A NEW NORMAL IN TECHNOLOGY, ARTIFICIAL INTELLIGENCE, AND DIGITAL MEDIA: CATALYST FOR MUSIC TEACHING IN NIGERIA

ADEYANJU, ADESOLA ISMAILA
Headquarters Directorate of Music, Nigerian Air Force Abuja;
University of Port Harcourt, Rivers State
adexdolor@gmail.com; adesola_adeyanju@uniport.edu.ng
+2348083949044
Orcid: 0009-0001-0282-9539

And

AYOKUNMI, OLAOLUWA MARVELOUS
University of Ibadan, Ibadan, Nigeria
ayokunmiolaoluwa2016@gmail.com; om.ayokunmi@mail.ui.edu.ng
+2347030597017
Orcid: 0009-0007-6072-1837

Abstract
The new normal in technology, driven by artificial intelligence (AI) and digital media, is changing educational practices worldwide; these including music teaching in Nigeria. Inadequate infrastructure, limited teaching resources, and insufficient exposure to new digital tools have constrained traditional music education in Nigeria. These issues have reduced learner engagement and restricted access to modern music production and performance skills. This study engages the Technological Pedagogical Content Knowledge (TPACK) framework and the Constructivist learning theory. The research uses a mixed-methods approach, including surveys, classroom observations, and semi-structured interviews with music educators and students from selected Nigerian institutions. This method allows for assessing current levels of AI and digital media integration, perceived barriers, and teaching outcomes. Findings show that AI-supported tools, such as adaptive learning platforms, virtual instruments, and digital audio workstations, greatly improve lesson delivery, personalized learning, and practical musicianship. Digital media platforms also support collaborative learning, content creation, and remote teaching. However, challenges remain, including poor internet access, inadequate teacher training in AI, and gaps in policy. The study suggests a framework focusing on building digital skills, redesigning the curriculum, and adopting AI-driven teaching technologies. Its implementation model shows how music researchers can integrate AI and digital media research into music education to improve teaching effectiveness, boost learner motivation, and enhance global competitiveness.

Keywords: *Artificial Intelligence, Digital Media, Music Teaching, Educational Technology, Nigerian Music Education.*

Introduction

Music education in Nigeria is evolving. Rapid advances in artificial intelligence and the spread of digital media are changing how teachers create lessons, how learners access music, and

how communities interact with music. This article argues that these technologies create a new normal. When used thoughtfully, they can improve access, diversify teaching methods, and make music education more relevant to the culture in Nigerian classrooms and communities. For decades, music education in Nigeria has combined rich local traditions with formal curricula from colonial and post-colonial systems. Today, affordable smartphones, better internet access, and cloud-based platforms provide new ways to share resources, teach remotely, and collaborate on music. At the same time, AI-driven tools like smart practice assistants, adaptive learning platforms, and automated transcription and composition aids are lowering technical barriers. They enable personalized learning paths that were previously difficult to achieve in many local areas. Despite these advances, the adoption of technology in Nigerian music education is still inconsistent. Many teachers lack training in digital teaching methods, schools face infrastructure challenges, and curricula often do not reflect the benefits of AI and multimedia. This article explores how AI and digital media can support music teaching in Nigeria. It will identify practical ways to integrate these tools, highlight challenges and ethical issues, and suggest actionable recommendations to connect technology with local teaching goals and cultural values.

Literature Review

Teachers' ability to turn technology into valuable learning relies on a solid understanding of content, teaching methods, and technology. The TPACK framework developed by Mishra and Koehler (2006) remains the most commonly used tool for examining this combination. Effective teaching happens at the intersection of Content Knowledge (CK) - music content, Professional knowledge (PK) - teaching methods, and Technological Knowledge (TK) - tools. Studies in Western music education highlight that technology is valuable only when tasks focus on musical thinking rather than just mastering the tools (Bauer, 2014; Ruthmann & Mantie, 2017). Research shows that teachers with better TPACK create tasks using DAWs (digital audio workstations) and compositions that encourage reflection, revision, and musical decision-making (Gai, 2024). However, in Nigeria, research shows a consistent issue: music teachers have strong subject knowledge but lack confidence in specific technological areas (Modeme, 2022; Amaegbe, 2023). Professional development (PD) often consists of general ICT workshops that do not address music-related tasks (notation, DAW routing, audio capture) or the skills needed for interpreting algorithmic feedback. This gap leads to two main problems: (a) under-use of powerful tools and (b) misuse, where technology becomes an end goal instead of a means to enhance musical learning. There is a need for thorough evaluations comparing PD models that focus on music-specific TPACK (e.g., micro-credential plus coaching versus one-time workshops). The solution is to implement and assess practice-based PD pilots that mix hands-on DAW labs, planning and teaching cycles, and reflective assessments, measuring both teacher TPACK improvements and student learning results.

AI tools like adaptive tutors, automated transcription, and generative composition systems provide immediate, data-rich feedback and new creative ideas (Li, 2023; Merchán Sánchez-Jara et al., 2024). From a sociocultural viewpoint (Vygotsky, 1978), these tools act as cultural mediators that can extend the zone of proximal development by providing support when human tutors are unavailable. Research in Western contexts shows short-term improvements in specific skills (intonation, rhythm) and increased practice motivation with AI tutors (Li, 2023). Generative systems also inspire ideas by providing students with musical material to adapt and critique (Merchán Sánchez-Jara et al., 2024).

However, algorithmic feedback often focuses on measurable aspects and may not capture expressive details and stylistic interpretation. Additionally, introducing AI creates a mixed

feedback environment where teacher, peer, and machine feedback interact in complex ways. Few empirical studies explore how learners balance and combine these feedback sources, and even fewer examine how teachers manage algorithmic evaluations to maintain musical values. There is limited research on mixed feedback environments in classrooms and on teaching methods for handling AI feedback. Classroom trials should compare different feedback setups (teacher-only, teacher plus AI, peer plus AI) and document their effects on expressive performance, compositional reasoning, and learner agency, alongside teacher methods for interpreting algorithmic results.

DAWs have expanded the definition of musical literacy, making arrangement, sound design, and multimodal composition key learning outcomes (Bauer, 2014). Research indicates that scaffolded DAW tasks, combined with reflective portfolios, more effectively demonstrate ongoing creative growth than single-performance assessments (Gai, 2024). In European contexts, reliable assessment of production work validates rubrics and inter-rater training (Wiggins & Forth, 2015). In Nigeria, some excellent programs (university studios, private academies) highlight the potential of DAWs, but many programs lack validated assessment tools and face infrastructure challenges that make regular DAW use difficult (Modeme, 2022; Amaegbe, 2023). Without process-focused assessments and clear authorship guidelines for AI-assisted work, evaluations risk favoring students with access to home studios or private resources. Therefore, there is a need for validated, context-sensitive rubrics that include process (drafts, reflections) and product (mix, arrangement), as well as AI authorship disclosure. Collaborating to develop and test portfolio rubrics with Nigerian departments, including training for raters and ensuring inter-rater reliability, is essential, as is incorporating AI authorship disclosure into standard assessment practices.

National policy documents (Federal Ministry of Education, 2019) and international reports (UNESCO, 2020) outline ICT goals, but many African institutions face implementation challenges like unreliable power, limited bandwidth, and tight maintenance budgets (Modeme, 2022; Amaegbe, 2023). These systemic issues influence who benefits from the "new normal." Local innovations—including mobile recording workflows, studio partnerships, and regional hubs—show promise but are often uneven and ad hoc. Equity concerns are pressing; technology can widen existing gaps unless paired with intentional access strategies (such as loan programs, scheduled lab time, and regional hubs). Translating policy requires discipline-specific plans that include costs for maintenance, technician roles, and PD, rather than just one-time equipment purchases. Existing models for sustainable music technology (solar-powered labs, offline DAW workflows, regional hubs) are few in number. There is a need to pilot and assess scalable infrastructure models with detailed budgets and maintenance strategies, and to push for funding that supports technician jobs and professional development linked to measurable outcomes.

AI systems often rely on Western data, raising issues of stylistic bias and cultural fit when used in African musical traditions (Merchán Sánchez-Jara et al., 2024). Unresolved questions about authorship and how to credit AI contributions in student work remain in many institutional policies. Ethical use also includes considering data privacy and consent when analyzing student performances. There is a lack of ethical guidelines tailored to the specific needs of music education that address cultural bias, authorship questions, and data governance. There is a need to bring together interdisciplinary groups (musicologists, ethicists, technologists) to create contextually relevant guidelines and classroom protocols for AI use, including diverse training datasets and clear authorship statements.

Methodology

This research adopts a mixed-methods approach to investigate how artificial intelligence (AI) and digital media enhance music education in Nigeria. The methodological choices are grounded in two primary theories. The first theory is Technological Pedagogical Content Knowledge (TPACK), which highlights the essential teacher knowledge required for effective technology use (Mishra & Koehler, 2006). The second theory is on sociocultural/constructivist principles, which view digital tools as cultural resources that facilitate learning within social environments (Vygotsky, 1978).

The study will use an explanatory sequential mixed-methods design. The first phase (quantitative) focuses on examining prevalence, relationships, and predictors (including TPACK and infrastructure) across various institutions. The second phase (qualitative) consists of targeted case studies aimed at elucidating mechanisms, classroom dynamics, and contextual challenges. This sequence enables statistical generalization regarding patterns and provides a purposeful depth for interpreting causal mechanisms. TPACK highlights quantifiable teacher knowledge, whereas sociocultural theory centers on interactional processes. The research includes samples from eight institutions across Nigeria's geopolitical regions to capture differences in resources and practices. These consist of two federal universities, two state universities or colleges, two colleges of education, and two private music academies. The researcher will craft all tools to apply the theoretical concepts in practice.

The quantitative analysis involves descriptive statistics that summarize access and usage trends. EFA and CFA are used to validate the TPACK instrument. Inferential analyses, such as t-tests and ANOVA, are performed to compare different types of institutions. Multiple regression analyzes student outcomes in relation to TPACK, infrastructure, and participation in professional development. Pre- and post-paired tests assess the impact of professional development. The researcher will use effect sizes and confidence intervals to aid in comprehending the findings. The qualitative analysis consists of transcripts and observational notes, which the researcher will use to scrutinize through thematic analysis employing both inductive and deductive approaches. Initial codes are derived from TPACK and sociocultural frameworks, while inductive coding uncovers new practices, such as hybrid feedback environments. Two independent coders assess a portion of the transcripts to ensure consistency, utilizing Cohen's κ. Analytic memos document interpretive decisions made throughout the process. Microethnographic case studies illustrate how teachers facilitate interactions, how students adapt, and how equity issues surface.

The researchers confirm validity by piloting the tools, combining surveys, observations, artifacts, and interviews, and consulting with participants on emerging themes. The researchers improve reliability through discussions among raters for the rubrics and the process involves double data entry for surveys, complemented by reflexive memos and an audit trail to enhance reliability. Limitations in purposive sampling restrict statistical generalizability, particularly given the rapid development of software tools. To tackle these challenges, the analysis prioritizes teaching methods and resilient workflows over specific software versions.

Ethical Considerations

Regarding ethical considerations and data governance, the researcher obtained approval from the lead institution's review board. We obtained informed consent and parental permission for participants under 18; participants may withdraw at any time. Data are anonymized and securely stored on encrypted drives. There are specific protocols in place for AI contributions: students

are required to disclose any AI work in their portfolios, and usage logs that contain personal data are kept confidential and destroyed after the designated retention period. Findings are reported in aggregate to protect the identities of both institutions and individuals. The approach offers validated resources such as TPACK-for-Music, evidence of the effectiveness of professional development, frameworks for hybrid feedback systems, and established workflows. These results actively apply the TPACK framework by assessing and enhancing integrated teacher knowledge. They also illustrate how tools impact learning in social settings. This study provides both theoretical understanding and practical guidance for advancing equitable, contextually aware music technology integration in Nigeria.

Data Presentation

This research examined the role of artificial intelligence (AI) and digital media in enhancing music education in Nigeria. Utilizing survey responses (N = 298; 183 educators, 115 students), twelve classroom observations, and 24 semi-structured interviews, the outcomes reveal a varied situation. While there are effective practices, overarching issues and gaps in teachers' technological preparedness limit broader influence. The findings below connect to the study's theoretical frameworks (TPACK and constructivist theory) and depict the existing condition of music education in Nigeria.

1. Teacher's knowledge and readiness: TPACK as a significant predictor Educators indicated strong content knowledge (CK mean ≈ 4.02/5) and moderate pedagogical knowledge (PK ≈ 3.45). However, technological knowledge (TK) emerged as the area needing the most improvement (≈ 2.58).The mean score for the integrated TPACK composite was approximately 3.12. Regression analysis indicated that TPACK emerged as the most significant predictor of perceived student learning improvements (standardized $\beta \approx = .36$, $p < .001$), even after accounting for factors such as infrastructure and participation in professional development (PD). These findings align with the central premise of the TPACK framework: possessing knowledge of content and teaching strategies is insufficient for effective technology integration. Educators must also have hands-on skills to select and modify tools that align with musical objectives (Mishra & Koehler, 2006). Interview insights reinforced this notion. Numerous teachers were able to articulate specific musical goals, such as ensemble balance, phrasing, and compositional intent. However, they felt uncertain about which DAW workflows or AI tutors would aid those aims without simplifying learning to just technical exercises.

2. Infrastructure and accessibility: ecological limitations affect opportunities: Infrastructure is a crucial factor. A significant 71% of participants reported regular power outages. Only 22% said they have stable, high-speed internet that supports synchronous remote collaboration. Access to institutional hardware varied widely. About 46% reported having at least one lab with audio interfaces, while many relied on personal devices or informal studio collaborations. Tools serve as cultural mediators, but their potential is only fully realized in supportive environments (Vygotsky, 1978). The findings from Nigeria show that the same technologies yield different educational outcomes depending on infrastructure, technical support, and institutional practices. Teachers' creative solutions, such as smartphones for recording, installing offline digital audio workstations, and scheduling after-hours studio time, demonstrate both resilience and creativity. However, these examples highlight that individual resourcefulness cannot replace the need for systemic investment in maintenance, technical staff, and reliable infrastructure.

3 Patterns of technology use: DAWs are dominant while AI is still developing. Digital Audio Workstations (DAWs) were the most commonly used production tools. 19% of participants used them weekly, and 22% monthly. In contrast, the use of AI-enabled tools, like ear tutors and composition assistants, was low, with about 4% using them weekly. The frequency of DAW use showed a strong association with technological knowledge ($r \approx .61$), suggesting that hands-on experience supports classroom application. DAWs serve as a basic entry point for production education in Nigeria. While AI tools have potential for personalized practice and creative generation (Li, 2023; Merchán Sánchez-Jara et al., 2024), they are mostly in the experimental stage. This gradual spread indicates that building technological knowledge through engagement with DAWs may be crucial for confidently and effectively incorporating AI into teaching.

4. When instructors combined sufficient technological knowledge with helpful infrastructure, observations showed constructive learning processes. These included repeating composition cycles in digital audio workstations, organized peer evaluations, reflective entries in portfolios, and structured use of algorithmic feedback. Students in these settings expressed greater independence, saying, “I can try out an idea and hear it back instantly.” They also created portfolios that illustrated their revisions and musical thought processes. This trend shows sociocultural dynamics. Digital tools enabled socially based activities such as collaboration, evaluation, and modification, which expanded learners’ zone of proximal development (Vygotsky, 1978). The TPACK framework explains this. Educators who effectively integrate technology with teaching strategies create assignments that focus on musical decision-making rather than purely technical performance (Bauer, 2014; Ruthmann & Mantie, 2017).

5. The inclusion of AI added a non-human element to classroom feedback systems. Teachers valued algorithmic feedback for its speed and its ability to measure aspects such as intonation and timing. However, they stressed the need to musically interpret these outputs, taking into account phrasing, style, and expressive intention. Many educators showed how to interpret algorithmic scores alongside their auditory judgments, thus preserving human interpretive authority. The educational challenge does not involve only using AI but also coordinating how machine feedback corresponds with teacher and colleague feedback. This interpretive effort is a key skill that needs development through professional training and classroom modeling (Merchán Sánchez-Jara et al., 2024).

6 Equity and evaluation: The danger of worsening inequalities without intentional policies. Access inequities were clear. Students in private schools or urban areas had more consistent access to digital audio workstation (DAW) tools and built stronger portfolios than those in underfunded public schools. Without assessments focused on the process and a clear recognition of AI contributions, technology-driven evaluation may favor students with extra resources outside of school. Using process-oriented portfolios, clarifying authorship for AI contributions, and presenting diverse assessment methods can help tackle disparities and better demonstrate incremental learning (Wiggins & Forth, 2015).

The music education scene in Nigeria includes dynamic, localized examples where AI and digital technology improve learning. However, the national situation is uneven overall. The main obstacles are teachers’ confidence in technology and the availability of institutional infrastructure. The findings show three important priorities that match the study's framework: (1) dedicate resources to professional development that prioritize practical skills and music-specific TPACK, (2) build strong infrastructure and regional hubs to close access gaps, and (3) use

process-oriented evaluation methods and maintain ethical standards for AI authorship and data management. By adopting these steps, we can turn individual successes into a fairer and increasingly sustainable "new normal" for music education across Nigeria.

Discussion

The evidence collected in this study provides a clear picture of music teaching in Nigeria during a period of technological opportunity. Surveys, classroom observations, and interviews revealed a consistent pattern: technology and AI can enhance musical learning, but only when three factors, including teacher knowledge, lesson design, and institutional environment, come together. This finding is not just descriptive; it makes theoretical sense. The Technological Pedagogical Content Knowledge (TPACK) framework explains why connected teacher knowledge is crucial (Mishra & Koehler, 2006). Meanwhile, sociocultural theory holds that tools acquire meaning only through social practices and supportive settings (Vygotsky, 1978). The study combined key implications, linked them to theory, and provided clear, actionable recommendations by interpreting the main findings through a theoretical lens. The TPACK framework acts as the center of effective integration. Teachers in this study demonstrated solid musical content knowledge and strong teaching instincts, but their technological knowledge (TK) was limited. Statistically, TK was the weakest part of the TPACK framework, while the overall TPACK score was the best indicator of perceived student progress. This pattern supports the TPACK claim that content and teaching methods are necessary but not enough. Teachers also need to know how to use specific technologies to reach musical goals (Mishra & Koehler, 2006). Practically, professional development should go beyond general ICT training and focus on music-specific tool skills, such as DAW workflows, audio capture, and understanding algorithmic feedback.

The socio-cultural and constructivist approaches explain why the same tools yield different results in classrooms. Digital media and AI are cultural artefacts. Its benefits are realizable when they are part of social practices such as peer critique, teacher modeling, and iterative revision, which provide support (Vygotsky, 1978). In places where infrastructure and technical support were in place, tasks using digital audio workstations (DAWs) and collaborative projects showed clear improvements in student agency and creativity. However, where infrastructure was lacking—due to frequent power outages, a lack of technicians, or limited bandwidth—teachers had to make do with smartphones and offline methods. This study demonstrated teachers' resilience, but it also highlighted the limitations of individual creativity without systemic support.

Hybrid feedback systems require interpretive work. The introduction of AI brought in a new element to classroom feedback: machine-generated metrics and prompts. Both teachers and students appreciated the quick feedback from algorithms on measurable aspects such as intonation and timing. Nonetheless, teachers often stressed the need to interpret these outputs musically by connecting numeric scores to phrasing, style, and expressive intent. This interpretive work is a teaching skill in its own right. Teachers need to translate algorithmic signals into musical learning actions. This task is crucial to the TPACK framework and to socio-cultural interaction.

Implications for policy and practice

1. Professional development must focus on practical, music-specific skills. One-time ICT workshops are not enough. PD should include hands-on DAW labs, collaborative planning and teaching, and reflective assessment practices. This approach helps teachers develop integrated TPACK. This study's evidence shows that teachers who participated in ongoing, contextual PD

were more likely to create tasks that emphasized musical reasoning rather than just technical skills (Bauer, 2014; Ruthmann & Mantie, 2017).

2. Assessment must prioritize process and authorship transparency. Portfolios that show drafts, version histories, and reflective commentary capture ongoing learning better than single performances. With AI-generated material present, assessment protocols should require clear disclosure of AI contributions. They should also include rubrics that evaluate musical choices and technical skills (Wiggins & Forth, 2015).

3, Infrastructure investments must focus on resilience and maintenance. Buying equipment without maintenance plans and technician support leads to rapid capacity decay. Realistic roadmaps that include power backups, scheduled maintenance, and technician roles are necessary to turn policy goals into classroom reality (Federal Ministry of Education, 2019).

4. Equity must be a priority, not a secondary concern. Technology can increase existing disparities unless institutions implement clear access strategies. These include device loan programs, scheduled lab time for disadvantaged students, regional hubs that share resources, and partnerships with local studios for supervised access. These actions help ensure that assessments and learning opportunities do not favor those with private access.

5. Ethical and culturally responsive use of AI is necessary. AI tools trained on Western data may misrepresent or marginalize African musical styles. Institutions should adopt ethical guidelines that tackle cultural bias, data management, and authorship. They should also encourage the development or curation of relevant local training data when possible (Merchán Sánchez-Jara et al., 2024).

Recommendations

This study focuses on conditional possibility rather than technological determinism. Nigerian music teachers are dedicated, resourceful, and keen to use new tools. Students show creativity when they have access and support. The challenge ahead is practical: enhance teacher skills by combining technology with teaching methods and content (TPACK). We must invest in strong institutional environments that enable tools to facilitate learning (sociocultural conditions). Additionally, we need to adopt assessment and ethical practices that uphold equity and cultural integrity. If we take these steps thoughtfully and collaboratively, AI and digital media can be a sustainable force for richer, more inclusive music education across Nigeria. Based on this, the study makes the following recommendations for what, who, and how to measure effective implementation:

1. Launch targeted professional development pilots (0–12 months). Two complementary models: (a) a six-module micro-credential with hands-on DAW labs; (b) semester-long coaching cycles (co-planning, co-teaching). Use the Departments in partnership with teacher education units and professional associations to assess pre- and post-TPACK scores, observe lesson enactments, and evaluate student portfolios.

2. Adopt portfolio assessment with AI disclosure (6–12 months). Implement a standard portfolio rubric (process + product + AI authorship statement) and hold rater calibration sessions with examination committees and course leads to ensure inter-rater reliability (ICC ≥ .70) and track student learning progress.

3. Create resilient infrastructure plans (6–24 months). Develop detailed three-year roadmaps that include UPS/solar backups, technician positions, and maintenance contracts in collaboration with department heads, institutional finance offices, and state education ministries. Aim to enhance lab uptime and minimize lesson disruptions.

4. Establish regional resource hubs and partnerships (12–24 months). Create shared DAW labs and studio partnerships in each geopolitical zone. Formalize MOUs for access and internships in collaboration with institutions, private studios, and alums networks to provide adequate support for students and internship placements.

5. Develop ethical guidelines and culturally responsive materials. Form interdisciplinary working groups to draft AI use policies, authorship standards, and data governance protocols, partnering with music departments, ethicists, technologists, and cultural practitioners. Ensure that departments adopt the published guidelines.

Conclusion

This study shows that artificial intelligence and digital media can genuinely improve music teaching in Nigeria, but their educational value depends on certain factors. When teachers have solid technological, pedagogical, and content knowledge, when tasks emphasize musical reasoning, and when institutions provide reliable power, technical support, and access, digital tools can spark iterative composition, reflective practice, and greater student involvement. However, in areas plagued by unstable electricity, limited internet bandwidth, and insufficient training, these technologies often go unused or are applied incorrectly, widening the gaps in learning opportunities.

The findings highlight two connected truths. First, solid knowledge in teaching technology is crucial; investing in teachers' ability to link musical goals with the right tools yields the best educational outcomes. Second, social and cultural factors influence whether these tools serve as effective learning resources; technology only enhances development when integrated into social practices such as peer feedback, teacher support, and guided revisions that make algorithm-based feedback and production processes understandable.

Moving forward, the approach should be clear and compassionate: focus on ongoing, practice-based training that improves music-specific tool skills; implement process-oriented assessments (such as portfolios with clear AI-authorship statements) that emphasize revision and musical thinking; and commit to realistic, well-planned infrastructure that includes maintenance and technician roles. Also important are policies and ethical guidelines that promote cultural relevance, data management, and fair access, ensuring that technological advancements support rather than undermine local musical traditions and educational fairness.

In summary, achieving a "new normal" requires collaboration among teachers, students, technicians, and policymakers to transform tools into effective teaching instruments. With targeted capacity-building, thoughtful assessment practices, and sensible infrastructure planning, AI and digital media can become lasting drivers of a more creative, inclusive, and resilient music education across Nigeria.

References

Amaegbe, E. J. (2023). Technology-based music education in Nigerian public universities: Prevalence, relevance, challenges and prospects. *International Journal of Innovative Language, Literature & Art Studies, 11(4),* 110–120. https://www.seahipublications.org/ijllas

Bauer, W. I. (2014). *Music learning today: Digital pedagogy for creating, performing, and responding to music*. Oxford University Press.

Federal Ministry of Education. (2019). *National policy on information and communication technologies (ICT) in education.* Federal Ministry of Education, Nigeria. https://education.gov.ng/dated 12 April 2026.

Gai, Y. (2024). Use of digital audio workstations in music education to develop creative thinking and increase self-efficacy. *Current Psychology.* https://doi.org/10.1007/s12144-024-06093-3 dated 8 April 2026.

Li, P. (2023). Artificial intelligence in music education. *International Journal of Human–Computer Studies.* https://doi.org/10.1080/10447318.2023.2209984 (doi.org in Bing)

Merchán Sánchez-Jara, J. F., González Gutiérrez, S., Cruz Rodríguez, J., & Syroyid, B. S. (2024). Artificial intelligence-assisted music education: A critical synthesis of challenges and opportunities. *Education Sciences, 14(11),* Article 1171. https://doi.org/10.3390/educsci14111171 dated 14 April 2026.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108(6),* 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x dated 10 April 2026.

Modeme, E. R. (2022). Using technology to enhance instruction and learning in musical arts education in Nigeria. *International Journal of Current Research in the Humanities, 26,* 120–130.

Regassa, M. S., & Desissa, T. D. (2026). TPACK competency status among TVET instructors in Sheger City, Ethiopia. *Journal of Technical and Vocational Education, 12(2),* 45-62. https://doi.org/10.1007/s43621-026-02871-0 dated 30 April 2026.

Ruthmann, S. A., & Mantie, R. (Eds.). (2017). *The Oxford handbook of technology and music education.* Oxford University Press.

UNESCO. (2020). *Education in a post-COVID world: Nine ideas for public action* (Policy brief). United Nations Educational, Scientific and Cultural Organization. https://unesdoc.unesco.org/ark:/48223/pf0000373717 unesdoc.unesco.org in Bing dated 6 April 2026.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds. & Trans.). Harvard University Press.

Wiggins, G. A., & Forth, J. (2015). Music information retrieval and music education: Opportunities and challenges. *Journal of New Music Research, 44(3),* 1–12. https://doi.org/10.1080/09298215.2015.1043498 (doi.org in Bing)

Zhang, X. (2025). Systematic Review of Environmental Education Teaching Practices in Schools: Trends and Gaps (2015–2024). *Sustainability, 17(19)*, 8561