforms that allow

students to explore different musical concepts in a fully immersive environment. These platforms allow students to experiment with different sounds and instruments, and to see how music is produced. This pattern can help to deepen the students' understanding of music and can also make learning more engaging and enjoyable. It also allows for a more personalized learning experience, as students are disposed to explore their interests and passions within the environment. Music technology has also led to a number of music career opportunities in the music industry. In the past decades, the music industry was basically focused on artists and musicians, but in recent times with the rise of technology and the digitalization of global activities including music, there are now new career paths in areas such as music production, sound design, and virtual performance. These career paths in music have opened opportunities for students who may not have had traditional background in music.

The new career paths will also help to diversify the music industry, and also make it more accessible to people from all backgrounds. One major way that this relates to music education is through the growing field of "music technology education ", which is a type of music education that focuses on the act of teaching students the use of technology in music production and performance (Moog, 2009). This process includes topics like audio production, digital music composition, and the use of music software. An example of this is Berklee College of Music's "Music Technology and Innovation "programs. Perhaps, this program teaches students the use of technology in music, and it also gives them hands-on experience with tools like digital audio workstations and electronic instruments.

- **Challenges of technology-based music education**

It is proposed that anything that has advantage also has its disadvantage. This situation is not void of the relationship between music technology and music education. According to Seddon (2016), and Adebowale (2008), music technology can be a valuable tool for music education, but there are a number of challenges to overcome in order to realize its full potential. Some of these few major challenges to overcome while applying music technology in music education are access to technological systems and trend, teachers' IT training, issues of assessment and evaluation with IT. These are discussed thus;

- **Assess to technological systems and trends:** One of the major challenges of using music technology in music education is the issue of access to technology. This challenge is relevant to consider due to the expensive nature of music technological systems. This expensive nature of music technological systems may

lead to schools and individual students not being able to afford the latest software and hardware. Thus, this situation can create a disparity between those who have access to the best and most trending music tech resources, and those who do not have. In addition, this can lead to a situation where some students are able to fully benefit from music technology, while others are left behind. This work therefore suggests that one way to address this issue is through government intervention on funding and grants to support music technology in schools the growth and development of music education.

- **Music teachers on-the-job training:** The second challenge of using music technology in music education is the issue of teachers on-the-job training to facilitate the effective application of technological systems by the teachers. Many teachers may not have the necessary training or skills to effectively use music technology in the classroom. This challenge can result to a situation where music technology is not used to its potential, and students are not able to fully benefit from the system. The teachers need to learn how to use the apps, before using it to teach the students. The teachers therefore need enough time to get used to these apps before teaching the students. On this ground, this work suggests that in order to solve this problem, there is need to provide teachers with ongoing professional training and development opportunities to learn about music technology and how to effectively use it in the classroom. However, these opportunities could be gotten from workshops, online courses, or other forms of human capital/manpower development and professional growth.

- **Issue of students' evaluation:** The next challenge is that it can be difficult to assess and evaluate students learning when using music technology, because it often involves non-traditional methods of learning and assessment. This pattern can make it difficult to ensure that students are meeting learning objectives, standards and outcomes. However, this work suggests that one way of solving this problem is to develop new methods of assessment that are geared towards the unique nature of music technology. These methods may include peer assessment, self-assessment, and performance-based assessment. In addition to the above challenges, the researcher found the following challenges relevant to this work;

- **Adaptability:** The change from analog to digital teaching/learning is very disruptive, as such some learners use enough time to adapt to the pattern. Also, students who are in default used to the traditional classroom teaching environment may be find it very difficult to adapt to online platform learning or other technology-based music appliances or applications (Adedeji, 2004). Besides, while

the exact content may be delivered for both physical and online platforms classes, comprehension rates differ amongst learners; thus, participation and interaction may not be fully detected.

- **Distraction:** Studying online using the internet via the via the various social media platforms can cause lots of distractions to learners. Most times, while studying with computer gadgets online, there are chances of deviating from what the student is learning and delving into other activities. Distractions from technological tools contribute to time wastage, loss of concentration, and equally reduces the effectiveness of technological tools in music education (Ikibe, 2000). However, to overcome distraction, students must identify their learning goals and objectives, try to building a study plan to achieve the learner's objectives.

- **Technical barrier:** Technical issues can cause disruption of classes during online learning. This process of teaching and learning with technologically enhanced appliances and facilities ranges from low internet connection to broken hardware parts, and entirely faulty software. Many technical problems arise from a lack of understanding of technological and computer applications. Thus, having a high-speed internet connection is one of the most suitable ways for an effective, efficient and flawless online learning experiences, and applications usage.

- **Student's computer knowledge:** One major issue on technology-based music education is that students must @ least possess some computer knowledge in order to handle such appliances. Unfortunately, most students do not have basic computer knowledge. Lack of computer knowledge will make it difficult for learners to use technology-based applications to flow effectively.

5. Conclusion

Music technology has had a pronounced impact on music education in contemporary society. It has obviously opened up new opportunities for music education, thus allowing students to explore different types of music, experiment with new sounds, and collaborate with others in new patterns. Music technology has also made music education more accessible to people from all backgrounds, and has led to the creation of new career paths in the music industry. In addition, the overall music technology has been a powerful force for innovation and creativity in music education, and will continue to play a significant role in shaping the future of music education. However, it is important to note that music technology is not a replacement for traditional music education, rather a

complement to the traditional methods, and can be useful in enhancing the learning processes and experiences. It is also considerate to acknowledge the ethical implications of using music technology music education. In addition, it is very feasible to ensure that students have the opportunities to develop their own creativity and unique voice, rather than simply emulating what they see on a screen. Music technology can be used in promoting inclusion and diversity in music education. It enhances teaching abilities and makes learning experience very easily, fun and interesting.

Finally, one specific way in which music technology is being used in music education is through the use of virtual reality. For instance, there is a project called "VR Music Box" that allows users to create their own virtual environments, including music and sound effects. This project is being used in schools to teach students about music composition and production. Relatedly, another example of the relevance of technology to music education is the "Sound Stacks" project, which allows users to create music with virtual building blocks. Thus, this project has been used in classrooms to teach students the fundamentals of music, such as rhythm, melody, and harmony.

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